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ABSTRACT

This tenth edition of the Research Directory of the Rehabilitation Research and Training (RT) Centers reports the FY 1980 research activities of twenty-one RT Centers (11 medical, 3 vocational, 3 mental retardation, 2 deafness, 1 blindness, and 1 mental health). The 266 abstracts are organized under the RT Centers located at these institutions: New York University (2), University of Minnessota, University of Washington, Baylor College of Medicine, Emory University, Tuffs University, Temple University, The George Washington University, University of Colorado, University of Wisconsin, University of Arkansas, West Virginia University, University of Oregon, University of Alabama in Birmingham, Northwestern University, Texas Tech University, University of Wisconsin-Stout, University of California/San Francisco, University of North Carolina at Chapel Hill, Boston University. Preceding the abstracts under each RT Center are listings of the center's core areas of research, and completed, continuing, new, discontinued, and proposed projects. Core area descriptions of four new RT Centers (1 mental illness, 1 independent living, 2 aged handicapped persons) are also provided. Each abstract includes objectives, methodology, findings, and applicability. The name of the principal investigator, status of the research activity, and relevant fiscal data are included in bolder type. A subject index and principal investigator's index are provided. (YLB)

Research

Directory of the Rehabilitation Research and Training Centers

Fiscal Year 1980

Office of Special Education and Rehabilitative Services
National Institute of Handicapped Research

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INTRODUCTION

The publication of this document is in partial fulfillment of the Rehabilitation Research and Training Centers' synergistic mission; namely, to widely disseminate and promote the utilization of the new knowledge and technology that emanates from that RT Center research which is directed toward alleviating, reducing, or stabilizing handicapping conditions, improving rehabilitation methodology and service delivery systems, and effectuating maximum physical, social, and economic independence.

This 10th edition of the **Research Directory of the Rehabilitation Research and Training Centers** contains 266 abstracts of research activities conducted by the 21 RT Centers (11 medical, 3 vocational, 3 mental retardation, 2 deafness, 1 blindness, and 1 mental health) sponsored by the National Institute of Handicapped Research during FY 1980. Core area descriptions of the four new Research and Training Centers (1 mental illness, 1 independent living, and 2 aged handicapped persons) are also described. Each abstract contains objectives, methodology, findings, and applicability. The name of the principal investigators, status of activity, and relevant fiscal data are printed in **bold type.** The abstracts are indexed by both subjects and principal investigators and have been assigned individual accession numbers. The project director's name and center's address appear at the beginning of each center's research listing and again at the end of the directory where the name of the director of research is also listed.

It should be of interest to note that while this document is a cooperative effort between the University of Arkansas Rehabilitation Research and Training Center and the National Institute of Handicapped Research, rehabilitation clients of the Hot Springs Rehabilitation Center participated in its production as a part of their vocational training experience in the data processing and printing departments.

Other publications of the Research and Training Centers Office include the **INFORMER,** a quarterly journal which reports news, developments in research and training, and upcoming training activities of NIHR Special Centers, and the semi-annual **Publications and Audiovisual Aids Directory of the Rehabilitation Research and Training Centers,** an extensive bibliography of materials produced by or available from RT Centers.

The **Research Directory of the Rehabilitation Research and Training Centers** and the other publications are made available to local, national, and international rehabilitation agencies, institutions, and consumer groups. It represents a combined effort of the centers to close the usual prevailing gap between the discovery of new knowledge and the application of that knowledge into practice.

All requests for more detailed information about the research projects in the directory should be sent to the project director of the appropriate center. For information about other publications write to the National Institute of Handicapped Research, Office of Special Education and Rehabilitation Services, Mary Switzer Building, 400 Maryland Avenue, S.W., Washington, DC 20202.

Joseph Fenton, Ed.D.
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Cover: Faye Clark, Ms. Wheelchair Arkansas 1980 and employee of the Hot Springs Rehabilitation Center, at the keyboard of the center's computer system. Appreciation is extended to the clients and staff of the HSRC Printing Department and the HSRC Data Processing Department for greatly simplifying the preparation of this **Research Directory.**

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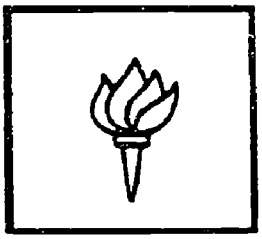

New York University (RT-1)
Medical Rehabilitation Research and Training Center

CORE AREAS

Orthotics-Prosthetics

Activities designed to yield immediate and practical improvements in the design and fitting of devices to aid amputees, as well as patients suffering from neuromuscular and/or skeletal disorders.

Neuromuscular Diseases

Activities designed to develop and apply new findings to aid in the rehabilitation of individuals with neuromuscular malfunction. These activities include evaluation techniques, research in neurophysiology and electrodiagnostics, with continuing application to the patient's functional abilities.

Behavioral Science

There are three foci to this program: (a) Psycho-social behavior, (b) Accountability, and (c) Perceptual-cognitive disturbances in brain damaged persons. The program currently focuses on assessment intervention techniques and on the development of "rehabilitation indications."

Cardiopulmonary

Activities designed to aid in the remediation of deficits originating from respiratory and cardiac disorders. This includes both diagnostic and treatment aspects.

Rehabilitation Engineering

Activities designed to meld engineering and medicine in the solution of disability related problems.

Regional Spinal Core Injury Center

All of the above core areas interact and interface with the Regional Spinal Cord Injury Center (at the Institute of Rehabilitation Medicine and the Department of Neurosurgery, New York University Medical Center).

NEW YORK UNIVERSITY MEDICAL CENTER

Joseph Goodgold, M.D., Director
New York University Medical
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COMPLETED

CONTINUING

NEW

DISCONTINUED

Demonstration of Benefits of Early Identification of Psychosocial Problems and Early Intervention Toward Rehabilitation of Cancer Patients

Electronic Anal Sphincter Stimulation for Fecal Incontinence Control and Barium Enema Examinations of Disabled Persons

PROPOSED

Clinical, Engineering, and Work Related Evaluation of Stationary Stand-Up Frames and Stand-Up Wheelchairs for the Disabled

Development of a Servo-Mechanical Steering Control Device for the Severely Handicapped Driver

Computer Technology in the Field of Technical Aids to Optimize Service, Both Directly and Indirectly for Maximal Functional Independence of the Physically Impaired Population

Investigation of the Current Status of Externally-Energized Orthotics and Prosthetics Systems, and Identification of Applicable Technology in Industry

A Biochemical and Radiological Investigation of Osteoporosis in Spinal Cord Injured Humans

Investigation of Reflexive and Intended Components of Movement During Motor Rehabilitation Following Stroke

Changes in Autonomic Nervous System Function and Metabolism of Biogenic Amines in Spinal Cord Injured Subjects

001 Orthotics and Prosthetics Design Improvements

Principal Investigator: H.R. Lehneis, Ph.D.
Status: Completed
Dates: October 1975-April 1979
Cost: Annual $19,218 — Projected Total $479,664
RT Annual $17,776 — RT % of Annual Total 92%
Annual Report Reference: #18, Page 93, R-59

OBJECTIVES:

1. **Pressure Mapping:** To establish and test a clinically applicable method of graphically quantifying static pressure over large complex surfaces at all points simultaneously.
2. **Universal Terminal Device:** A prosthetic terminal device is being developed that provides function similar to that of a hook but looks like a hand. This is to eliminate that stigma associated with the appearance of a hook, yet to provide the superior prehensile function of a hook.
3. **Electric Arm Orthosis:** A powered orthosis is being developed that provides prehensile function as well as essential degrees of freedom for arm functions to allow for needs of Activities of Daily Living and to reach certain vocational goals.

METHODOLOGY: **Pressure Mapping, Universal Terminal Device and Electric Arm Orthosis.** Pressure mapping was completed and the final report submitted in last year's report. This year's report is concerned with the remaining two projects, universal terminal device, and electric arm orthosis.

Universal Terminal Device. Subject population in this project consists of below-elbow and above-elbow amputees, rather than higher levels of amputation since the B/E and A/E amputee is a generally more active user of his prosthesis than higher level amputees. In addition, their vocational potential is greater in general. Testing procedures are standard procedures used in occupational therapy in training amputees which record performance in standard tasks expected of the amputee. In addition, a questionnaire has been developed which aims at a comparative evaluation between standard terminal devices and the universal terminal with regard to performance from the patient's point of view, as well as acceptance and convenience.

Electric Arm Orthosis. The subject population in this project are quadriplegics above C-5, i.e., who are unable to place their hand or arm in space and do not have prehension. The age range is between 18 and 65, i.e., patients who have either college training or vocational potential. An objective evaluation of both designs by an independent institution is also planned.

1. **Pressure Mapping.** The pressure transducer system can be focused at various pressure ranges depending on concentration of reactants, the stacking arrangement, the pressure exposure intervals, the moisture content, and the reactant type. The following sample arrangement was used to evaluate the cut-out board (described in Section 8, Methodology & Procedures):
   a. Stacking arrangement and reactant composition (by weight): first layer—Saran Wrap; second layer—plain urethane foam, 1/16" thick, 50 pores per inch; third layer—acid indicator suspended in plain foam. Indicator consisted of 1% Allied Color Precursor No. 1 and 6% glycerin in ethylene glycol; fourth layer—10% citric acid and 1% glycerin in water suspended in plain foam; fifth layer—Saran Wrap
   b. Pressure was steadily applied to the transducer for 15 seconds
   c. Monitoring range—0.5 to 5 psi
   d. The layers are separated after pressure exposure and either compared with calibration for immediate quantitative information or photographed with calibration to preserve the response.
2. **Universal Terminal Device. Patient Testing.** During this report period, follow-up on one adult patient was done and three pediatric patients were newly fitted with the UTD. Past clinical evaluation of the UTD has been presented in preceding progress reports and copies of this Research Directory.

P.C., a 24-year-old male with a traumatic left below-elbow amputation, continues to use the UTD. He has had the device for 1½ years and recently had the cosmetic glove replaced. A follow-up questionnaire was administered and substantiated by personal interview. He reports using the UTD approximately 40 percent of the time. He still finds that the UTD offers better function in most tasks than the conventional hook and in many tasks that cannot be done with a functional hand. Both light (eating) and heavy (lifting, car maintenance) tasks were specifically mentioned. The increased gripping surface of the device was again emphasized by the patient as a boon to function. He stated the design of the UTD seldom, visually or physically, interfered with function. Cosmetically, the patient continues to consider the UTD better than the alternative terminal devices.

The pediatric included D.H., a 10-year-old boy with a congenital left below-elbow amputation and two girls, C.Z. and A.P., ages 6 and 8½ years, both congenital right below-elbow amputees. Three months after receiving the UTD, D.H. and his parents reported by questionnaire that he uses the device approximately 20 percent of the time. He has experienced somewhat reduced function with the UTD in comparison to a conventional hook, especially with intricate activities such as tying shoes, due to interference from the nonfunctioning fingers. Nevertheless, much improved cosmesis was noted and he wishes to keep the device.

A similar follow-up with A.P. revealed usage of the UTD 50 percent of the time, with a similar report of somewhat decreased function and markedly improved cosmesis in comparison to the coventional hook. No physical obstruction from the design of the UTD was experienced. The patient also wished to retain the UTD.

C.Z. and her mother were interviewed one month after receiving the UTD and reported using the device approximately 60 percent of the time. They reported the same function with both the UTD and conventional hook; however, the patient was not previously an avid hook user. The cosmesis afforded by the UTD resulted in its use primarily at school as the patient manages without the prosthesis at home. She no longer uses the hook. A functional performance evaluation was also performed with C.Z., both one month and seven months after receiving the UTD. She demonstrated active use of the device in holding objects during bilateral activities (e.g., reading, cutting paper) and passively as a stabilizer (e.g., in writing). C.Z. recently received a new cosmetic glove and continues to use the UTD.

3. **Electric Arm Orthosis.** No additional patients have been tested with the EAO during this report period. See previous reports for patient testing and Section 11a, "Discussion," and Section 11b, "Conclusions and Recommendations" for further explanation. (Annual Report 16-P-56801/2-18).

APPLICABILITY: Since this system enables the clinician to predict future pressure-induced skin ulceration and allied difficulties without the use of complex, expensive equipment and additional technical assistance, the efficiency of the rehabilitation process is expected to increase and resultant costs are expected to decrease. Consumers will be the general upper limb amputee population who currently use one or more types of terminal devices.

002 Bone Mineralization in Spinal Cord Injured Man: A Biochemical and Radiologic Investigation

Principal Investigator: N. Eric Naftchi, Ph.D.

Status: Completed

Dates: September 1969-September 1979

Cost: Annual $34,178 — Projected Total $531,231
RT Annual $25,086 — RT % of Annual Total 73%

Annual Report Reference: #18, Page 285, R-60

OBJECTIVES:

1. To determine the causes of excessive bone demineralization in patients with paralysis due to spinal cord lesions.
2. To prevent demineralization.

3. To arrest and treat complications of osteoporosis by controlling calcium and phosphate metabolism.
4. To elucidate the cause of myositis ossificans and thereby prevent the restrictive, debilitating effects, either by inhibiting its formation, or once formed, cause its resorption or maturation by pharmacologic means.

METHODOLOGY:

1. The objective of this study is to arrest bone absorption and favor bone deposition by means of administering several therapeutic agents separately and in combination. The pharmacologic agents will be inorganic phosphates (Hyper-phos. K), diphosphonates, and thyrocalcitonin. The following techniques will be employed to determine successful therapy: (a) chromium corrected phosphate, calcium, magnesium, nitrogen balances will be studied for two consecutive four-day periods after appropriate equilibriation; (b) radiographic measurement of metacarpal and metatarsal cortical thickness; (c) quantitative, serial measurement of forearm and leg bone density by means of gammaphoton densitometer.
2. The results of quantitative serial measurements of bone density by simultaneous radiographic and gamma-photon densitometry and 18F uptake will be correlated with mineral balance and collagen turnover in acute and chronic quadriplegia and paraplegia. These results, in turn, will be compared in patients with a different level of spinal cord transection in acute, recovery, and chronic phases in order to determine the effects of various levels of transection of spinal cord on skeletal demineralization.

FINDINGS TO DATE:

1. Bone mineral content was measured by single photon absorptiometery using a modified Packard bone densitometer with 125I as the source. In 45 hemiplegic subjects, matched for sex and age, the bone density was compared bilaterally on the radius and ulna two and four centimeters above the wrist. The non-paralyzed side served as a control for the paralyzed side. There was an equivalent number of right-dominant, right-paralyzed and left-dominant, left paralyzed subjects. The results indicate a consistent, general loss of bone mineral on the paralyzed side compared with the non-paralyzed side. Right-dominant, left-paralyzed patients showed a greater loss of bone density than left-dominant, right-paralyzed subjects. The absorption ratio of the paralyzed versus the non-paralyzed sides revealed that there was a 6.8% and 7.3% decrease in the average bone density at four centimeters and two centimeters above the wrist, respectively. There was a progressive loss of bone mineral content relative to time after the onset of paralysis, amounting to an average of 5% from both sites measured approximately three months after onset of injury. The effect of physical and drug therapy on the rate of demineralization following paralysis remains to be elucidated.

2. This study was undertaken to assess the feasibility of the osteodensitometry for determination of bone mineral content. Hemiplegic subjects were chosen as simpler models in order to compare the paralyzed with non-paralyzed arm and set-up the technique for spinal cord injured subjects who are more challenging to study. The progressive loss of bone mineral content relative to the time after the onset of paralysis will be measured as above in spinal cord injured subjects in order to determine the extent of bone demineralization and the effect of drug treatment.

3. Urinary excretion of magnesium and calcium was measured in 11 quadriplegic and 7 paraplegic subjects from the date of the onset of injury and was followed longitudinally once a week for a period of 15 to 24 weeks. Both groups of subjects excreted calcium and magnesium significantly higher than normal during the first eight weeks after the injury. The mean levels gradually decreased towards but did not reach normal levels 24 weeks later. The excretion of calcium in both quadriplegic and paraplegic subjects was of the same magnitude but the excretion of magnesium in paraplegic subjects was about 75% of that in quadriplegic subjects.

4. Dysfunction of mineral metabolism has been studied in our laboratory in order to elucidate the cause of the disorder and thereby correct the problem by the appropriate therapy. 120 paraplegic rats and 103 paraplegic and quadriplegic human subjects were investigated. Balance studies of calcium, magnesium and phosphorus were carried out in paraplegic rats and were compared with the sham-operated, age-matched litter mates. Measurement of the excretion of the above cations and anions including that of hydroxproline was carried out in human subjects longitudinally immediately after the onset to four months post injury in chronic subjects chosen at random up to six years after the injury. The results in human subjects were similar to those in animal models and showed that bone resorption starts rapidly after the onset of injury leading to osteoporosis.

   Thyrocalcitonin therapy in rats reversed the negative calcium, magnesium and phosphorous balances and changed the survival rate of animals, which died mainly from hydronephrosis, from 25% to 85%. Studies in man involving therapy with thyrocalcitonin and diphosphonates is anticipated.

   Our findings of excessive bone mineral loss which commences almost immediately after the onset of spinal cord injury is very significant. In humans, within six to eight months after the injury, the process of bone resorption renders the subjects osteoporotic in addition to causing other side effects such as renal calculi and periarticular bone formation. We have found that the immediate treatment of spinal cord injured animals with thyrocalcitonin reverses the negative mineral and hydroxyproline balance and increases the survival rate of rats from 25% to 80%. Most of the untreated animals died of hydronephrosis secondary to bladder infections. As a result of this finding in collaboration with the Departments of Neurosurgery and Neuroradiology, we are initiating the treatment of acute spinal cord subjects with thyrocalcitonin. The patients will be monitored both biochemically and radiologically using computerized tomography for bone scanning. These techniques may be utilized in other rehabilitation centers and may find further use in treatment and follow-up of post-menopausal osteoporosis and Paget's disease.

APPLICABILITY: Calcium and phosphate metabolism is deranged in spinal cord injured humans. The associated complications, kidney stone, myositis ossificans, bone pain and fractures limit the independence, employability and rehabilitation of spinal cord injured man. In the present study, under dietary control, calcium and phosphate metabolism will be determined before and after specific treatment and correlated with bone density measurements and other biochemical findings. These treatments have proven successful in arresting bone resorption and favoring bone deposition in animals and some humans with bone fractures. The development of methods for the control of calcium and phosphate metabolism in spinal cord injury is essential in order to reduce debility, protracted and recurrent hospitalization of these patients.

003 Sympathetic Activity and the Metabolism of Biogenic Amines in Spinal Cord Injured Patients

Principal Investigator:	**N. Eric Naftchi, Ph.D.**	
Status:	**Completed**	
Dates:	**September 1968-September 1979**	
Cost:	**Annual $83,336** **RT Annual $48,737**	**Projected Total $939,913** **RT % of Annual Total 58%**
Annual Report Reference:	**#18, Page 298, R-61**	

OBJECTIVES:

1. To determine the relationship between cutaneous circulation and catecholamine metabolism in paraplegic and quadriplegic subjects with the purpose of elucidating the cause of trophic skin ulcers and spasticity.
2. To measure the effect of various levels of injury on the metabolism of catecholamines and correlate the degree of derangement in regulatory, integrative and stress functions with concentration of these neurotransmitters and their metabolites.

3. To measure the degree of sympathetic activity in different levels of spinal cord injury.
4. To develop measures for reducing the incidence of decubitis ulcers in the spinal cord injured human.

METHODOLOGY:

1. Catecholamines and their metabolites will be measured in plasma and urine and spinal fluid of cord transected individuals. Various levels of cord transection and their effect on these hormones and neurohormones will be investigated. Methods used include column and bidimensional paper and thin layer chromatography, ultra-violet fluorescent and atomic absorption spectroscopy; and the use of ultracentrifuge scintillation spectometry and strip scanning for radioisotopic analysis of the hormones and ions involved. Sympathetic activity will be evaluated by reactivity of the patients to exogenously infused norepinephrine, tyramine or angiotensin. Digital calorimetry will be used for the studies on reactivity to norepinephrine or other pressor substances. Gas-liquid chromatography, mass spectrometry and infrared spectrometry will also be employed for separation and identification of unknown compounds.
2. Digital blood flow will be measured calorimetrically and by means of mercury-in-rubber Whitney strain gauge.
3. Heart rate, arterial blood pressure and plasma levels of NE, DBH, C-AMP and cortisol were measured to determine the degree of sympathetic activity in different levels of spinal cord injury.

FINDINGS TO DATE:

1. In seven C5-C7 quadriplegic subjects blood volume was measured by means of double isotope technique, using 125I and 51 Cr. In five other C5-C7 quadriplegic subjects autonomic hyperreflexia was induced by expansion of the urinary bladder by means of water intake. Cardiac output was measured by indicator dilution method and arterial blood pressure by auscultatory technique. During hypertension there was no appreciable change in either cardiac output or cardiac index. By contrast, there was a significant rise in mean arterial blood pressure and total peripheral resistance and a sharp fall in pulse rate. Preliminary studies on blood volume reveal that during hypertension there is a 10% rise in hematocrit but relatively little change in total blood volume. These results indicate that during hypertension there is: (1) an increase in hemoconcentration, probably due to an increase in capillary permeability; (2) hypertension is caused mainly by a pronounced decrease in blood flow of the upper and lower extremities and by a sharp increase in the total peripheral resistance. This marked vasoconstriction correlates with increased activity of serum dopamine-B-hydroxylase, the enzyme responsible for the synthesis of the neuro-transmitter, norepinephrine. This enzyme is released together with norepinephrine during hypertensive stress (Naftchi, N.E., et al., Frontiers in Catecholamine Research 1973, pp. 1143-47, Pergamon Press) and is thus an index of sympathetic activity (Naftchi, N.E., et al., Circ. Res. 35:850-6, 1974).
2. Reactivity of the digital vascular bed to infused 1-norepinephrine (NE) was measured in 15 subjects with complete physiologic transection of the spinal cord at various levels and was compared with that of 16 normal subjects. At least one hour before the test a continual bladder drainage was insured by means of an indwelling Foley catheter imbedded in Lidocaine gel. Sympathetic nerve discharge was inhibited by indirect heating of the subjects and continuous infusion of trimethaphan camphorsulfonate (TMCS), a ganglion blocking agent. Following the measurement of digital blood pressure and flow in this phase of vasodilation, vasoconstriction was brought about by infusion of NE while the infusion of TMCS continued. Flow-pressure ratios were converted to radius equivalents of digital circulation and the work of vasoconstriction was quantified in ergs per microgram of NE infused per minute. The reactivity of NE in paraplegic subjects with lesions below the T6 dermatome was within the range found for normotensive subjects. In subjects with spinal cord transection above the T6 dermatome, reactivity to NE was more than two-folds greater than that of normotensive and paraplegic subjects with lesion below T6 dermatome. The significance of these findings with respect to denervation supersensitivity and the level of spinal cord lesion is being investigated further.

3. A new radioenzymatic high performance liquid chromatographic method which is sensitive and specific enough to measure dopamine, norepinephrine, and epinephrine simultaneously in 50 microliters of plasma has been developed. We have identified norepinephrine as the causative neurotransmitter involved in paroxysmal hypertensive episodes which accompany autonomic dysreflexia. Furthermore, the concentrations of prostaglandins PGE_2 in arterial blood rise during the attacks of autonomic hyperreflexia which are associated with flushing of the face and neck, chest pain, and headache. The identification of norepinephrine involvement in autonomic dysreflexia provides rationale for the treatment of acute hypertensive crises and long term maintenance of quadriplegic subjects susceptible to hypertension.

   Prostaglandins PGE_2 infusions are known to cause facial flushing and headache. This finding in 28 subjects will also aid in treatment of headache by antiprostaglandin agents. During the stress of head-up tilt (30°-40°), heart rate increased in all subjects but the blood pressure dropped significantly in quadriplegic and remained unchanged in control and paraplegic subjects. In 34 subjects studied, both norepinephrine and dopamine-B-hydroxylase increased significantly 20 minutes after tilt. The latter two may be considered good indices of sympathetic activity.

APPLICABILITY: Too frequently, after substantial investments are made in the physical and vocational training of paraplegic and quadriplegic patients, numerous complications arise which necessitate re-hospitalization, frequently for a prolonged period, and thus jeopardize further employment of the patients in their prehospitalization job or a new job following discharge from the hospital. If through the proposed investigation the basic underlying physiological factors which contribute to decubiti, urinary infection, and other similar complications could be identified and possibly brought under control, the vocational rehabilitation of these severely disabled persons would be greatly enhanced.

004 Rehabilitation Indicators: A Method for Enhancing Accountability and the Provision of Rehabilitation Service

Principal Investigator:	**Leonard Diller, Ph.D.**
Status:	**Continuing**
Dates:	**October 1974-October 1979**
Cost:	**Since May 1, 1977 this project has been supported under independent grant RSA #12-P-59047/2.**
Annual Report Reference:	**#18, Page 187, R-88**

OBJECTIVES: The RI methodology, when used in rehabilitation settings, will serve several purposes (long term goals):

1. Rehabilitation settings will become **more accountable** through a broader and more objective information flow and improved decision making. In line with the resource provider's expectations; these expectations are stated in terms of access (who is to receive services), process (what is to occur) and outcomes (the types of goals that are viewed as valid).
2. Rehabilitation settings will provide **better** services in that individual client planning, tracking and follow-up can be tied to RI's; also program planning can be more clearly tied to the types of primary goals and instrumental sub-goals addressed within the population.
3. Rehabilitation systems will be able to **define "disability"** in functional terms and define "needs" of the disabled in terms of skills and environmental supports needed to reach goals.

METHODOLOGY: The project will be implemented in three phases: Phase I initial development of RI's (October 1974-May 1977); Phase II: Final development of RI's and field testing (May 1977-October 1979); and Phase III: Demonstration and Utilization/Dissemination (October 1979-).

FINDINGS TO DATE: A lexicon has been developed which consists of three sets of indicators which constitute an objective and hopefully clarified language for rehabilitation. This modified language can be implemented in many ways within varying rehabilitation systems, including the use of the lexicon within a structured interview, an unstructured interview, and/or within an observation paradigm. The particular method selected would depend on factors such as the type of client, the type of rehabilitation services and the type of rehabilitation setting.

The focus of the lexicon is behavioral and observable, but not behavioristic, in that no particular theory of behavior is adopted nor any behavior change methods.

APPLICABILITY: Status indicators, activity indicators and external factor indicators can be used within the process of rehabilitation, utilizing a basic systematic approach. In this approach the rehabilitation indicators would be used to fulfill several purposes, including defining status goals, necessary skills, and external strengths and problems, for the purpose of individual rehabilitation planning, and defining changes in status activities and external factors for evaluation purposes.

005 Diagnosis and Remediation of Deficits in Verbal Abstraction and Visual Information Processing in Brain Damaged Adults

Principal Investigator: Leonard Diller, Ph.D.

Status: Continuing

Dates: October 1975-December 1981

Cost: Annual $121,606 — Projected Total $860,000
RT Annual $70,418 — RT % of Annual Total 58%

Annual Report Reference: #18, Page 190, R-92

OBJECTIVES: To develop and validate a normative scale and calibrated neuropsychologic module for the differential diagnosis of remediation and prognosis of dysfunctions of visual information processing in various types of brain damaged adults. This will further result in the development of a taxonomy of deficits of visual information processing found in brain damaged adults. These objectives may be broken down in terms of the objectives for each of four sub-studies to be carried out in three years.

Past Objectives:
Study I. The objective of the past year of research was to evaluate the efficacy of a three-stage VIP training module (scan, simultaneity, successiveness) on mild to moderately impaired right brain and left brain damaged stroke patients.

Study II. The objective of the past year of research was to evaluate the efficacy of a training module designed to facilitate V.A. thinking in right and left brain damaged stroke patients.

Future Objectives:
To compare the differential outcomes of conventional medical rehabilitation efforts with one which includes a comprehensive program designed to remediate the cognitive deficits associated with C. CVA.

To describe the longitudinal impact of stroke on these two groups of patients relative to a matched group of normal controls.

To differentially describe and predict recovery of function in these two groups of patients from appraisal of data derived from: demographic, clinical neurological examination, CTT scans, psychometric evaluation, and RI evaluation.

To study the relationships among the above mentioned data sets in order to develop typologies which can describe the types of changes expected in subgroups of patients.

METHODOLOGY: This study aims to improve abstract thinking and higher order visual information processing (simultaneity and successiveness) in unilateral brain damaged adults. Each of these aims is pursued through a series of studies involving: (1) the development of criteria for abstract thinking and visual information processing in normals; (2) gathering normative data on hemiplegics; (3) piloting remediation techniques on a small sample of patients; (4) a study in which experimental groups receive training in abstract thinking or visual information processing and controls do not, to see if treatment can impact the criteria. Subjects for abstract thinking will include 48 normals, 48 hemiplegic patients for normative purposes and 60 patients to form experimental and control groups. For the VIP study, 60 normals will be used, 45 hemiplegics will be used for normative purposes and 34 patients will participate as experimentals or controls.

FINDINGS TO DATE: 52 normals (age 45-75) were administered the test battery enumerated below. This was done in order to standardize the battery and derive a set of age appropriate norms. The battery has also been administered to 23 (13 left and 10 right) hemiplegics. 22-37 additional hemiplegics were seen during the next several months in order to complete the standardization process. Approximately 4 months were devoted to pilot studies in training. During 1978 Substudy IV (Training in Visual Information Processing) and Substudy V (Training in Verbal Abstraction) have commenced. To date 57 patients have been seen. This amounts to approximately 50% of the total number of patients projected to be seen in these two substudies. Results indicated that training had both task specific (verbal vs. visual) and general effects.

Test Battery
Full WAIS
Conditional Cancellation (developed by Staff)
Embedded Figures (Ayers)
Cube Analysis (Stanford - Binet)
Perceptual Analysis and Synthesis (Birch & Lefford, 1965)
Autobiographical Statement (developed by Staff)
Parts of the Ravens (selected by Staff)
Parts of the Letter (selected by Staff)
Goldstein Object Sorting Task
Visual Simultaneity (developed by Staff)
50 Visual and Pictorial Similarities (developed by Staff)
Trail Making (Part of Reitan Battery)
Knox Cube
Porteus Mazes
Symbol - Symbol (Jastak)
Visual Digit Span
Bender-Bestalt
Metropolitan Achievement Test (Comprehension and Arithmetic)
Simultaneous Recognition (developed by Staff)
Poragraph Titles

APPLICABILITY: Hemiplegia constitutes the largest physical disability group with an estimated prevalence of 200-2,000 per 100,000. Our previous studies have indicated that perceptual disorders common to right brain damage are critical bottlenecks in successful rehabilitation (Diller, et al.) (Lorenz & Cancro).

006 Rehabilitation of Cognitive and Perceptual Defects in People with Traumatic Brain Damage

Principal Investigator:	**Leonard Diller, Ph.D.**	
Status:	**Continuing**	
Dates:	**April 1978-March 1984**	
Cost:	**Annual $144,899** **RT Annual $93,196**	**Projected Total $721,000** **RT % of Annual Total 64%**
Annual Report Reference:	**#18, Page 251, R-93**	

OBJECTIVES:

1. To assess the efficacy of a pilot demonstration program for chronic traumatic head injured patients.
2. To assess the efficacy of four domains of remedial training which are part of the pilot demonstration program.
3. To assess the effect of the program on the patients by a one-year follow-up study to include psychometric criteria, Rehabilitation Indicators (RI's) and neurologic measures.
4. To predict differential outcome from intake data. The data to be collected include (1) psychometric tests; (2) a problem oriented record and a prescriptive remedial plan (i.e., the specific "action" plan for a given cycle); (3) Rehabilitation Indicators; and (4) neurologic assessment.

METHODOLOGY: The program consists of treatment cycles of ten weeks each. Each cycle includes (1) assessment, (2) orientation, (3) treatment, and (4) reassessment. Since the original proposal was submitted and approved, our experience with a successful pilot program in Israel suggests that it is prudent to plan that each patient will receive two cycles. Therefore, the program consists of four cycles a year. The time between cycles is used for screening new applicants and for follow-up studies. Over a five-year period, we estimate processing a total of 54 patients.

Subjects: A "chronic" TBD is defined as an individual who is at least 12 months post injury and who has been shown to be stable in functioning on two baseline examinations which are administered at least three months apart (conducted at least twelve months post TBD). For the purposes of this project stable means that scores on the baseline test sampling the generic domains of cognitive function are within the limits of one standard deviation and the Rehabilitation Indicators (RI's) are stable.

Design: On application to the program a subject (who will have to be at least one year post TBD) receives the psychometric tests, the RI's and the neurologic examinations and is told that he/she will be placed on a waiting list. If the pre-examination three months later reveals the person is stable, he/she is eligible to enter the program as soon as an opening is made available. If the person is not found stable, he/she is told to wait another three months and then return for re-examination. These tests are repeated at the end of each treatment cycle and at the end of the one-year follow-up period.

Procedure: Following assessment, the patient's requirements in terms of remedial interventions in four domains of perceptual-cognitive functions is determined. These modules are as follows:

a. Orientation, i.e., systematic training in attention/concentration.

b. Visual information processing.

c. Eye-hand coordination with dexterity and constructional skills.

d. Verbal abstraction.

Remedial interventions are also given in the area of social roles and in a sampling of pre-vocational skills related to module c (eye-hand coordination).

The orientation module will be administered to all patients first so that "overlay" phenomena can be eliminated before commencing any other type of systematic cognitive training.

FINDINGS TO DATE: Various assessment measures under the following categories were shown:

a. Psychomotor tests of vigilance, persistance and concentration

b. Tests of dexterity and functional (tool use) samples

c. Tests of visual perception and perceptual motor integration

d. Measures of cognitive perceptual integration and memory

e. Measures of memory and basic academic skills

f. Measures of general and specific intellectual aptitude

g. Measures of reasoning, self-knowledge, openness and social skills

h. Prevocational module

Preliminary data has been collected. Analysis will not be available until a later date.

APPLICABILITY: Patients with traumatic brain damage who enter medical rehabilitation settings generally exhibit disturbances in motor and/or speech functions and cognitive and perceptual defects which interfere with normal functioning. They generally require long-term attention in a variety of therapies. These therapies have to deal with the layering effects of these multiple problems and their generic relationships to vocational outcomes. While physical and ADL restoration can often be attained, the relationship between these gains and a vocational outcome is severely attenuated unless the cognitive and perceptual deficits are treated as well. Our work with hemiparetics due to cerebral vascular accidents (CVA) suggested that our way of approaching diagnosis and remediation would also be of value for traumatic brain injury cases. During the past several years, we have had the opportunity to apply to this population some of the skills acquired in managing, diagnosing and treating stroke victims.

007 Muscle Re-Education in the Hemiparetic Patient by use of EMG Feedback

Principal Investigator: Arthur Eberstein, Ph.D.

Status: Continuing

Dates: September 1977-September 1980

Cost: Annual $113,249 — Projected Total $300,000
RT Annual $101,485 — RT % of Annual Total 90%

Annual Report Reference: #18, Page 326, R-94

OBJECTIVES: **General Hypothesis:** Functional recovery in the hemiplegic upper extremity will be facilitated by providing the patient with audiovisual feedback derived from EMG activity transduced by means of surface electrodes and integrated over 100 msec intervals. Active range of motion and functional performance will correlate positively with EMG performance.

Secondary Hypothesis A: The employment of video display consisting of two simultaneously presented EMG channels, each of which represents one member of an agonist-antagonist pair, will be particularly effective as a source of feedback in training the reduction of spasticity.

Secondary Hypothesis B: A flaccid member of an agonist-antagonist pair can be selectively trained through the employment of a variable threshold level, displayed as a horizontal line on the video screen, coupled with an audio signal whose presence is made contingent upon the patient's production of an EMG level greater than or equal to the threshold level.

METHODOLOGY: **Validity:** Computation and recording of EMG activity was accomplished by means of a Functional Biosystems bioconditioner (Model 6801). It is an established fact that EMG integrated over brief time intervals is a valid index of muscular activity occuring during the execution of movement patterns. Validity was further assured by observing the actual movement performed by the patient during daily acquisition of integrated EMG response for each muscle, in addition to the initial and physical assessments employing traditional physical and occupational therapy procedures.

Reliability of measurement was insured by employing the following procedure: (1) Location of optimal electrode placement sites was achieved by reference to anatomical landmarks and motor point location by means of electrical stimulation. Electrode placement was finally established by measuring distance and resistance between each member of an electrode pair with reference to the indifferent electrode. (2) Where necessary the skin surface of the affected extremity was shaved. (3) The starting position of the involved extremity was kept the same both between and within sessions, during daily acquisition of measurement. (4) Simultaneously recording an integrated EMG response for each muscle and its antagonist during an attempted movement on at least six occasions per session. The six data points were obtained over two sweeps during which time the patient was instructed to perform three responses per sweep. The EMG performance for each of these sweeps was stored in memory, and displayed on the video screen during which time they were photographed. The six data points obtained from each muscle activity were averaged and a single daily representative value calculated.

FINDINGS TO DATE: Eighteen hemiplegic patients, 5 in the acute and 13 in the chronic phase of hemiplegia participated. All acute patients were undergoing physical and occupational therapy during the time they were in the study, although none for the affected upper extremity. Five chronic patients were receiving traditional therapeutic exercise but only one for the affected upper extremities. The remainder had undergone traditional therapies and had reached an apparent limit of progress in upper extremity function.

All patients without exception gained in their ability to produce and modulate EMG activity in the hemiparetic upper extremity. Of the various target muscle groups the biceps-triceps combination, whether trained to perform elbow flexion or elbow extension, yielded the most impressive and reliable effects. These gains were reflected not only in improved EMG response but in noticeable improvements in active range of motion. The latter fact has prompted us to incorporate the measurement of AROM's as an integral part of our evaluative techniques (see below). During shoulder flexion all patients were able to reduce the synergistic pattern of elevated EMG activity of the upper trapezius relative to the anterior deltoid, and to increase their active range of motion on this task.

With regard to functional gains, as gauged by the performance of activities of daily living (ADL) finger extension proved critical. Patients who had not achieved finger extension reported little practical use of their affected upper extremity. Patients who could extend their fingers visibly reported dramatic functional gains - viz. using the extremity to pick up items, to hold utensils, etc.

Overall the results obtained to date have been confirmatory to the general hypothesis posed above as well as to the secondary hypotheses. It is evident that some aspects of our EMG feedback training are responsible for recovery of upper extremity function in the hemiplegic patients who participated in our study. The use of the single-case multiple baseline design, together with the fact that many of the patients studied were chronic hemiplegics who had received traditional therapies and had reached an apparent limit of progress, enables us to be confident that the observed gains were associated with treatment and not with general recovery or other forms of treatment.

APPLICABILITY: This project has immediate relevance to rehabilitation of neuromuscular dysfunction. EMG feedback in this clinical application represents an extra tool in the armamentarium of rehabilitation techniques applied to hemiparetic patients, improvement of motor function may be obtained in a shorter span of time as compared to conventional procedures.

The goal of this project is the retraining of the patient's own capacities in the most efficient manner possible. Combining the efforts of the therapist with self-generated feedback from the patient promises to provide a substantial increase in the efficiency of the educational process. This should lead to earlier recovery of the patient, thereby saving his/her time and expense as well as time of the therapist.

008 Factors Underlying Improvement in Respiratory Function Following Cervical Cord Injury

Principal Investigator:	**Francois Haas, Ph.D.**	
Status:	**Continuing**	
Dates:	**August 1976-July 1981**	
Cost:	**Annual $85,712**	**Projected Total $390,000**
	RT Annual $85,712	**RT % of Annual Total 100%**
Annual Report Reference:	**#18, Page 23, R-98**	

OBJECTIVES: The object of this study is to quantify the patterns of improvement in several different areas of respiration and to assess the role played by each of several factors which may promote improvement from the onset of a traumatic cervical cord injury until stabilization occurs. These include studies on (1) the effects of loss of sensation from the rib cage on the reflex ability to regulate ventilation (sensory studies), (2) the factors which lead to improvement in respiration throughout the clinical course (motor studies), and (3) the effects of sensory and motor dysfunction on the ability to maintain effective blood gases and acid-base balance (blood gas studies).

METHODOLOGY: In order to accomplish these goals the following tests have to be carried out. These tests are noninvasive and are designed to produce a minimum of discomfort to the patient and start as close to the time of injury (the best time to be at the inception of the rehabilitation program) as possible and continue for a period of 3 years. First at monthly monitoring, and then every three months. A base line pulmonary function test using either the Goddard Twin Bell Spirometer or the CIP Pulmolab will be carried out at the admission of the patient to the study, and then twice yearly. In addition, the following physiological measurements for each of the other areas of investigation are planned:

I. **Sensory Studies:** The methods used in the sensory studies involve strictly non-invasive techniques. Patients inspire in the supine position through a J-valve and expire into the atmosphere. The inspiratory limb contains a pneumotachograph to record air flow and a pressure transducer to monitor mouth pressure. Tidal volume is obtained by electronic integration of the flow signal. Samples of expired air are delivered to a capnograph to monitor end-tidal CO_2.

   Each patient's respiratory resistance and elastance are measured. The anticipated tidal volumes under load conditions are computed from a first order linear differential equation assuming a sinusoidal inspiratory pressure waveform. Deviations between observed and calculated values of tidal volume are used to deduce reflex or mechanical alterations in inspiratory pressure during the loaded breath.

   The experimental groups studies thus far have been chosen to include a range of lesion levels (fromT-3 to C-4) and ages (13 to 40) to determine the effect of lesion level and age on respiratory performance.

II. **Motor Studies:** The methodology of this part of the project requires noninvasive measurements obtained at bedside. The measurements include (1) vital capacity and its subdivisions from a spirometer. (2) rib cage stabilization from chest pneumograms during different breathing maneuvers, (3) respiratory compliance from a weighted spirometer bell to produce a change in lung volume at FRC, (4) peak inspiratory pressure against a closed shutter to determine the isometric pressure generated by the diaphragm, and (5) neurological improvement obtained from physical examination.

   Each new patient has these measurements made once monthly and an attempt will be made to correlate these results with age, sex, and level of lesion.

III. **Blood Gas Studies:**
   (1) For the blood gas and acid base balance, the Astrup Micro method will be used as described by Segal and Anderson. The capillary blood was chosen to avoid the use of arterial puncture, and possible complications (this test is as accurate as arterial). This test should be given monthly in the early stages and every three months in the latter stages.

(2) Chest stability, sighing and respiratory compliance data will be obtained from measurements in Motor Studies. (See above Motor Study Methods 2 and 3).

FINDINGS TO DATE:

I. **Sensory Studies:** We have completed the quantification of the first-breath ventilatory response to a range of both elastic and resistive (inspiration through a narrow tube to stimulate a sudden increase in airway resistance) loads in a group of 80 naive normal subjects (i.e., unfamiliar with respiratory experimentation). As stated in our previous progress report, this new study stemmed from our finding that some of the naive normal subjects in our initial study produced VT responses against elastic load which differed markedly from previously published responses that were apparently obtained in experienced subjects. We therefore set out to establish a realistic set of standards which could be used to analyze loaded breathing responses in our cord-injured population. The results of this study indicated that previously published "normal" responses represent only one point in a continuum of possible responses and thereby demonstrates that the application of the existing "normal" standards to patient populations can lead to erroneous conclusions. We derived a new mathematical model which permitted us to predict the mechanical effects of added loads on inspiration. This model, in turn, enabled us to demonstrate that the continuum of ventilatory responses in naive subjects, which could not be explained by mechanical considerations, represented individual variation in inspiratory motoneuron output under load conditions. In contrast to previous studies which emphasize VT-defense against loads, these new findings indicate that other parameters provide better indices of load-compensating mechanisms when variations in inspiratory motoneuron output occur. The results of this study, which is the most comprehensive work on loaded breathing to date appeared in the April 1979 issue of the **Journal of Applied Physiology: Respiration, Environmental and Exercise Physiology.**

We have employed these data from normal subjects to analyze the ventilatory response to graded elastic and resistive loads in a group of 18 cord-injured subjects. The derivation of a new mathematical model has enabled us to demonstrate that rib cage proprioceptors influence the duration and timing of the phrenic motoneuron train but not its average intensity. These findings were presented at the 63rd Annual FASEB Meetings, April 1979 and have been published only in abstract form. This work is currently being prepared for submission to the **Journal of Applied Physiology: Respiration, Environmental and Exercise Physiology.**

II. **Motor Studies:** A total of 56 cervical cord-injured patients whose level of injury ranged from C3 to T4 had partial respiratory motor tests performed. Analysis of the expiratory flow-volume loop indicated that subjects who were at least 12 month post injury had significantly improved flows and volumes as compared to those less than 12 months post-trauma. This further substantiates the hypothesis that there is significant improvement in pulmonary function over the first 12 months post-trauma. The factors which underly this improvement remain uncertain, consequently we have purchased, and are awaiting delivery of magnetometers with which rib cage stability can be ascertained. In addition we have started our analysis of the inspiratory phase of flow-volume. We are continuing to test patients and have instituted the new protocol outlined above. The data summarized in last year's progress report is presently being prepared for publication.

APPLICABILITY: Results from this study should facilitate:

1. Ones ability to plan a more appropriate and realistic vocational rehabilitation program, because of increased accuracy of knowledge of nature and extent of deficit, particularly with respect to potential energy resources;

2. Less interruption from respiratory problems of an ongoing vocational rehabilitation training program resulting in more efficient use of the program's resources; and

Reduced hypoxemia providing greater energy resources and mental acuity for the patient.

009 Communication Disorders in Adults With Traumatic Brain Damage

Principal Investigator: Martha Taylor Sarno, M.A.
Status: Continuing
Dates: October 1977-September 1980
Cost: Annual $30,473 — Projected Total $88,000
RT Annual $26,854 — RT % of Annual Total 88%
Annual Report Reference: #18, Page 145, R-102

OBJECTIVES:

1. To determine the characteristics of language, cognitive and perceptual-motor impairments due to traumatic head injuries, exclusive of those incurred by gunshot wounds.
2. To correlate those impairments with the ability or inability to function socially and vocationally.
3. To determine the degree and course of recovery of such impairments.
4. To establish correlations between degree of recovery and age, length of coma, locus of pathology, time post-trauma and severity.
5. To identify those deficits which lend themselves to treatment or amelioration through the application of rehabilitation techniques, the end purpose of which is improved psychologic, social and vocational potential.

Hypothesis to be Tested: The language, cognitive and perceptual impairments secondary to brain damage resulting from closed head injuries differ in nature, characteristics, degree, and course of recovery from impairments secondary to brain damage resulting from other etiologies.

METHODOLOGY: In this study, the term **anatomical discontinuity** refers to injuries in which there was documented evidence of infarction or laceration of cerebral tissue. This includes any trauma (except missile wounds) which resulted in tearing, loss or compression of brain tissue.

The designation **aphasia** was limited to patients who manifested specific deficits in the processing of information via the speech code, that is, patients whose use of speech for expression and/or reception was impaired. This definition, then, excluded patients with reading deficits who did not also exhibit some of the classical speech symptoms of aphasia (i.e., paraphasic errors, word finding difficulty).

Types of aphasia were designated according to the classification of Geschwind (7) and Benson (1). It should be noted that the designation of aphasia was made exclusively on the basis of clinical observations and in a few instances there was disagreement among speech pathology staff members as to whether a patient was indeed aphasic. **Dysarthria** was defined as a speech deficit on the basis of pathology of the motor speech system evident in defects of the acoustic aspects of the speech stream (i.e., articulation, resonance, stress and intonation). The term **subclinical aphasic disorder** was used to refer to evidence of linguistic processing deficits on testing in the absence of clinical manifestations of linguistic impairment. The notion of the existence of linguistic deficits secondary to brain damage which do not resemble the classical aphasic syndromes but which are not associated with a state of dementia is not new to the aphasia literature. Boller and Vignolo (3) referred to "latent aphasia" and Geschwind (5, 6) addressed himself to the characterization of a variety of non-aphasic naming defects.

Subtests of the Neurosensory Center Comprehensive Examination for Aphasia were administered. Four subtests were used as a database: visual naming; work fluency; sentence repetition; and the token test.

The patients had been referred to the Speech Pathology Service at various points in the post-traumatic period ranging from three weeks to eight years. Time since onset (TSO) at first test for the whole group was 48 weeks (mean time), and 27.5 weeks (median). Whenever possible, testing was administered at three months post-injury and thereafter at six month intervals.

FINDINGS TO DATE: Fifty-six closed head injured patients (CHI) referred for speech pathology services were examined to determine the presence and nature of verbal deficits. Eighteen (32%) presented classical symptoms of aphasia, 21 (38%) had motor dysarthria, and 17 (30%) had no discernible aphasic deficits in spontaneous speech but showed clear evidence of verbal deficit on testing.

No patient admitted with sequelae of CHI was spared some degree of verbal impairment, however mild or apparent. Furthermore, dysarthric patients without exception, showed subclinical linguistic deficits. Though the patients studied were thought to be more severe than most of those reported in the literature, our findings suggest the desirability of a careful linguistic evaluation of all CHI patients because of the potential impact of verbal deficits on rehabilitation outcome.

The data are being analyzed to determine the nature, characteristics, degree, and course of recovery from impairments secondary to brain damage. Correlations will be established between degree of recovery and age, length of coma, locus of pathology, time post trauma, and severity. These impairments will also be correlated with the inability to function socially and vocationally.

APPLICABILITY: The patient with brain damage of any kind represents a challenge to rehabilitation because of the complexity and severity of the pathology. The group being studied here, by virtue of the mode of injury, presents problems which appear to differ from those manifest in patients with brain damage on the basis of vascular infarcts or gunshot wounds. Specifically, in some patients there appear to be subtle deficits of verbal behavior which can interfere with vocational or educational performance, in spite of the fact that language may be adequate for every day social purposes.

In order to improve the social and vocational potential of the population under study, it becomes a matter of importance to identify the nature and extent of deficits in higher brain functions, with particular attention to verbal behavior. The findings should help provide guidelines for the physiatrist in making rehabilitation management decisions and for all rehabilitation team members in their direct therapeutic efforts on behalf of these patients (i.e., prevocational exploration).

The ability to use all of the modalities of language adequately is essential to the majority of vocational pursuits, hence the importance of this study.

010 Quantification of Electromyography with Computer Analysis

Principal Investigator:	**Arthur Eberstein, Ph.D.**	
Status:	**New**	
Dates:	**January 1979-December 1981**	
Cost:	**Annual $76,184** **RT Annual $58,120**	**Projected Total $190,000** **RT % of Annual Total 76%**
Annual Report Reference:	**#18, Page 363, R-100**	

OBJECTIVES: The goal of this study is to differentiate muscle fiber types within electromyography.

The specific objectives are as follows:

1. Record electrical activity from skeletal muscle during weak contraction.
2. With a computer, derive power spectrum for the recorded myoelectric activity.
3. Calculate the action potential conduction velocity for the sampled muscle fibers.
4. Compare conduction velocities of muscle fibers in normal muscle with those obtained in diseased muscle.

METHODOLOGY: The methodology is based on a mathematical model which describes the Fourier transform and power spectrum of single motor unit action potentials. In the model, muscle fibers are described as long cylinders lined up in parallel, and action potentials propagating in both directions from an innervation point. The sum of the action potentials from a group of single fibers contributing to the motor unit potential can be derived for a point in the muscle volume. This potential variation with respect to time can be transformed into a Fourier series. From this, the power spectrum for a single motor unit action potential can be derived. The power spectrum is a function of the (a) temporal dispersion of individual fiber potentials, (b) spatial dispersion of the fibers, and (c) action potential velocity dispersion. The present study is based on the dependency of the power spectrum on the conduction velocity. Thus, knowing the power spectrum we may calculate the conduction velocity.

The experimental procedure utilizes conventional electromyographic (EMG) technique. Standard EMG electrodes and equipment are used throughout the study.

FINDINGS TO DATE: Data was collected and analyzed from 15 normal male subjects, ranging in age from 28-48 years. The procedure in each case involved placing two surface electrodes over the distal portion of the biceps brachii muscle, aligned parallel with the muscle fibers. The electrodes are metal discs, 1 cm in diameter, embedded in a plastic holder so that their separation is fixed at 3 cm. The electrodes were connected to a TECA electromyograph.

Weak volitional contractions permitted single motor unit potentials to be detected and recorded on magnetic tape. The entire procedure of affixing the electrodes and recording approximately 5 sec of data required about 30 min. The potentials were then entered from the tape into the computer (DEC PDP 11/34). Since the frequency response of our recording system was set at 20 to 5,000 Hz, the EMG signals were converted to digital form with a sampling rate of 10,000 Hz by means of an A/D converter. A fast fourier transform was performed by the computer on 1024 points.

A fourier transform and power spectrum was computed for each recorded potential. For each subject, the average of 10 power spectra was calculated and plotted. It is seen that the amplitude of the power is relatively constant up to about 90 Hz and then drops precipitously. The spectral minima are clearly visible. The first spectral minima (n=1) occurs at approximately 150 Hz. Since d is 3 cm, n is 1, f is 150 Hz, then for this subject the muscle conduction velocity ($v=df/n$) is calculated to be 4.5 m/sec. In this manner we calculated the muscle conduction velocity for each subject. The velocity ranged from 3.3 to 4.5 m/sec., with an average of 4.3 ± 0.4 m/sec.

The close agreement in velocity between subjects is very encouraging in terms of the procedure we used and the analysis of the data. We now plan to collect data from patients with various forms of myopathy as well as continue to accumulate data from normal subjects.

APPLICABILITY: Neuromuscular diseases are among the leading causes of severe chronic disability in children and adults. Previously well-defined classifications of these diseases into neuropathies and myopathies are now subject to question and considerable alteration. This creates problems associated with the diagnosis of an ailment which in turn become problems on rehabilitation since an incomplete or incorrect assessment of the disorder results in inadequate and less successful rehabilitation of the patient to independent functioning. This study is relevant to the goals of rehabilitation as defined in Section 202 (a) of the 1973 Vocational Rehabilitation Act. The Act specifically mentions that projects supported under this section "may include medical and other scientific, technical, methodological, and other investigations into the nature of disability, methods of analyzing it; and restorative techniques; . . . and relative activities which hold promise of increasing knowledge and improving methods in the rehabilitation of handicapped individuals and individuals with most handicaps."

Due to the complicated nature of classification of neuromuscular disease through electromyography, we have elected to computerize correlations between electrical activity and specific muscle and nerve pathophysiology. With increased sophistication that is inherent in such a system physicians will be able to diagnose neuromuscular pathology in a much more rational manner, with greater rapidity.

011 Long Term Follow-up of Stroke Patients with Aphasia

Principal Investigator: Martha Taylor Sarno, M.A.

Status: New

Dates: July 1979-March 1982

Cost: Annual $5,415 — Projected Total $50,000
RT Annual $4,322 — RT % of Annual Total 80%

Annual Report Reference: #18, Page 166, R-106

OBJECTIVES: The proposed study intends to extend the time limits of our data beyond the first year post stroke by asking the patients who are still available and who participated in our one year post study, and an additional group of 80-90 patients who were not participants but for whom we have test data obtained during the first year to return for reevaluation. The time since onset for the total group ranges from one to ten years. Data analyses should provide a basis for achieving the following objectives:

1. Identify and quantify the recovery of communication behavior, if any, which takes place in aphasic patients after the first year post stroke.
2. Compare changes which occur in the period beyond the first year with those during the first year post stroke.
3. Raise research and clinical questions concerning the long term management of aphasic post stroke patients.

METHODOLOGY: Patients will be selected for study from consecutive referrals to the Speech Pathology Service over the seven year period ending September 1978. Based on previous census figures we anticipate that approximately 100 aphasic patients will meet the subject selection criteria. Because this study concerns long term followup it is anticipated that all of the patients will be outpatients.

The patients selected will be aphasic on the basis of cerebrovascular lesions of the left hemisphere which, if possible, have been confirmed by neuroradiologic studies. Those who have suffered arteriovenous malformations or ruptured aneurysms will not be included since their recovery course is known to differ from the stable cerebrovascular group (Kertesz and McCabe, 1977). All of the patients will be right handed, native speakers of English with normal hearing thresholds (30 db) across the speech frequencies. Patients must have a history of literacy and be able and willing to travel to IRM. For this reason only those who live in the greater New York area will be contacted. Signed Consent Forms will be obtained from all participants in accordance with the N.Y.U. Medical Center policy concerning research on human subjects.

Patients will be excluded from this study who have a history of alcoholism, pre-existing speech disorder, psychiatric disease, previous CVA, or known TIA, or neoplasm, equivocal handedness, or evidence of right hemisphere pathology. Patients who acquired English after the age of twelve will not be included since it is generally agreed that language is lateralized before puberty (Lenneberg 1967). Patients who are not alert, attentive or otherwise seem unable to cope with the testing process because of illness, severity of cognitive and/or aphasic deficits will also be excluded.

Each patient will receive a personal letter establishing our interest in his welfare and eagerness to learn from his experiences after discharge from the IRM program. Those patients who agree to come for retesting will be scheduled for a battery of tests as follows:

1. Functional Communication Profile (FCP)
2. Neurosensory Comprehensive Examination for Aphasia (NCCEA)
3. Functional Life Scale (FLS)
4. Interview

The interview and the spontaneous speech sample on the FCP will be tape recorded and will provide the basis for classifying patients into the diagnostic categories elaborated by Benson (1967), Geschwind (1971), and Goodglass and Kaplan (1972): Fluent (F); Non-fluent (NF); Global (G).

The interview will be essentially open ended and will include, if possible, a member of the patient's family or friend as an additional informant. Its purpose is to elucidate information concerning the patient's life style, goals, activities, concerns, etc. A "script" will be designed as the basis for the questions which will be posed at this session.

Depending on the number and distribution of those patients who return for retesting, they will be classified according to type of aphasia and time of retest. We expect that the time intervals will be classified as: 1 to 2 years; 2 to 4 years; 4 to 6 years; and 6 years or more post stroke. If there are a sufficient number of patients in each diagnostic category within each time group we will analyze and compare the data accordingly.

APPLICABILITY: About 84,000 (21%) of the 400,000 new strokes each year have aphasia. About 10,000 of these (2½%) are estimated as severe in the 4-12 week post stroke period (Brust 1976). Our findings should suggest specific, practical modifications in the implementation of speech pathology services for this patient group. A therapeutic time table may evolve which would help gear the focus of rehabilitation practices at various points along the recovery continuum.

The patients studied in this program represent a considerable group of those who seek rehabilitation services after stroke. The magnitude and complex interaction of the psychological, social, and vocational sequellae which they manifest makes them a particularly challenging group to manage effectively. The study findings should enlighten all members of the rehabilitation team concerning the long term expectations of communication effectiveness. This information is needed if family counseling, vocational training and placement, and social services are to be effectively used.

012 Improved Orthotic Design and Biofeedback in Scoliosis Management

Principal Investigator:	**H.R. Lehneis, Ph.D.**	
Status:	**New**	
Dates:	**May 1979-May 1984**	
Cost:	**Annual $38,468** **RT Annual $28,043**	**Projected Total $384,000** **RT % of Annual Total 73%**
Annual Report Reference:	**#18, Page 121, R-107**	

OBJECTIVES:

General Objectives:

1. To design, fabricate, and fit a variation of the presently used Milwaukee brace to improve cosmesis, allow for easier donning of the orthosis by the patient, and improve the effectiveness of the orthosis, especially, in controlling lumbar curvatures.
2. To design, fabricate, and fit a prototype of a biofeedback system for scoliosis management.

Specific Objectives:

1. Redesign of Milwaukee brace
   a. To design, fabricate, and fit an orthosis with an anterior opening to facilitate donning by the patient.
   b. To investigate more extensive use of plastics to improve cosmesis, decrease weight, lessen interference with clothing, and diminish bulkiness of the upright projections.
   c. To fit patients with the orthosis through the already existing evaluation and management system used by the scoliosis clinic at IRM.
   d. To establish methods of ascertaining patient response to design changes through written questionnaires, observations, and interviews.
   e. To compare patient response to the redesigned orthosis and traditional orthotic design, in regard to cosmesis and self management.
   f. To investigate the feasibility of an underarm, unitized orthosis for the treatment of kyphosis and scoliosis.

2. Biofeedback System

   a. To select a patient currently in treatment, who is willing to act as a model during the development of the system.

   b. To investigate what designs and materials are most appropriate for construction of the system.

   c. To investigate which feedback modality, an audio signal or noxious stimulus, and what feedback schedule, are most feasible, effective, and tolerable to the patient.

   d. To compose diagnostic criteria for future therapeutic application of the system.

METHODOLOGY: Orthotic management of scoliotic deformities has changed little in the last 25 years. There remains a great need to innovate in this area and make orthotic treatment more palatable to the typical adolescent scoliosis patient who is particularly anxious to remain active and has new-found concern over his/her appearance to others. Reducing the psychological trauma that these patients seem to experience while undergoing orthotic treatment through improved cosmesis and comfort, and easier donning is, therefore, of great importance. Being able to discard an orthosis in favor of a considerably less restrictive biofeedback system would go even further toward that end.

These approaches will be accomplished through improved orthotic design, and the use of modular components in redesigning the conventional scoliosis orthosis, and the development of a prototype biofeedback-orthosis system for the scoliotic patient.

Improvement in conservative scoliosis management will further diminish the adverse psychological and physical effects of this progressive deformity. A wider range of remedial treatment will become available for the typical patient at a pre-vocational age and free them to pursue a normal and productive life.

FINDINGS TO DATE: A scoliosis orthosis with an anteriorly opening pelvic girdle was fitted within the last year. No formal follow-up by the orthotist was needed and the patient is only seen when adjustments are required.

APPLICABILITY: Injection-molded, modular, neck ring components for the chin and occiput may be applied to head support and alignment systems in other rehabilitation and medical patient populations.

The prototype biofeedback instrumentation will be portable and compact and may act as a model for application of biofeedback therapy in other rehabilitation and medical patient populations as well as possible applications in education for developmental disabilities.

013 Effect of Electrical Stimulation on Denervated Muscle

Principal Investigator:	**Arthur Eberstein, Ph.D.**	
Status:	**New**	
Dates:	**October 1978-September 1981**	
Cost:	**Annual $59,108**	**Projected Total $180,000**
	RT Annual $52,872	**RT % of Annual Total 89%**
Annual Report Reference:	**#18, Page 371, R-108**	

OBJECTIVES: The goal of this project is to determine the effect of electrical treatment on resting membrane potential and passive electrical properties of denervated white mammalian skeletal muscle.

The specific objectives are as follows:

1. Denervate one side of rat.
2. Stimulate, starting four days after surgery, the denervated muscle daily for two weeks.
3. Measure resting potential, action potential and membrane input resistance and compare with similar measurements in denervated unstimulated muscles.

4. Determine if fibrillation potentials are present in denervated stimulated muscles.
5. Record twitch and tetanic responses from denervated stimulated muscles and compare with those from denervated unstimulated muscles.

METHODOLOGY: Fifty male Wistar rats weighing 150-200 gms will be used in this study. 25 will be controls and 25 will be test animals. The right hind limb of each rat will be surgically denervated by excision of a 0.5 cm segment of the sciatic nerve, just proximal to the befurcation of the tibial and common peroneal nerves. The cut end of the proximal portion of the nerve will be capped with silastic tubing to prevent subsequent re-innervation.

The animals will be divided into two groups, according to the treatment received. One group will have their extensor digitorum longus (EDL) muscle stimulated, starting four days after surgery. The other group will not have their muscles stimulated but will serve as denervated controls. To prevent infection or damage to the denervated muscles, electrodes will not be implanted in the legs of the rats. To stimulate, short monopolar EMG electrodes will be placed subcutaneously at either end of the muscle belly (similar to the procedure followed by Westgaard, R.H. et al., J. Physiol., 280:499, 1978). These will be withdrawn at termination of stimulation. The muscle will be stimulated two times each day for 30 minutes each time with pulses 1 msec in duration, 150 volts in amplitude and at a frequency of 10 Hz.

Measurements of resting potential, action potential and membrane input resistance will be performed in vivo after two to four weeks of treatment. For this phase of the study, the EDL will be exposed and bathed in oil maintained at body temperature. A micropipette electrode, filled with 3M Kcl, will be slowly lowered into each muscle fiber and the resting potential, indicated by a rapid change in baseline deflection, will be recorded. The micropipette will serve as a recording and a stimulating electrode. The fibers will be stimulated by passing pulses of current through a 10^9 ohm resistor in series with the recording electrode connected in a bridge circuit. In this way the action potential can be initiated and recorded.

Input resistance is the ratio of the steady state electronic potential to the applied current and will be measured by passing a known current through the microelectrode and recording the change in membrane potential.

The mechanical properties of the muscles will be determined by in vivo recording of isotonic contractions. The animals will be anesthetized with sodium pentobarbital, restrained in the left-lateral position, and the EDL muscle exposed on the right side. The proximal tendon after release will be attached to a displacement transducer. Flexible wires will be embedded directly into the EDL and the muscle stimulated for 0.5 sec with supra-maximal square-wave pulses of tetanizing frequency (100 Hz). All contractions will be performed with the muscle initially at rest length and under a constant 3 to 5 gm load.

All measurements will be performed similarly in denervated unstimulated and denervated stimulated muscles. The mean and standard deviation for each test will be calculated and the significance of the difference between the means of the treated and control groups will be determined.

FINDINGS TO DATE: Twenty-four male Wistar rats, approximately 200 gms in weight, were denervated on one side. One group of 12 rats had their denervated muscles stimulated for 21 days, twice each day for 10 min each time with pulses of 1 msec in duration and at a frequency of 5 Hz. The stimulus strength was set at a level to produce observable extension of the toes. The second group of 12 rats were not stimulated and served as controls.

Prior to any physiological testing of the two experimental groups of muscles, a histochemical survey was performed. EDL muscles from denervated-stimulated and denervated-nonstimulated animals were removed with a biopsy clamp, the mid-portion of each muscle cross-sectioned and stained for ATP-ase. Measurements of muscle fiber diameters were performed in a light microscope. One hundred Type II muscle fibers were measured in each muscle. The non-stimulated muscles had a greater percentage of smaller diameter fibers than the stimulated ones.

The average fiber diameter and standard deviation was 23.0 ± 2.0 μm for the denervated-stimulated fibers and 21.0 ± 2.0 μm for the denervated-nonstimulated fibers. Applying the standard t-test, the mean difference was significant. Thus, we can say that stimulation prevented some atrophy of the denervated muscles and that our experimental procedure is valid.

The mechanical response of each denervated EDL muscle was measured in vivo by recording their isotonic displacement following direct stimulation. The animals were anesthetized with sodium pentobarbital, restrained in the left-lateral position, and the denervated EDL muscle exposed. The proximal tendon was attached to a displacement transducer and flexible wires embedded directly into the muscle. The muscle was stimulated with either a single supramaximal square wave pulse (1 msec duration) for a twitch response, or at a 100 Hz frequency for 0.5 sec for a tetanus.

No difference was found between the two groups in terms of amplitude of response or rise time. The average amplitude of twitch and tetanus for the denervated-nonstimulated group was 4.5 ± 1.5 and 7.0 ± 2.8 mm, respectively; for the denervated-stimulated group, twitch and tetanus was 4.6 ± 1.6 and 6.6 ± 3.2 mm, respectively.

APPLICABILITY: The findings of this study will be utilized by rehabilitation workers in the treatment of patients with spinal cord injuries or lesions of the peripheral nerves. The results will assist in the formulation of guidelines to determine whether this specific treatment should be instituted and the duration of the treatment. It is anticipated that current procedures utilized in stimulation of denervated muscles will be varied in accordance with our findings to optimize the stimulation parameters.

014 Carrier Detection with Quantitative Electromyography

Principal Investigator:	**Arthur Eberstein, Ph.D.**
Status:	**New**
Dates:	**October 1979-September 1981**
Cost:	**Not Specified**
Annual Report Reference:	**#18, Page 379, R-109**

OBJECTIVES: To detect carriers of Duchenne muscular dystrophy.

The specific objectives are as follows:

1. Select true carriers using family history as a guide from the NYU Medical Center Neuromuscular Disease Clinic.
2. Perform an electromyographic examination of the biceps while under fixed load.
3. Compute the ratio of turns to mean amplitude as well as the duration and number of phases of motor unit potentials at ten different sites in the muscle.
4. Determine the serum CPK level.
5. Review and integrate results.

METHODOLOGY: Two groups of female subjects will be tested; one group will consist of approximately 20 normal individuals without any personal or family history of neuromuscular disease and a second group will consist of at least 20 known carriers of Duchenne muscular dystrophy. The first group will serve as controls in the study.

The testing program is based on an automatic analysis of the electromyographic interference pattern originally developed in 1964 and revised and improved in 1975. In this test, electrical activity will be ied-off from a concentric needle electrode inserted into one of the elbow flexors (biceps brachii or brachialis muscles) and amplified within a frequency range of 20 to 10,000 Hz. The constant force to be maintained by the subject during the recording session will be 30% of the ascertained maximum force. The subject will be supine with the elbow flexed at 90°.

The electromyographic signal, once detected, is processed digitally by a TECA APA 6 Action Potential Analyzer to provide two pulse trains. One pulse train represents the point of change in phase of the potentials (denoted at "turns"), and the other train of pulses corresponds to every change in potential greater than 100 μV. This threshold level was selected to avoid counting small random oscillations and noise. Thus, changes in direction of the potentials and the mean amplitude are counted. The pulse trains are separately totalized and normalized by the APA 6 Analyzer to provide an alpha-numeric display and automatic print-out of the number of amplitude counts and turn counts per second.

Each pattern of electrical activity recorded for 0.5 sec. of isometric effort will be characterized as follows: (1) the number of turns; (2) the amplitude of voltage changes; (3) the mean amplitude obtained from the number of counts of amplitude divided by that of turns; (4) the ratio of turns to mean amplitude. These parameters will be determined for each of 10 different sites examined per muscle, and then each parameter averaged for the whole muscle. The 10 sites to be examined in each muscle will be obtained by three insertions in the proximal, middle and distal parts of the muscle and by changing the depth of insertions in steps of at least 5 mm.

Serum creatine phosphokinase (CPK) will also be determined for each subject.

In this way, the interference pattern of each muscle will be defined so that these results as well as the CPK values for the normal subjects can be compared with those for the carriers.

Future investigation will include analysis and detection of probable and possible carriers of Duchenne Muscular Dystrophy.

FINDINGS TO DATE: None to date.

APPLICABILITY: Results of this study may be utilized by rehabilitation professionals concerned with counseling parents and relatives of disabled children due to neuromuscular disease. The study not only attempts to improve current procedures for the detection of carriers but will make workers in the field of rehabilitation aware of laboratory practices that are available other than serum CPK determinations. Unfortunately, it is still a common practice to base the advice and guidance presented to a client on a single CPK estimation. With this study, we are therefore increasing the data base from which a more accurate appraisal can be made, benefitting the mother and the relatives.

015 Evaluation of Functional Ability and Training Efficiency in Chronic Obstructive Pulmonary Disease

Principal Investigator: Horacio Pineda, M.D.

Status: New

Dates: October 1978-September 1981

Cost: Annual $66,087 — Projected Total 210,000
RT Annual $66,087 — RT % of Annual Total 100%

Annual Report Reference: #18, Page 34, R-111

OBJECTIVES: To identify appropriate objective and subjective criteria for COPD patients that correlates with loads or work stress of sufficient intensity, duration and frequency which could be used to:

1. Develop a standardized diagnostic method of exercise testing for COPD patients, and
2. Develop reconditioning exercise programs specifically designed to increase VO_2 maximum in these patients.

METHODOLOGY: The population will consist of one hundred twenty patients with diagnosed COPD divided into equal groups of severe, moderate, or mild COPD. Classification will be based on reduction of the effort independent flows (e.g., FEF 25-75%, FEV_1/FVC): below 50% of predicted will be classified as severe, 50-60% moderate, 65-85% as mild.

Patients will be recruited from the patient population seen at University and Bellevue hospitals and physician referrals. Each patient will be given a complete initial evaluation comprised of a clinical history and physical (CBS SMA12, EKG, X-ray) complete pulmonary function tests and vocational and psycho-social work-up. Complete aerobic metabolism will be studied (VO_2, VCO_2, MET, RQ, Lactic Acid, blood gasses) at basal metabolic level, rest (sitting) and during exercise. Treadmill exercise will be closely monitored by a physician in regard to EKG. Exercise levels will be increased every minute in 50 kpm increments (8.5 watts 100m 102) until a maximum is reached. Heart rate and blood pressure for gas analysis will be drawn. Maximum tolerable exercise (Wmax) will be limited by any or all of the following standards set by the National Heart Association, EKG changes, patient discomfort, or VO_2 maximum. This test will be repeated with supplemental oxygen to maintain adequate saturation as determined by the blood gasses. During this time the breathing pattern and gait will be analyzed for efficiency by a physical therapist.

Following the initial evaluation three sessions will be devoted to teaching more efficient breathing and ambulation techniques. In addition, endurance will be tested as 60% of the Wmax. The exercise period will be of 15 days duration, 3 days per week for five weeks. Each group of patients will be divided into matched pairs on the basis of age, degree of pulmonary impairment, and maximum work tolerance. Both groups will rest for 30 minutes prior to exercise, in order to establish a resting baseline. Supplemental oxygen will be administered when needed to maintain adequate saturation, and EKG and heart rate will be monitored during the rest, exercise, and recovery periods. Group A will perform continuous work at levels of 60% Wmax until a heart rate of 85% of predicted is reached. Group B will also exercise to 85% of predicted heart rate but they will alternate 15 seconds at 40% of Wmax. At the end of the exercise program, patients will be given the same evaluations as the pre-test.

The cardiopulmonary laboratory presently has all the facilities and equipment required except for a high incidence EKG monitor that can be used during exercise. The data obtained will be analyzed as follows: (1) For the individual patients, a home program of exercise will be devised to maintain or further improve his/her physical fitness; (2) The data for the group will be analyzed statistically (e.g., multiple correlation and canonical analysis) so that a profile may be derived for functional disability assessment and physical reconditioning, and to ascertain target norms for respiratory stress tests.

FINDINGS TO DATE: In view of the delay regarding the acceptance of this program and consequent postponement of purchase of an EKG monitor suitable for exercise monitoring, we have not performed any tests on patients. We have, however, spent the few months since the project was proposed in calibrating our other equipment using healthy individuals.

APPLICABILITY: The proposed dissemination and utilization plan is a broad one, designed to reach not only physicians and paramedical personnel, but to impact also on the vocational rehabilitation service-delivery system. Such a broad plan is necessary in order to change the knowledge and attitudes of all professionals involved in the rehabilitation of the individuals with chronic obstructive pulmonary disease (COPD).

It is hoped that the results of this project will help:

1. to gain acceptance for an objective and universally acceptable rehabilitation admissions criteria for rehabilitation; and
2. to generate policy changes, based on more accurate evaluation of disability and remaining functional capacity, to reduce inequities in disability benefits.

016 Effects of Resistive Exercises in Improving Respiratory Function in COPD and Neuromuscular Disease

Principal Investigator: Albert Haas, M.D.
Status: New
Dates: October 1978-September 1980
Cost: Annual $38,523 — Projected Total $76,000
RT Annual $38,523 — RT % of Annual Total 100%
Annual Report Reference: #18, Page 42, R-112

OBJECTIVES: To assess the benefits of resistive exercises on respiratory muscle function in Chronic Obstructive Pulmonary Disease, Muscular Dystrophy, Hemiplegia and Quadriplegia.

METHODOLOGY: The inability to meet added oxygen demands during increased work levels resulting from ventilatory muscle fatigue results in a decrease in the efficiency of any rehabilitation program. Results from exercises to increase respiratory muscle endurance predicated on isotonic muscle work have been equivocal. The use of isokinetic (resistive) exercise has not been fully explored as a technique for respiratory muscle readaptation. Consequently we have devised an exercise program for both inspiratory and expiratory muscles based on the principle if isokinetic work to be used in patients with COPD or neuromuscular induced weakened respiratory muscles. The improvement will be assessed in terms of isometric pressure generation, peak airflow and maximum breathing capacities.

Assessment of Respiratory Muscle Fatigue

Respiratory muscle fatigue will be ascertained by analyzing the high to low frequency spectrum from the diaphragm and intercostal muscles EMG. Bipolar surface electrodes will be placed in the 6th and 7th intercostal space to measure the diaphragmatic EMG. Intercostal EMGs will be obtained by electrodes placed in the 2nd and 3rd intercostal space parasternally. The EMGs will be recorded on magnetic tape and frequency analysis performed after removing the EKG artifact. (The EKG introduces low frequencies artifacts into the power spectrum and thus must be removed prior to analysis).

FINDINGS TO DATE: In view of the delay in notification of the status of this project and the consequent delay in obtaining magnetometers, work has not begun on the patient program. However, from continuing pilot work and from reports from other laboratories protocol have been modified to reflect the state of the art thinking.

APPLICABILITY: The proposed dissemination and utilization plan is a broad one, targeted to not only the physicians and paramedical personnel but also the vocational rehabilitation service-delivery system. Such a broad plan in necessary in order to increase the familiarity of all professionals involved in the rehabilitation field with the importance of respiratory rehabilitation.

The results of this study are quite vital insofar as they present a technique for improving work tolerance through increased respiratory muscle endurance.

017 A.D.L. - Activities of Daily Living - A New Form

Principal Investigator: Edith Lawton, M.A.
Status: New
Dates: Not Specified
Cost: Not Specified
Annual Report Reference: #18, Page 385, R-114

OBJECTIVES: To study and modify the Pilot A.D.L. form and its abbreviated version the "A.D.L. Checklist" so they may be used to fulfill the following purposes:

1. Review of items on form by three experts in the field (P.T., O.T., R.N.) to agree that the items on the form are necessary.
2. To establish reproducibility of the grading system by different professionals administering the test.
3. To show on a continuous basis from admission to discharge, a patient's ability to carry out daily activities so that functional status (progress, regression) can be documented at any time during his/her program.
4. To determine the degree of independence of a given patient in grades which express what he/she can do, as well as what kind of help and equipment, if any, is needed.
5. To measure and record time needed for carrying out activities in addition to grades as an essential factor of an over-all functional evaluation.
6. To record when needed equipment is ordered and received, so that the length of the rehabilitation program is not unduly increased by waiting for delivery.
7. To assess whether the form can be used for a wide range of patients, not only for a special group.
8. To determine whether the form is easy to use in a general working situation.

METHODOLOGY: The proposed form was pre-tested for 6 weeks by an affiliating physical therapist who was not RT-1 sponsored. The recommendations of the pre-test are incorporated in the proposed test form.

The Pre-test was administered to 10 patients with different disabilities: 2 paraplegics, 2 quadriplegics, 2 amputees, 2 hemiparetics, 2 multiple problems. The conclusions of the pilot study are as follows:

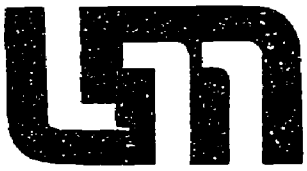
1. The basic organization of the form serves its purpose. It establishes the patient's functional level on a continuous basis.
2. To measure and record time needed for pertinent activities, in addition to a grade, was recognized as an essential factor for a realistic assessment.
3. The number of items tested and their sequence on the form was found practical.
4. The number of grades and the method of grading was informative and adequate after some revisions of the definitions of grading were made. Specific examples "How to grade" and "How to time" were added in the explanation of the form.
5. The form was tried by an affiliating physical therapist who was **not** a member of the staff. After a very short time she could complete a test in 1½ hours. However, if this form were used by a therapist or a nurse who worked continuously with a patient the testing time could be reduced considerably.
6. The form can be used in a rehabilitation setting.

APPLICABILITY: The findings recorded on the proposed test form will aid in program planning. The activities for which "help" and/or equipment is needed and which take a great deal of time, will (1) constitute the A.D.L. program; (2) show activities that need to be practiced in other departments, e.g., balancing and strengthening in the physical therapy department, eye-hand coordination, fine finger movements in the occupational therapy department; (3) aid in selection of equipment.

The form will further aid to (1) determine staffing patterns and work schedules, (2) facilitate discharge planning, (3) delineate architectural barriers at home and in a potential work situation.

Since five evaluations can be made on the same form, easy assessment of change in the patient's functional efficiency can be made at any given time and thereby facilitate cost analysis, documentation of treatments rendered, and early vocational planning.

The A.D.L. Check List (the short form) will be especially useful to Vocational Rehabilitation Counselors in their placement efforts.



University of Minnesota (RT-2)
Medical Rehabilitation Research and Training Center

CORE AREAS

Neuromuscular

Studies of causes, effects, responses and adaptations related to injury or impairment of function of prolonged duration in the neruomuscular system.

Psychosocial-Vocational

Programs on problems in the psychological, social or vocational areas which relate to ability to adapt or respond to the requirements of normal living.

Cardiac Rehabilitation

Activities which communicate research findings of cardiac, pulmonary and vascular requirements for activities throughout the range of normal performance and especially related to adaptation to the requirements of normal living following pathological changes.

Health Care Delivery

Health needs and the efficacy and efficiency of various health services in relation to rehabilitation.

Education in Rehabilitation

Needs, applications, adaptation and modifications of education related to rehabilitation.

Bionomic Adaptations

Methods for responding to or compensating for losses or impairments of interaction with the environment which increase the capacity for performance of the quality of life of the chronically ill or handicapped patient.

Ergonomics

The quantitative evaluation of muscular force, work, power and energy of man.

Spinal Cord Injury

Problems in rehabilitation and adaptation to living including community integration in patients who have suffered spinal cord injury.

UNIVERSITY OF MINNESOTA

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COMPLETED **ACCESSION NO.**

CONTINUING

NEW

TRANSFERRED

PROPOSED

Ambulatory Monitoring of Work Costs

Wheelchair Propulsion System for Spinal Cord Injured Patients Using FES of the Lower Extremities

Effects of the Orthokinetic Cuff on Upper Extremity Function of the Adult Hemiplegic Patient

Reproducibility of Hip Extension Measurements in Children with Spastic Cerebral Palsy

Long Term Outcome of Patients After Electrical Injury

Compression Neuropathy (Ulnar Nerve Conduction Velocity Slowing) in Acute Spinal Cord Injury

Chronic Pain, Attention, and Anxiety: A Psychophysiological Analysis

018 Bibliography of Psychosocial, Vocational, and Sexual Aspects of Spinal Cord Injury

Principal Investigator: Jerry Martin, Ph.D.
Status: Completed
Dates: November 1975-June 1979
Cost: Annual Not Applicable; Projected Total Not Applicable
RT Annual Not Applicable; RT % of Annual Total Not Applicable
Annual Report Reference: #18, Page 251, R-58

OBJECTIVES:

1. To provide a well organized, comprehensive bibliography of all confirmed publications about psychosocial, vocational, and sexual aspects of spinal cord injury;
2. to distribute the bibliography widely, both to justify its development and to facilitate the updating process.

METHODOLOGY: Letters stating the purpose of the project and requesting copies of any locally produced bibliographies and articles were sent to all regional spinal cord injury centers and member physicians of the American Spinal Injury Association. In addition to the letters, a review of RSA supported research and a standard search of the medical and psychosocial literature was done using the MEDLARS and PASAR computer search systems. The citations in relevant publications were checked and all references were verified. By updating the literature searches every year and including a request for further materials along the distributed bibliography an up-to-date bibliography will be continually available.

FINDINGS TO DATE: Approximately 1,500 copies of the bibliography have been distributed. The Educational Resources Information Center has published a resume and the bibliography is now listed on Medline. One hundred and ninety supplements have been distributed.

A special issue of Rehabilitation Psychology, the journal of Division 22 of the American Psychological Association, included update listings and was distributed to nearly 1,000 individuals.

APPLICABILITY: The rapid growth of spinal cord injury rehabilitation programs, the conceptualization and expansion of the regional spinal cord injury centers, and the concommitant increase in research and theoretical publications make a centralized integration of the diffuse knowledge essential for providing maximally effective utilization for rehabilitation and further research.

This project has provided an indexed bibliography which has been purchased and used by researchers working in the psychosocial and vocational aspects of spinal cord injury.

019 Studies of Urologic Function in Patients Following Spinal Cord Injuries

Principal Investigator: Mary Price, M.D.
Status: Continuing
Dates: October 1963-October 1983
Cost: Annual $201,952; Projected Total $1,007,000
RT Annual $116,726; RT % of Annual Total 58%
Annual Report Reference: #18, Page 3, R-2

PART I
OBJECTIVES:

1. To study renal function and micturition and their relationship to recurrent bladder infection in patients with spinal cord injury;
2. to test methods for improvement of urinary bladder function and management in patients with spinal cord injury;

3. to record the changes of urinary tract function of paraplegic and quadriplegic patients over a period of time.

METHODOLOGY:

1. Renal function is tested by blood and urine analysis after intravenous injection of insulin and para-amino hippurate.
2. The mechanism of urination is studied by air-cystometry, clinical analysis, and radiographic techniques. In catheter-free patients, the amount of urine remaining in the bladder after voiding is measured.
3. Urine culture results in the patient's history of bladder infections are correlated with the findings of the preceding studies.
4. Prediction of the control of bladder contractility is attempted through the use of the urecholine denervation super-sensitivity tests.
5. Data from testing is available for patient information and major statistical analyses.

FINDINGS TO DATE:

1. Sister Kenny Institute patients have withdrawn from this project because of staffing and transportation difficulties.
2. With the approval of the Federal Drug Administration the Renal Function Laboratory was chosen by Amar-Stone Laboratories to compare the efficiency of the modified from of inulin with the older form of inulin in testing glomerular filtration rate. The two substances compared closely with each other. The FDA has approved the inulin and inulin clearance testing has resumed throughout the United States.
3. Five hundred eighty-three patients have been tested to date.

APPLICABILITY: Preliminary reviews of systematic, ongoing evaluations of spinal cord injury indicate that urinary tract deterioration is not inevitable and that funds spent in training patients, physicians, paramedical personnel, and the families of patients in their proper care will result in a great saving of funds formerly spent as a result of the treatment of physical and psychological deterioration.

Part II

OBJECTIVE: To determine change of renal function in paraplegic and quadriplegic patients who have required ileac diversion and compare these changes with spinal cord injured patients who have not required ileac diversion.

METHODOLOGY: Studies of renal function as outlined in Part I are carried out immediately before diversion and annually thereafter.

FINDINGS TO DATE: Data analysis is being completed. Preliminary statistical analysis suggests that renal function does not deteriorate more rapidly in patients treated by diversion than in those treated conservatively.

APPLICABILITY: The surgical procedure, ileac diversion, is being more frequently performed to avoid kidney deterioration resulting from poor kidney drainage. There is need for objective evidence regarding the efficacy of this procedure.

Part III

Discontinued

Part IV

OBJECTIVE: To compile a comprehensive bibliography of the world literature concerning the urinary tract function of patient with spinal cord injury, emphasizing especially the pathophysiology of the urinary tract, laboratory methods for diagnosis, therapeutic approaches and statistical methods of documentation.

METHODOLOGY: Medline is being used to search major medical indices. Primary reference cards are made for 71 subtopics with cross referencing. These have been catalogued.

FINDINGS TO DATE: As of FY 1978, 14,200 references are filed, with an additional 10,150 cross references, and 15,000 authors listed. Members of the laboratory have read 7,800 of the references.

APPLICABILITY: Through the bibliography it has been possible to improve research techniques and to apply therapeutic findings to patient treatment.

Part V

OBJECTIVE: To accumulate data for future study of the relationship of immunological processes to urinary tract infection.

METHODOLOGY: Electrophoretic patterns of serum proteins are obtained for each patient receiving a urinary tract evaluation. Antibody coating determinations have been requested with selected urine cultures.

FINDINGS TO DATE: Analysis of data from antibody coating determinations has not been completed.

APPLICABILITY: Since urinary tract infections are prevalent in patients with spinal cord injuries, treatment of these infections, aided by the determination of immunological changes in the blood, would significantly aid in the rehabilitation and maintenance of rehabilitation of these patients.

Part VI

OBJECTIVE: To document changes in bladder contractility through the use of the Merrill Gas Cystometer.

METHODOLOGY: The gas cystometer is used to record changes in bladder pressure at weekly or bi-weekly intervals for inpatients and at the same time of return visits by outpatients.

FINDINGS TO DATE: During FY 1977, one hundred forty-two gas cystometrograms were made, together with 25 denervation and supersensitivity tests, utilizing Urecholine. The gas cystometrogram was used for education for trial of voiding for 20 patients. During FY 1978, one hundred eighty gas cystometrograms were made, together with 18 denervation and supersensitivity tests utilizing Urecholine. The gas cystometrogram was used for education for trial of voiding for 20 patients.

APPLICABILITY: The results of this study will aid in improving patient care through the more accurate assessment of the value of cholinergic and symphatomimetic drugs in augmenting or depressing bladder contractibility, through the determination of length of period of spinal shock, through predictions of the success of trials of voiding, and through the correlation of the level of spinal cord injury with the changes of pattern contract[illegible]

Part VII

Discontinued

Part VIII

Discontinued

Part IX

OBJECTIVES:

1. To assess the efficacy of a telescopic double lumen catheter in minimizing contamination of urine obtained for culture from the ileal conduit;
2. to establish a reliable method for obtaining urine cultures from patients with ileac diversions.

METHODOLOGY: Urine is obtained for culture by inserting a double lumen catheter into the ileal conduit and by sterile swab from the stoma.

FINDINGS TO DATE

1. A telescopic double lumen catheter has been used to obtain urine specimens from 165 patients with ileac diversions. Urine culture from the ileal loops of 39 patients showed no growth, 126 cultures showed growth with from 1 to 5 different species of microorganisms: 51% of positive urine cultures grew more than one organism. Urine cultures from the loops of 39 patients showed no growth even through the stoma swab from the same patients indicated the presence of up to 8 different species of microorganisms on the area surrounding the opening to the loop.

2. These studies indicate that the double lumen catheter method of obtaining urine culture specimens presents a reliable method of determining ileal loop infection and avoids the possibility of contamination as the catheter is inserted through the stoma.
3. This procedure has been incorporated into routine procedures for evaluating the renal function of patients with ileac diversions.
4. Results indicate that improper care of the ileostomy and appliance is a possible source of infection because bacteria may be introduced into the ileal loop and subsequently to the kidneys from a contaminated stoma or collection bag. An illustrated manual was prepared after observation of patient care, both in and out of the hospital, indicating the need for a more explicit educational program for both patients and attendants.

APPLICABILITY: The use of the double lumen catheterization procedure may provide a method of obtaining urine specimens free from contamination as the catheter is inserted through the stoma.

Part X

OBJECTIVES:

1. To study the sources of urinary tract infections in patients with ileac diversions;
2. to determine the extent of bacterial flora present in the ileal loop at the time of diversion and to establish if this bacterial flora plays a part in subsequent infections;
3. to determine if post diversion infections are related to prediversion urinary tract infections;
4. to determine possible sources of postdiversion reinfections.

METHODOLOGY:

1. Aerobic and anaerobic cultures are made from a section of the ileal wall and both ureters at the time of ileac diversion. Urine cultures are made before the operation and serially following the operation.
2. Antibiotic sensitivity tests are made on all organisms present and organisms are saved for future study.

FINDINGS TO DATE

1. Thirty-three patients with recurrent urinary tract infections exhibiting no fewer than two organisms isolated by urine culture have been followed since before their diversions.

   At the time of diversion cultures were made from sections of the ileum (15 had bacterial growth, 7 did not), the right ureter (14 had bacterial growth, 15 did not), and the left ureter (10 had bacterial growth, 15 had no growth and 5 were not cultured).
2. There has been no correlation between organisms found in the tissue cultures and those found in the post diversion urine cultures.

   Results indicate that improper care of ileostomy and appliance is a possible source of infection.

APPLICABILITY: The incidence of bacteriuria in spinal cord injured patients with ileac diversion has remained high. It is important to evaluate the possible reasons for this high incidence of bacteriuria and to establish procedures of care and medical management that will help eliminate urinary tract infection.

Part XI

OBJECTIVE: To determine the predictable normal annual variation of glomerular filtration rate, renal plasma flow, and tubular excretion of individual patients.

METHODOLOGY: A least-squares regression line is plotted using successive test values following the third evaluation of each patient.

FINDINGS TO DATE: Though the doctoral candidate did not finish his dissertation, findings will be published in an abbreviated form.

APPLICABILITY: This study will provide the first documented data regarding the yearly fluctuations of function. This knowledge will provide physicians with guidelines for assessing the clinical im-

portance of changing rates of glomerular filtration rate, renal plasma flow, and tubular excretion in a given patient.

Part XII
OBJECTIVES:

1. To implement a program of patient instruction and training in the care of the urinary tract and urinary collecting devices, emphasizing the importance of maintaining optimal kidney function from the beginning of acute care of the patient following spinal cord injury;
2. to assess the understanding of the patient regarding urinary tract care prior to his leaving the hospital;
3. to assess the value of this program in preventing urinary tract infections and maintaining renal function by comparing information obtained at periodic follow-up of these patients with data from patients not exposed to this program.

METHODOLOGY:

1. Educational material has been prepared and will be given to each spinal cord injured person after admission to the hospital.
2. The staff will check off, date, and sign each subject after it has been discussed.
3. The patient will be tested before discharge. Any remedial education necessary will be done at that time.
4. An effort will be made to include families and attendants in the educational program.

FINDINGS TO DATE: The materials for this patient education program have been developed.

APPLICABILITY: A patient who had adequate understanding of his urinary tract and the methods of caring for it will have less medical-hospital expense and morbidity. The patient will benefit financially, socially, and vocationally.

020 Study of Cardiac Work Evaluation and Reconditioning After Myocardial Infarction

Principal Investigator:	**William Kubicek, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1972-October 1981**	
Cost:	**Annual $139,856** **RT Annual $67,109**	**Projected Total $817,000** **RT % of Annual Total 48%**
Annual Report Reference:	**#18, Page 32, R-5**	

OBJECTIVES:

1. To study the hemodynamic parameters involved after acute myocardial infarction;
2. to study the response of the damaged heart to exercise and stress testing at mild and moderate energy expenditure in early post-myocardial infarction patients.
3. to investigate correlation of the electrocardiograph changes and the cardiac function as recorded from the impedance cardiograph during exercise stress testing in the early subacute stage, at 21 days, and after 3 months or more; and
4. to determine whether the impedance cardiograph and electrocardiograph monitoring of graded exercise tests can be used to establish the safe level of patient performance and progressively test the patient until he or she has demonstrated adequate physical capacity to leave the hospital.

METHODOLOGY:

1. The Minnesota Impedance Cardiograph and a multilead electrograph are used to monitor patients exercising at various levels of exertion, ranging from mild exercise in the early con-

valescent phase to moderately strenuous bicycle ergometer or treadmill exercise in the post-discharge period.

2. Calculations from the wave forms are made for stroke volume, cardiac output, and parameters related to cardiac contractility.
3. A laboratory for cardiac and metabolic function has been installed at the University of Minnesota Hospitals. This laboratory provides research capability for complete cardiac and metabolic evaluation. The laboratory has the following list of equipment:
    a. an automated medical Systems PFA-5 mass spectrometer system for metabolic function analysis.
    b. a model 304A impedance cardiograph,
    c. a Quinton-Monark Model QI-870 electrically controlled bicycle ergometer,
    d. a Quinton model 18-49-CI electronically controlled treadmill,
    e. a Gould model 2400 three-channel analog recorder for use with mass spectrometer system,
    f. Gould model 481 eight-channel analog recorder for use with mass spectrometer system,
    g. Physio-Control series 70DC defibrillator,
    h. Marquette automatic electrocardiograph model 3300, and
    i. Decwriter connected via telephone with UCC for the input of data into computer storage and calculations.
4. The impedance cardiograph continues to be compared to other methods of measuring cardiac function. The mass spectrometer has been calibrated to a degree that exceeds the accuracy needed to measure physiological functions.

APPLICABILITY: Problems directly involving the heart can be studied and the status of the patients more accurately assessed, using the Minnesota Impedance Cardiograph. Another field of use is monitoring the amount of fluid in the chest or lungs, such as incongestive heart failure. The third major use of this system is in peripheral vascular disease. Therefore, any doctor treating these patients would have use for the Impedance Cardiograph. The mass spectrometer system is useful for these patients, especially those with cardiopulmonary diseases.

Part I
Completed

Part II
Completed

Part III
OBJECTIVES:

1. To establish an individualized cardiac rehabilitation program:
2. to determine the usefulness of ZCG and ECG monitoring of graded exercise tests in establishing safe levels of patient performance;
3. to determine whether tested progression results in a shorter stay than the standard program: and
4. to determine whether short term rehabilitation restores the patient to vocational activity as fast as the standard program.

FINDINGS TO DATE: A program was established with the cardiologists, cardiac surgeons, and physiatrists. A manual to explain and reinforce the program after discharge is being prepared.

Part IV
Completed

Part V
OBJECTIVE: To determine the efficacy of measuring, by a non-invasive method, the mechanical

pumping action of the heart in patients undergoing surgery for a coronary bypass, to attach an electric pacemaker to the heart, or undergoing heart valve surgery for either commissurotomy or prosthesis.

METHODOLOGY: Impedance cardiograph studies will be made on patients with electrically paced hearts, undergoing aorta-coronary artery bypass surgery, and heart valve surgery for either commissurotomy or prosthesis. Each patient wil be studied pre- and postsurgery and follow-up observations will be made.

FINDINGS TO DATE:

1. Recordings were made of 72 patients with electronic pacemakers. Of these, 43 patients exhibited the dz/dt waveform suitable for computing the various cardiac parameters involved. Data shows that the pre-ejection period is longer in the electrically paced heart than in the normal heart.
2. Of the 61 bypass surgery patients studied, 32 had a presurgery dz/dt waveform suitable for computation of the pre- and postsurgery parameters indicated that the bypass procedure had little if any effect on cardiac function in this group of patients.
3. Thirteen patients with heart valve disease were studied. Approximately 2 years will be required to acquire enough data for statistical analysis.

Part VI

OBJECTIVES:

1. To determine the accuracy of using treadmill grade and speed as a measure of the work level performance of cardiac patients undergoing a progressive exercise stress test;
2. to determine whether the addition of metabolic parameters will improve the sensitivity of the progressive stress test to detect coronary artery disease;
3. to objectively evaluate the work level change of coronary artery bypass surgery patients; and
4. to determine whether metabolic parameters will be useful in determining which patients will benefit most from an exercise rehabilitation program.

METHODOLOGY:

1. The actual work level as determined by the oxygen uptake will be measured and then compared with the value predicted by various tables.
2. The data obtained by the ECG and metabolic parameters will be compared with the results obtained by angiography or other events such as myocardial infarction or death due to heart disease.
3. The work performance of patients pre- and post-coronary artery bypass surgery will be evaluated using the metabolic parameters.
4. The metabolic parameters will be correlated with improvement in work performance that occurs on an outpatient exercise program.

FINDINGS TO DATE:

1. The results of the 100 exercise stress tests performed in which the metabolic parameters were evaluated, suggested that an accurate prediction of a patient's work capabilities cannot be made only from predictions based on the grade and speed of the treadmill at the end of an exercise stress test.
2. VO_2/beat/kg versus the difference between measured METs and predicted METs was plotted. The pattern of the graph shows the greatest difference between normal persons and cardiac patients for the various parameters studied to date.

APPLICABILITY: If the progressive stress test can more effectively evaluate patients, physicians can advise patients regarding employment more confidently and can evaluate coronary artery bypass surgery more effectively.

Part VII

OBJECTIVE: To develop a low-cost, small, portable device to monitor the exercise level of patients in the cardiac rehabilitation program.

METHODOLOGY: A device will be developed to monitor the heart rate and emit a signal that will indicate deviations of the heart rate from some present level. A second phase of the development will detect arrythmias.

FINDINGS TO DATE: Two events occurred that caused the discontinuation of this project. The first was the death of Dr. Ozel. The second was the development of a prototype instrument of similar design by Med General, Inc.

APPLICABILITY: A small, portable, low-cost device that can give audio feedback about the physiological level of exercise seems to be ideal to carry out an exercise program for a cardiac patient.

021 Quantitative and Qualitative Evaluation of Muscular Hypertonia in Patients with Central Nervous System Disease

Principal Investigator: Daniel Halpern, M.D.
Status: Continuing
Dates: August 1964-October 1980
Cost: Annual $79,757 — Projected Total $325,000
RT Annual $60,652 — RT % of Annual Total 76%
Annual Report Reference: #18, Page 66, R-6

OBJECTIVES:

1. To develop an apparatus and system to objectively evaluate the character of abnormal muscle tone and the alterations of tone accomplished by various procedures; and
2. to analyze abnormal muscle tone and evaluate therapeutic procedures.

METHODOLOGY: The analytic system is based on the current neurological concept that the muscle spindle, a sensory organ within skeletal muscle, responds to two parameters of elongation, the amount of stretch, and the velocity of the movement. Recordings are made of the force applied and electromyographic activity during a standardized series of passive movements imposed at velocities varying from 3° to 150° per second. Analysis of the data yields quantitative information in the form of a numerical value of the related physical parameter. This system also allows quantitative study of central nervous system activity giving rise to dystonic states that are not mediated by the fusimotor system. By carrying out an analytic procedure that specifically identifies the responsiveness of the skeletal muscle to lengthening and to the velocity of length, not only can these two elements be identified and measured, but the influence of other sources of tone may be measured as well.

FINDINGS TO DATE: During the year 1976-1977, the construction, assembly, and testing of electrohydraulic automated drive apparatus were completed. A total of 371 examinations were carried out in 1977-1978. Sixty-eight patients were examined multiple times. Twenty-three patients were examined to evaluate the effectiveness of medication on hypertonia, 3 patients were examined to evaluate the effect of intramuscular neurolysis, 2 patients for reflex analysis, 5 patients for orthopedic surgery, and 5 patients were examined in connection with cerebellar stimulation for the treatment of dystonia. The patients studied for medication participated in a special double-blind study to evaluate the relative effectiveness of Diazepam and D-tetrahydrocannabinol on spasticity in spinal cord injured patient. Fifteen normal subjects were evaluated for gastroc soleus tone. The results revealed that the structures of the gastroc soleus muscles in normal individuals gives rise to significant measures of static and dynamic tone related to elastic and viscous forces within the muscle.

APPLICABILITY: At the present time many procedures for the treatment of patients with muscular hypertonia are being carried out, with little more than subjective judgements as to their validity and continued usefulness. Evaluation of each of these treatment techniques would provide a solid

scientific basis for their use, and the objective measures would be worthwhile. Treatment of patients with central nervous system disease would be rendered more effectively, less wastefully, and more economically.

022 Study of the Changes in the Structure, Ultrastructure, Innervation and Enzymes of Skeletal Muscle in Neuromuscular Disease

Principal Investigator: **Essam Awad, M.D., Ph.D.**

Status: **Continuing**

Dates: **September 1969-October 1981**

Cost: **Annual $153,470** **Projected Total $406,000**
RT Annual $106,002 **RT % of Annual Total 69%**

Annual Report Reference: **#13, Page 85, R-8**

OBJECTIVES:

1. To study the histopathologic changes occurring in disabling neuromuscular diseases;
2. to study the electrophysiological changes in the neuromuscular system;
3. to study the changes in enzyme activity in these muscles;
4. to identify the specific cause of muscular weakness in individual patients;
5. to improve diagnostic criteria for the neuromuscular diseases that are seen in rehabilitation;
6. to study the ability of human muscle to regenerate as seen in samples taken from patients since the beginning of the project; and
7. to review all the biopsies and enzyme levels of blood samples collected since the beginning of the project.

METHODOLOGY: Patients are evaluated by history, physical examinations, clinical laboratory tests as indicated, and electromyographic and nerve conduction studies. Histopathology of muscle and terminal nerve endings is studied by performing a motor point biopsy to sample the involved muscle(s) and its nerve. The tissue is then processed for electron microscopic examination of ultrastructure; vital staining with methylene blue to determine the changes in the branches of the intramuscular nerve and the motor end-plates; PAS staining to demonstrate glycogen; toluidine blue staining to demonstrate acid mucopolysaccharides; hematoxyline and eosin staining to demonstrate the structure of the muscle fibers and their nuclei; trichrome staining to evaluate the connective tissue elements in muscle; chemical microanalysis to determine any abnormal constituents in the tissue; review of the biopsy material; and determine the stage of growth or maturation and changes of the cells.

FINDINGS TO DATE: The serum and muscle enzyme analysis that has been done during the course of this project has been reviewed. A cumulative report will soon be completed summarizing the experience from 1969-1978, showing changes in enzyme levels and LDH isoenzyme patterns and serum and muscle of patients with different neuromuscular disorders are specific to certain categories. In group 1, the dystrophies, these were characterized by an increase in all the serum enzymes. The isoenzymes showed elevation of the IV and V fractions in the serum and reduction of the same fractions in the muscle. Group 2, the collagen diseases, including rheumatoid arthritis, dermatomyositis, polymyositis, systemic lupus erythematosus, and scleroderma was characterized by slight elevation of serum LDH in the acute phase. The isoenzymes showed elevation in the III fraction of LDH and serum. In the third group, the serum enzyme activity was normal. There was elevation in the third fraction of the isoenzymes in central core disease, while the same fraction was normal in upper motor neuron diseases and in neuropathies.

APPLICABILITY: The muscular weakness of many disabled individuals is not clearly understood and needs to be clarified by this research approach, otherwise their rehabilitation will not be complete. As the cases accumulate, the data is analyzed in terms of populations with specific disabilities and their characteristic findings. After studying enough cases in depth, definite conclusions may be drawn that will enable the practicing physicians to identify and analyze the patient's disability

and place the patient in the proper perspective.

023 Training Program for Upper Extremity Activities in Cerebral Palsy Patients

Principal Investigator: Daniel Halpern, M.D.
Status: Continuing
Dates: September 1965-July 1981
Cost: Annual $88,396 — Projected Total $313,000
RT Annual $68,431 — RT % of Annual Total 77%
Annual Report Reference: #18, Page 93, R-14

OBJECTIVES:

1. To develop an experimental design and technology to evaluate therapeutic method used in cerebral palsy that will be specific enough to measure difference between methods;
2. to identify elements of neuromuscular function that are important in the development of manual coordination;
3. to test the effectiveness of specific component procedures presently available to develop improved coordination in upper extremities of athetoid patients;
4. to develop a series of procedures to train manual coordination, based on neurophysiologic concepts of motor learning that have been shown experimentally to have therapeutic validity;
5. to develop, by using quantitative evaluation techniques for motor coordination, a method that identifies the specific limitations, or the level of coordination that represents a maximum level of performance in an athetoid patient.

METHODOLOGY: Adult patients acted as their own controls. The effectiveness of the training methods was tested by comparing rates of learning during a given time period. Evaluation was done by attaching battery powered small lights to the hand, wrist, and arm of the patient. Still photographs were then taken by a camera with the shutter open. The resulting data indicated direction, range, tortuosity, regularity of rate, and speed. Half of the group was scheduled into an EXPERIMENTAL-CONTROL-EXPERIMENTAL training sequence, and the other half into a CONTROL-EXPERIMENTAL-CONTROL sequence. More accurate observations were made in this way. The photographic data was recorded by computer. During this past year, the table that allowed electromechanical digitization of the localization of the coordinates of the projected image was constructed, standaraized, calibrated, and made operational.

FINDINGS TO DATE: Control of manual skill improved with both INHIBITION and CONTROL training. Therefore, careful direction of attention with feedback and reinforcement for correct activity are the basic elements of motor learning and provide the basic success that was observed. Experimental conditions and method of data analysis were further examined. Using "best" scores, rather than a mean, and increments of improvement in "best" scores have been productive in increasing validation in selecting the optimum treatment. Using the present system of analysis of motor control, data is being collected on the influence of medications, like Diazepam, L-Dopa, and tetrahydrocannibanol. Results are not complete enough for evaluation.

APPLICABILITY: The public, the medical profession, the rehabilitation therapies, and the education profession are engulfed in a morass of opinions, relating to all systems of therapy for cerebral palsy. A clear definition of valid therapeutic principles would improve the function of handicapped patients, relieve the frustrations of their families, prevent wasteful expenditure, and provide a common realistic body of thought among professionals. The identification of the feedback parameters and sensory avenues for monitoring performance that are most effective for motor learning should be a direct consequence of an extended series of investigations using this procedure.

024 Quantitative Studies of Muscular Strength and Muscular Work

Principal Investigator:	**Martin Mundale, R.P.T., M.S.**	
Status:	**Continuing**	
Dates:	**August 1963-September 1981**	
Cost:	**Annual $83,887** **RT Annual $61,167**	**Projected Total $298,000** **RT % of Annual Total 73%**
Annual Report Reference:	**#18, Page 106, R-18**	

OBJECTIVES:

1. To develop standardized testing procedures for the major muscle groups;
2. to establish normal values for age and sex;
3. to make meaningful estimates on how much weakness a patient has relative to an adopted norm;
4. to evaluate the deviation of fatigability and endurance from expected normalcy;
5. to evaluate the muscular function of patients prior to surgery and therapy and to evaluate strength and endurance; and
6. to provide experience for medical students, medical residents, and physical therapy students in quantitative methods employed to evaluate strength and endurance.

METHODOLOGY: Transducers and electronic recording equipment are used to test the strength of various muscle groups. Testing has been standardized for hip flexion, hip extension, knee flexion, knee extension, ankle plantar flexion, elbow extension and hand grip. Development of techniques for testing other muscle groups are still under study.

FINDINGS TO DATE: Patients with dermatimyositis have been followed from one to four years, comparing quantitative muscular strength with clinical evaluation and laboratory measures of systemic inflammation. The following studies are in progress: Procedure for Testing Ankle Plantar Flexion and Norms Established, Procedures for Testing Handgrip Force and Norms Established, Comparison of Grip Strength and Grip Endurance During Isometric Exercise, Kinesiology of Hip Extension, and Voluntary Maximal Torque.

APPLICABILITY: Precise, quantitative techniques for measuring muscular strength during isometric contraction make it possible to localize neurologic deficits and quantitative muscular weakness and to follow the effects of treatment. Repeated measurements of strength are used to monitor the patient's status during treatment which aids in deciding the treatment program.

025 Follow-up Study of the Psychological, Social, and Vocational Adjustment of Spinal Cord Injured Adults

Principal Investigator:	**Gary Athelstan, Ph.D.**	
Status:	**Continuing**	
Dates:	**January 1973-June 1980**	
Cost:	**Annual $20,382** **RT Annual $15,764**	**Projected Total $141,000** **RT % of Annual Total 77%**
Annual Report Reference:	**#18, Page 125, R-47**	

OBJECTIVES:

1. To gather and analyze descriptive data pertaining to the psychological, social, and vocational adjustment of spinal cord injured adults;
2. to develop and define categories of rehabilitation outcomes, including non-vocational outcomes, based upon measures of psychological adjustment;

3. to identify factors relating to rehabilitation outcomes, including such variables as the psychological and social characteristics of spinal cord injured persons and the various treatments they receive, with a special effort to identify variables which can be manipulated to increase the frequency of desired outcomes.

METHODOLOGY:

1. A sample of 301 spinal cord injured adults, who have been injured for at least 2 years, has been identified. All available relevant data on these patients were tabulated and analyzed to describe the persons and evaluate their psychosocial and vocational adjustment and medical status.

2. Indepth interviews were conducted with the spinal cord injured patients and members of their families. Specially designed interview schedules and standardized instruments were used to gather detailed information on the experiences of the subjects and the steps involved in the process of social, psychological, and vocational adjustment to disability.

3. Psychosocial outcome measures and their relationship to other characteristics of the spinal cord injured patients were developed and refined.

FINDINGS TO DATE:

1. The initial phases of the project have been completed, with 128 subjects and 66 significant others having been interviewed. The extensive data have been edited, coded, and most analyses finished.
2. The definition of psychological adjustment was broadened to devise a composite measure of productive activities apart from employment in which a severely disabled person might engage.
3. A handbook for rehabilitation counselors has been compiled.
4. A handbook for spinal cord injured patients to assist them in vocational rehabilitation is in production.

APPLICABILITY: Since rehabilitation goals tend to be defined in vocational terms, little attention has been devoted to specifying goals for people who need rehabilitation services but have little or no prospect of vocational rehabilitation, including many severely disabled spinal cord injured patients. Specifically designed psychological and social, as well as vocational objectives will aid in focusing the treatment program for persons with spinal cord injuries. Even for those spinal cord injured persons who are not employable, better personal adjustment may carry economic rewards in terms of increased self-care and lower medical costs.

026 Voluntary Control of Autonomic Processes Using Biofeedback and Reinforcement Procedures

Principal Investigator:	**Alan Roberts, Ph.D.**	
Status:	**Continuing**	
Dates:	**January 1974-December 1979**	
Cost:	**Annual $31,576** **RT Annual $24,408**	**Projected Total $134,000** **RT % of Annual Total 77%**
Annual Report Reference:	**#18, Page 132, R-53**	

OBJECTIVES: To conduct a series of experiments which will provide answers to some questions concerning the voluntary control of autonomic functions, especially skin temperature, and the applicability of autonomic learning to the clinical treatment of disabling disorders associated with dysfunction in peripheral circulation.

METHODOLOGY: Two autonomic reactivity and control scales are administered to subjects. Selected subjects are given a number of baseline tests of autonomic reactivity and control in the laboratory. Subjects selected from the second group are further trained in controlling the temperature of their fingertips. The data from the individual psychophysiological screening sessions on hand-

warming are analyzed. The physiological measures are subjected to ANOVA comparisons of two groups at a time. The physiological measures are subjected to factor analysis, yielding five factors.

FINDINGS TO DATE: A cursory inspection of the data on the 10 subjects who have completed all 16 training sessions suggests that subjects in the high variability group demonstrated much greater ability to control skin temperature.

In a Double Blind Study of the Effectiveness of Skin Temperature Self-Regulation As a Treatment for Raynaud's Disease, 36 patients were studied. Group 1 was trained to increase finger temperature; group 2 was receiving EMG feedback from the frontalis muscle; and group 3 kept records of symptoms at home. Data is being analyzed and preliminary results indicate that no significant differences among the 3 groups are evident for any of the clinical measures recorded.

In Specific Autonomic Learning In a Partially Paralyzed Human Subject, a 23-year-old, male, paraplegic patient was taught to control the skin temperature in his fingers and toes. This patient had intact sensation in his lower limbs, suggesting that sensation may be an important mediator for the instrumental learning of independent and specific visceral responses. At least one human subject learned to voluntarily control a highly specific autonomic function without mediation from striated muscles below the T12 spinal cord level.

APPLICABILITY: As a treatment technique biofeedback will not totally supersede any of the current management systems. In its broadest sense, however, it is bound to become a significant tool for practitioners dealing with specific problems or with a particular aspect of rehabilitation. Even in those instances in which the patient cannot sustain the learning from clinic into his or her daily life, technologies are now available and will be developed to provide permanent biofeedback aids to patients that they can use outside of the clinic, either to maintain or improve their levels of performance. Perhaps one of the most significant advantages of biofeedback training to the disabled patient is that giving the performance information directly to the patient allows him or her to assume a more active and responsible role in his or her own rehabilitation process.

027 Investigation of Decubitus Ulcer as a Manifestation of a Psychosocial Problem

Principal Investigator:	**Thomas Anderson, M.D.**	
Status:	**Continuing**	
Dates:	**September 1975-December 1979**	
Cost:	**Annual $6,556** **RT Annual $5,001**	**Projected Total $49,000** **RT % of Annual Total 76%**
Annual Report Reference:	**#18, Page 152, R-57**	

OBJECTIVES:

1. To develop a measurement of decubitus ulcers that would reflect the impact of their occurrence on the patient;
2. to identify those psychosocial factors associated with the occurrence of pressure sores;
3. to develop a new program for training patients and health care workers in the prevention of decubitus ulcers.

METHODOLOGY: This study has two stages. The first stage attempted to delineate those psychosocial factors that would predispose an individual to the increased probability of skin ulceration. Differences on three psychosocial measures among 141 spinal cord injured, both inpatients and outpatients, were examined along with their history of decubitus ulcers since the onset of their injury. The psychosocial measures used were the Tennessee Self Concept Scale, a self-report measure of the individual's personal satisfaction with his life activities, and a measure of individual responsibility in skin care. Multiple linear regression was used to determine those factors associated with the variance in incidence of decubitus ulcers.

The second stage will utilize the information gathered from stage one to determine the direction, content and methods of a new education program. This program will be directed at health care

workers and patients to decrease decubitus ulcer incidence.

FINDINGS TO DATE:

Stage 1

1. Individuals who had lost no days from their major activity in the past 2 years showed significantly higher levels of satisfaction with the activities of life and responsibility in skin care.
2. In individuals who had problems with pressure sores, the extent of the pressure sore problem was related to level of injury, help in skin care, satifaction with activities of life, responsibility in skin care, and self esteem.

Stage 2

The education program, emphasizing personal responsibility in skin care, is being worked out with the nursing staff.

APPLICABILITY: The isolation of some psychosocial aspects of decubitus ulcer incidence will aid in signaling conditions which could predispose a patient to the development of pressure sores. Physicians, DVR counselors, patients and their families can watch for and use these signals.

The development of new programs for teaching skin care hopefully will lower the incidence of decubitus ulcers and their cost.

028 Follow-up Study of Patients Treated in the Pain Treatment Program, Physical Medicine and Rehabilitation Service, University of Minnesota Hospitals

Principal Investigator:	**Alan Roberts, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1976-May 1980**	
Cost:	**Annual $63,814** **RT Annual $42,314**	**Projected Total $98,000** **RT % of Annual Total 66%**
Annual Report Reference:	**#18, Page 161, R-63**	

OBJECTIVES:

1. To devise a questionnaire to collect data from all patients evaluated in the pain clinic;
2. to administer the questionnaire and the MMPI to these patients and their spouses 12 months after discharge;
3. to interview these patients regarding their experience with the Pain Clinic and/or Pain Treatment Program;
4. to determine the effectiveness of the Pain Treatment Program;
5. to determine possible improvements in evaluation, selection, and treatment procedures; and
6. to test the hypothesis that patients treated in the Pain Treatment Program will show greater activity, more paid employment or other appropriate work, less drug use, and less use of health care than those rejected or not treated.

METHODOLOGY: A thorough review of the current literature on pain research will be conducted and the research will be coordinated with other pain treatment programs (cf. Projects R-61and R-63, University of Washington) in order to enhance the use of current knowledge, avoid duplication and coordinate interviews and questionnaires with data being collected at other treatment centers. Approximately 30 patients admitted to the Pain Treatment Program, 30 patients accepted but not admitted, and 30 patients rejected for treatment will be evaluated by means of a questionnaire and an interview with a social worker or psychologist trained in the evaluation of chronic pain problems. They will also retake the MMPI. Spouse or other significant person in their lives will be evaluated when these individuals are evaluated as part of the initial intake assessment.

FINDINGS TO DATE: Data analysis on 58 subjects are complete. The following criteria are used to determine whether a subject is functioning adequately at follow-up: (1) pain does not prohibit the subjects from performing usual tasks in their chosen roles; (2) subjects are not on pain-related compensation; (3) subjects have had no pain-related hospitalizations or surgeries since discharge from the Pain Treatment Program; and (4) the subjects are not using any prescription medications typically used for pain-related problems.

Of the 26 subjects in the treated group 20 (77%) meet these criteria and are considered total treatment successes. Of the 6 subjects not considered total treatment successes, 4 (15%) exhibit moderate success, and only 2 (8%) exhibit absolutely no improvement over baseline.

Subjects treated in the Pain Treatment Program show greater activity levels, more pain employment or other appropriate work patterns, less drug use, and less use of the health care delivery system for problems related to pain than subjects in the other 2 groups.

APPLICABILITY: The claims of a high rate of successful treatment in behavior modification of pain programs have often motivated chronic pain patients to undertake the difficult and costly inpatient treatment program. Other patients severely disabled by chronic pain are not being referred to pain treatment programs of this type because success rates have not been clearly documented. Documentation of this data is important for future patients, for referring physicians and for those responsible for paying the costs of inpatient treatment as well as the extremely high costs of chronic pain not successfully treated. Specific factors identified as indicating potential for successful treatment will be useful to physicians, insurance companies, vocational rehabilitation personnel and workman's compensation programs in considering the recommending and financing of such treatment for their patients or clients. Identification of factors predicting unsuccessful treatment will also significantly reduce costs.

029 Functional Assessment Inventory for Rehabilitation Evaluation (formerly A Functional Limitation Scale for Rehabilitation Evaluation)

Principal Investigator:	**Nancy Crewe, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1977-September 1982**	
Cost:	**Annual $65,694** **RT Annual $52,258**	**Projected Total $132,000** **RT % of Annual Total 80%**
Annual Report Reference:	**#18, Page 169, R-67**	

OBJECTIVES:

1. To refine the preliminary version of the Functional Assessment Inventory (FAI) into a helpful tool for rehabilitation counselors;
2. To determine the validity of the scale for predicting vocational outcomes with disabled persons;
3. To evaluate the usefulness of the FAI in classifying severity of disability; and
4. To evaluate the effectiveness of the FAI for grouping patients who present similar rehabilitation problems.

METHODOLOGY:

1. The Pilot phase involves Scale expansion and reliability testing. The following aspects of the scale will be examined: potentially critical assets that may find the impact of functional limitations; existing coding conventions; preliminary reliability conventions and testing; a new series of interviews; and inter-rater reliability coefficients.

2. The Validation phase will involve counselors from settings other than the University of Minnesota. A large number of subjects will be located. Training programs and materials for participating counselors will be developed. Counselors will complete the FAI on 30 clients and then follow up the clients at specified intervals. The relationship between the FAI and the follow-up criterion will be investigated. A manual on the FAI will be developed.

FINDINGS TO DATE: Reliability testing has been completed, a provisional inventory was published, and field testing was done. As a result of an RSA-sponsored study, "State of the Art in Functional Limitations Measurement," the investigators have requested an extension of this project for additional development and testing of the Functional Assessment Inventory.

APPLICABILITY: The Functional Assessment Inventory should provide a new method for assessing the impact of disability on work potential. The FAI, if successfully validated, could also aid in counselor training and in provision of vocational rehabilitation services by ensuring attention to the entire range of possible client problems.

030 Evaluation of Outcome of Rehabilitation Measured by Costs of Rehabilitation and Maintenance and Changes in Quality of Life (formerly A Method of Measuring some Patient Characteristics, Goals, Results, and Costs of Medical Rehabilitation)

Principal Investigator: Frederic J. Kottke, M.D., Ph.D.

Status: Continuing

Dates: October 1976-October 1981

Cost: Annual $200,667 — Projected Total $292,000
RT Annual $110,615 — RT % of Annual Total 55%

Annual Report Reference: #18, Page 176, R-68

OBJECTIVES:

1. To document gains made by patients on a general rehabilitation service as a result of participating in medical rehabilitation programs;
2. to compare goals set at admission with gains made;
3. to assess the functional utility of gains;
4. to measure the durability, after one year, of gains made while in the hospital;
5. to assess the cost of achieving rehabilitation gains; and
6. to apply the method of measuring patient progress to a large number of general rehabilitation patients.

METHODOLOGY: The patient description forms developed in R-45 have been used to obtain data on 150 patients. Data is stored in a computer. Methodology is being developed to collect annual follow-up data on patients discharged from the Rehabilitation Center. For 185 stroke patients followed after discharge, when patients and families were adequately trained and followed up, the gains of rehabilitation were maintained until supervening additional disability or death further impaired performance.

FINDINGS TO DATE: Work has continued on objectives 1, 2, 3 and 6. Because of computer problems, the data is being transferred to a larger computer. Levels of performance are indicated by intact (6); limited (4); helper (2); and null (0). Change of status is being evaluated and recorded on a variety of problems.

APPLICABILITY: Both the quality and outcomes of health care are scrutinized by this project. The cost of Social Security Disability Insurance in supporting the disabled is enormous. Only through rehabilitation can the disabled re-establish self-sufficiency. The identification of techniques of adequate rehabilitation will be of benefit to both the patient and the government agency that supports the cost of disability.

031 Investigation of the Cause and Prevention of Ischemic Ulcers

Principal Investigator: Robert Patterson, Ph.D.
Status: Continuing
Dates: July 1977-October 1981
Cost: Annual $55,242 — Projected Total $185,000
RT Annual $42,421 — RT % of Annual Total 77%
Annual Report Reference: #18, Page 187, R-69

OBJECTIVES:

1. To obtain continuous recordings for periods of 6 hours of the pressure and temperatures over the ischial tuberosities and/or posterior surface on both normal and spinal cord injured persons.
2. to correlate the pressure-time patterns of patients with no history of ischemic ulcers with patients who have developed ulcers: and
3. to estimate the frequency and duration of push-ups needed to prevent ischemic ulcers.

METHODOLOGY: Data will be recorded on a small, portable four channel tape recorder (Medilog) able to record data continuously for 24 hours. Small, thin pressure transducers will be used to record the pressures over the ischial tuberosities. A LINC digital computer will reduce the data. The capillary pressure of 32 mmHg will be carefully studied.

FINDINGS TO DATE: Equipment was obtained, calibrated, and five types of pressure trandsducers were investigated. Seven paraplegics have been studied.

APPLICABILITY: Data on the frequency and duration of push-ups or shifts in the position that spinal cord injured patients must do to prevent the development of ischemic ulcers would greatly aid in the creation of a workable program to prevent ulcer generation. The generation of ischemic ulcers is one of the major medical problems that causes repeated hospitalization and loss of work time for spinal cord injured patients.

032 Social Skills Training for Young Adults with Cerebral Palsy

Principal Investigator: Jerry Martin, Ph.D.
Status: Continuing
Dates: October 1977-June 1981
Cost: Annual $10,875 — Projected Total $33,000
RT Annual $7,320 — RT % of Annual Total 67%
Annual Report Reference: #18, Page 192, R-71

OBJECTIVES:

1. To identify social situations that commonly elicit maladjustive social behavior from young adults with cerebral palsy;
2. to develop a training program to deal with these situations;
3. to assess the generality and durability of the social skills training program; and
4. to assess the effect of the program on work or program suitability.

METHODOLOGY: An intensive survey will identify problem social behaviors in young adults with cerebral palsy. These behaviors will be compiled into a Problem Situation and Behavior List that will form the basis for the social skills training package. Young adults with cerebral palsy at the University of Minnesota Rehabilitation Center will be exposed to the training package in daily individual sessions. Reassessment of individuals will be made at specific intervals. The adaptability of the training package to group settings will be assessed.

FINDINGS TO DATE: A large portion of this year's activity was devoted to rethinking and revising the project in response to the feedback provided by the Peer Review Site Visit, 1977. The first portion of the extensive survey to identify problem social behaviors has been completed. Small group training

sessions are currently underway.

APPLICABILITY: Personality and social adjustive problems in adults with cerebral palsy have been major deterrents to employment and job success. Only when social-adjustive barriers are removed will the true potential of these individuals be known.

033 Energy Cost, Blood Pressure and Heart Rate Studies During Sexual Intercourse

Principal Investigator: Joseph Bohlen, M.D., Ph.D.
Status: Continuing
Dates: October 1977-September 1981
Cost: Annual $32,245 — Projected Total $75,000
RT Annual $26,242 — RT % of Annual Total 81%
Annual Report Reference: #18, Page 202, R-72

OBJECTIVE: To determine the energy cost during sexual intercourse by measuring heart rate and blood pressure in normal and coronary subjects during sexual activity.

METHODOLOGY: Ten volunteer married couples will be thoroughly examined and exercise tested. Each couple will have an intercourse session with all electrodes in place but not recording. During masturbation and intercourse sessions various parameters will be continuously monitored. Couples will record blood pressure and heart rate during intercourse at home with portable ECG recorders and automatic blood pressure recorders.

FINDINGS TO DATE: This research project has been delayed because of the death of the first principal investigator and problems in obtaining monitoring equipment. Data has been collected on several of the physiological variables during masturbation. Recruitment of couples is in progress.

APPLICABILITY: Obtaining information on the energy cost and hemodynamics of sexual intercourse will help post myocardial infarction patients to save their physical and emotional health, as well as their marriages and futures. Patients who can return to a premorbid sexual level will be more emotionally stable, perform their reconditioning programs more willingly, and return to their jobs faster.

034 Radiographic Study of the Restriction of Spinal Mobility Using Thoracolumbosacral Orthoses

Principal Investigator: Seth Rosenbaum, M.D.
Status: Continuing
Dates: October 1977-June 1980
Cost: Annual $11,215 — Projected Total $11,970
RT Annual $1,274 — RT % of Annual Total 11%
Annual Report Reference: #18, Page 206, R-74

OBJECTIVES:

1. To study the effectiveness of three commonly used TLS orthoses on the range of motion of TLS spine in saggital plane using roentgenographic method; and
2. to compare clinical methods of assessing range of motion of back using radiographic data.

METHODOLOGY: Ten healthy adult males will be assessed clinically for range of motion of the back and x-rayed in neutral maximum flexion, and extension positions. They will then be fitted with each of the three orthoses. The lateral standing spine films will be repeated and the inter-vertebral motion will be calculated. Radiographic data will be used to compare clinical measurements.

FINDINGS TO DATE: All data have been collected. The analysis is in progress. No information has been published to date.

APPLICABILITY: An understanding of what a particular TLS orthoses can and cannot do is very important when prescribing this expensive apparatus. The data from this study will be valuable in proper brace prescription which will lead to early mobilization and rapid rehabilitation of patients with back disabilities.

035 Comparison of Delta 9-Tetrahydrocannabinol and Valium's Effect on Spasticity of the Spinal Cord Injured Patient

Principal Investigator: **Ronald Bateman, D.O.**

Status: **New**

Dates: **September 1978-September 1980**

Cost: **Annual $14,112** **Projected Total $22,466**
RT Annual $8,466 **RT % of Annual Total 60%**

Annual Report Reference: **#18, Page 211, R-77**

OBJECTIVES:

1. To compare the effect of valium and delta-9-THC on spasticity in the spinal cord injured patient;
2. To determine any adverse effect on the cardiovascular system in the spinal cord injured patient, especially blood pressure and heart rate;
3. To compare the dose of valium and delta-9-THC needed to effect spasticity. Coordination, judgment, motor planning, attention span, and reaction time will be studied.

METHODOLOGY: Ten spinal cord injured male volunteers with complete spinal cord lesions and spasticity in the lower extremities will be evaluated by physical examination, quantitative assessment of spasticity, and psychological evaluation. Each subject will receive one unknown medication orally on different days. The five different medications will be randomly coded and placed in opaque capsules prior to distribution to the subjects. Each subject will be tested by a total of five trials, and each test period will be separated by at least 72 hours. The doses of valium and delta-9-THC will be 5 mg per square meter of body surface per dose and 10 mg per square meter of body surface per dose. After the subject's degree of spasticity is evaluated, there will be a 45-minute period of psychological testing. The subject's blood pressure, heart rate, changes in conjunctiva, and mood will be recorded throughout the testing period. Blood samples will be drawn before the medication, at 1 hour, 2 hours, and 3 hours postingestion.

FINDINGS TO DATE: Ten male spinal cord injured patients with spasticity in their lower extremities completed a double-blind study with valium, delta-9-THC, and placebo. There were no adverse reactions during this study. The subjects' blood pressure and heart rate remained stable throughout the study.

Data are being analyzed for these drugs' effect on spasticity, coordination, judgment, motor planning, attention span, and reaction time.

APPLICABILITY: The findings of this research project will begin to assess the effect of marijuana on spasticity in the spinal cord injured group of patients. The findings will help assess the effect of marijuana on the central nervous system.

036 Efficiency of Bicycle Exercise

Principal Investigator: Robert Patterson, Ph.D.
Status: New
Dates: September 1978-March 1980
Cost: Annual $33,317 — Projected Total $40,000
RT Annual $25,660 — RT % of Annual Total 77%
Annual Report Reference: #18, Page 215, R-78

OBJECTIVES: To determine how the amount of stored energy, pedalling speed, and experience affect the efficiency of bicycle exercise.

METHODOLOGY: A Quinton Model Q1870 bicycle ergometer will be used in the experiment. The subjects will ride at various constant pedalling rates between 50 to 100 RPM; the workload will be varied between 75 and 200 watts; and each work load and pedalling rate will be maintained for six minutes. During the exercise period, breath-by-breath oxygen uptake, CO_2 production, minute ventilation, end tidal oxygen and carbon dioxide percentages, respiratory exchange ratios, and heart rate will be measured using a mass spectrometer system developed in the department. A subjective rating of the difficulty of the work load will be made by the subject on a scale of 1 to 10. At least five subjects who are not competitive or long-distance riders and five competitive bicyclers will be used for subjects. An estimate of the maximum oxygen uptake will be made for each subject using a progressively increasing stress test. Outdoor tests on a track will be performed at the same pedalling rates as were used for the indoor portion of the study.

FINDINGS TO DATE: The original flywheel weight of 20 pounds on the Quinton bicycle ergometer was modified to include a light (6 pound) flywheel, and a heavy (80 pound) flywheel. The light flywheel caused the pendulum to oscillate in an uncontrolled manner. The control was redesigned with a load cell used to measure the reaction force of the load controlling generator. This replaced the pendulum position as a control signal.

APPLICABILITY: If the results of this study suggest that a different design bicycle ergometer would result in a more pleasant exercise period, this information would be communicated to patients involved in various cardiac rehabilitation programs, as well as to manufacturers and other rehabilitation institutions.

037 Energy Cost of Ambulation with Assistive Devices (formerly Energy Cost of Locomotion—Ambulation with Prosthetic or Assistive Devices)

Principal Investigator: Steven Fisher, M.D.
Status: New
Dates: October 1978-October 1981
Cost: Annual $65,699 — Projected Total $118,000
RT Annual $50,899 — RT % of Annual Total 77%
Annual Report Reference: #18, Page 219, R-79

OBJECTIVES: Data will be obtained on the energy consumption and cardiovascular stress of ambulating with various assistive devices on level ground, up a hill, and on stairs.

METHODOLOGY: In all the investigations, patient oxygen consumption will be measured with an Oxylog, a portable oxygen and ventilatory analyzer that can be easily carried in a backpack. A four channel Medilog tape recorder will be used to collect O_2 and heart rate data. Gas samples of the expired gas will be collected in meterological balloons and analyzed to determine the respiratory quotient. The respiratory quotient value will be used to correct the minute oxygen consumption determined by the Oxylog. Maximal upper and lower extremity stress tests will be done on each subject before and after crutch ambulation. Development of methodology to study the kinesiology of crutch walking will be developed using an interrupted light photography approach.

FINDINGS TO DATE: Analysis of the initial data shows that the cardiovascular stress of crutch walking is indeed high and that patients with cardiopulmonary disease may not be expected to perform at

the rate of speed initially estimated. In fact, for some patients with cardiovascular disease, crutch walking would not be recommended because of the high resultant heart rates. Stair climbing seems to be especially taxing from a cardiopulmonary viewpoint.

APPLICABILITY: The data will have immediate and direct application in the selection and prescription of proper assistive devices. Additionally, the information will be used in deciding feasibility of ambulation versus wheelchair locomotion.

038 Porteus Maze Performance and Impulsivity in Stroke Rehabilitation Patients

Principal Investigator: Sondra Weiss, M.A.
Status: New
Dates: October 1978-June 1980
Cost: Annual $14,092 — Projected Total $27,000
RT Annual $11,986 — RT % of Annual Total 85%
Annual Report Reference: #18, Page 224, R-80

OBJECTIVES:

1. To assess and remediate the impulsivity among adult rehabilitation patients with acquired brain damage;
2. To gather data toward validation of the Porteus Maze Test as a procedure for assessing impulsivity and unreliability in practical living situations.

METHODOLOGY: This is a retrospective analysis of results of psychological assessment of stroke patients admitted to Sister Kenny Institute for rehabilitation prior to 1977. The records of one hundred patients, 50 diagnosed as right hemiplegic, and 50 diagnosed as left hemiplegic will be reviewed. These records include Porteus Maze Test scores, Wechsler Adult Intelligence Scale full Scale Intelligence Quotients, Verbal Intelligence Quotients, and Performance Intelligence quotients. Criteria for rating impulsivity from the medical records will be determined and a scale developed. In addition to stroke subjects, a group of 30 to 50 subjects will be tested for use as a normal comparison group. The data will be analyzed, and a comparison will be made (1) between stroke patients and controls, (2) between left and right hemiplegics, and (3) among admission scores, discharge scores and follow-up scores.

FINDINGS TO DATE: An open-ended questionnaire was sent to members of various rehabilitation disciplines asking them to list behaviors which would be labeled "impulsive" in brain-damaged adults. The behaviors identified as impulsive by the members were tallied and grouped and tallied according to specific areas of rehabilitation training. Procedures for rating impulsivity from Medical Records were established. Twenty normal comparison subjects have completed the Porteus Mazes, and preliminary analysis shows a Test Age mean score of 14.225 and a Standard Deviation of 2.16.

APPLICABILITY: This study and its results will form a baseline for the current use of the Porteus Mazes in assessment of stroke individuals and will provide a better estimate of Porteus Maze scores to be expected from a nonbrain-damaged older population.

039 Perceptual and Judgment Factors in Rehabilitation of Hemiplegic Patients

Principal Investigator: Sondra Weiss, M.A.
Status: New
Dates: October 1978-September 1980
Cost: Annual $14,000 — Projected Total $29,300
RT Annual $13,279 — RT % of Annual Total 95%
Annual Report Reference: #18, Page 231, R-81

OBJECTIVES: To develop a systematic program of perceptual retraining and training of impulse control in left hemiplegics.

METHODOLOGY: There will be three stages to this study. The first stage involves the definition of the variables and the assessment of their predictive validity. During the second stage retraining will take place, responses will be recorded, and treatment effects will be assessed and analyzed. The third stage will assess persistence of treatment effects.

The subjects will be 50 consecutive patients admitted to Sister Kenny Institute who have left hemiplegia as the result of a cerebrovascular accident. Patients with complicating medical problems or psychiatric disorders will be excluded from the study.

FINDINGS TO DATE: A battery of psychological tests that assess visual perceptual organization, impulse control, foresight, and planning ability have been selected. The investigator selected target activities of daily living and designed measures of performance of these activities. The ADL Status Rating Scale will be used to rate competence in mobility, transfers from wheelchairs, and light hygiene. Rating scales were also developed to assess those aspects of performance of a transfer and light hygiene which staff members feel are most affected by problems of impulsivity and hemi-neglect.

APPLICABILITY: This study will generate a systematic program of perceptual retraining and training of impulse-control that may be adopted by other rehabilitation facilities. Success in this program could enhance the individual's ability to return to independent living upon discharge from the hospital.

040 Pilot Study: Training Patient Responsibility in Selected Areas of Self Care

Principal Investigator:	**Thomas Anderson, M.D.**	
Status:	**New**	
Dates:	**September 1978-June 1984**	
Cost:	**Annual $14,540** **RT Annual $10,871**	**Projected Total $73,500** **RT % of Annual Total 75%**
Annual Report Reference:	**#18, Page 240, R-82**	

OBJECTIVES: To develop a program for developing responsible self-management in spinal cord injured persons.

METHODOLOGY: There will be three stages to this study. In the first stage, we will identify the specific behaviors that are necessary for maintenance in selected areas of self care, develop instruments to measure the performance of these behaviors by the subject, and test a group of control subjects using these instruments. In the second stage, we will train responsible behavior, record frequency and consistency of behaviors, and analyze treatment effects. In the third stage, we will assess the persistence of treatment effects.

FINDINGS TO DATE: The past year's activities have concentrated on one of the self care areas in order to make the development of this project easier to manage and control. This year's activities focused on (1) the development of the skin care education program, (2) the meeting of stage one objectives for skin care, and (3) the delineation of the general program for responsibility training.

APPLICABILITY: The findings from the first stage will form the structure for the training stage. If the program to train responsibility in selected areas of self care can demonstrate an increase in independence and responsibility and a decrease in the related medical problems, then this program would be expanded to include more areas of self care and more patients.

041 Behavior Modification: A Problem-Oriented, Learning-Based, Research Strategy for Rehabilitation

Principal Investigator: Jerry Martin, Ph.D.

Status: Transferred to R-63 and R-82

Dates: October 1976-June 1979

Cost: Annual Not Applicable — Projected Total Not Applicable
RT Annual Not Applicable — RT % of Annual Total Not Applicable

Annual Report Reference: #18, Page 256, R-62

OBJECTIVES:

1. To demonstrate the applicability of behavior modification procedures to the improvement of motor functioning of medical rehabilitation patients in physical and occupational therapy;
2. to determine whether rehabilitation therapists can learn to generate treatment programs based on a behavior analysis or precision teaching model;
3. to focus upon the adolescent medical rehabilitation population so that program effectiveness may be reflected in vocational outcomes; and
4. to evaluate the long-term effectiveness of behavior modification on severely handicapped medical rehabilitation patients through reassessment in outpatient follow-up clinics.

METHODOLOGY: Severely handicapped adolescents with cerebral palsy, closed head injuries, and spinal cord injuries who are hospitalized for medical rehabilitation will be included in this study. Behavior modification will be applied as an adjunct in the treatment of specific motor functioning problems. Short term effectiveness will be evaluated in outpatient follow-up clinics.

FINDINGS TO DATE: A critical review of the literature has been completed. The data collected indicated that behavior modification is useful in rehabilitation settings, but problems occur when patients leave that setting.

APPLICABILITY: The use of behavior modification in rehabilitation has been limited to a very narrow range of problems. Thus, it is not widely used in comparison to its applications elsewhere. Demonstration of behavior modification effectiveness over a broad spectrum of motor behaviors in the severely handicapped should stimulate other facilities to use these techniques for problems other than management of patient misbehavior.

University of Washington (RT-3)
Medical Rehabilitation Research and Training Center

CORE AREAS

Bioengineering

Biophysics: The bioeffects of nonionizing radiation (electromagnetic, high frequency current, acoustic wave propagation, radiant and conductive heat) resulting in improved designs of therapeutic applicators in the various modalities for safer and more effective use. The basic rationale for the use of specific methods to heat specific human structures is described. National and international standards for safety and efficacy are also discussed.

Biomechanics: Detailed theoretical and actual study of lower extremity biomechanics. The quantification of force interactions between limbs and orthoses has resulted in the more precise fitting of orthotic design to patient need. Analyses of commercially-available and experimental orthoses continue to be made.

Engineering Applied to Clinical Problems: The development and evaluation of adaptive aids through human factors engineering to contribute to improved clinical service.

Behavioral Sciences

Research predominantly centered around the introduction of learning-based behavior modification strategies to traditional rehabilitation by increasing self care skills in the physically disabled and decreasing the impact of chronic pain. Work is focused on those items which might be predictors for success or failure in a contingency management program. Biofeedback represents another more specialized technological application of learning-based strategies to be examined. Additionally, different treatment methods in speech and communication will be reviewed for their effectiveness.

Neurophysiology

Elevating the knowledge of neuromuscular electrodiagnosis and discoveries of animal models for various human crippling disorders.

Muscle Physiology

Maximizing positive functions of normal or diseased muscle and minimizing secondary disabilities resulting from damaged or impaired muscle.

Health Care Delivery

A series of projects related to the improvement of efficiency and quality of health care, whether through the expansion of training to meet demand or the study of the cost-benefits of rehabilitation outcomes of certain categorical diseases.

Multiple Sclerosis

Activities designed to improve the rehabilitation of disabled individuals with multiple sclerosis through research into major problems such as dysfunction of the urinary bladder, psychological dysfunction, speech and communication dysfunction, and weakness; to assess the actual reasons why MS patients do not work and identify comprehensive rehabilitation needs; and to promote and provide better diagnostic and prognostic specificity for this disability group.

UNIVERSITY OF WASHINGTON

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COMPLETED

CONTINUING

NEW

PROPOSED

Resolution Rate of Muscular Hematomas with Microwave Diathermy

Energy Expenditure of Wheelchair Ambulation

Quantitative and Qualitative Study of Subtalar Joint Motion During Stance Phase of Walking

Development of a Wheelchair Attachment for Long Range Ambulation

Muscle Tension Versus Pain: An In Vivo Examination of the Temporal Relationship Between Subjective Pain and Muscle Activity

Influence of Judge Familiarity with the Speaker on Dysarthric Speech Intelligibility Scores

Microcomputer-Based Non-Vocal Communication Systems with Self-Organizing Vocabularies

Severe Disabling Polyneuritis of Unknown Cause: The Development of a Research and Treatment Model

Effect of Parachlorophenyl Gamma Aminobutyric Acid (Baclofen) on External Urinary Sphincter Activity in Spinal Cord Injured Patients

Development of a Methodology to Determine the Origin of Bacteriuria in Chronically Catheterized Patients

Development of Training Strategies to Teach Compensation for Left Side Neglect

Comparison of Videocassette Instruction and Lecture/Discussion/Demonstration in Teaching Occupational Therapy Evaluation of Hemiparesis Secondary to CVA

Southern California Postrotary Nystagmus Test: Test-Retest Reliability for Preschool Children

Cerebral and Spinal Cord Evoked Potentials in Multiple Sclerosis

Value of Specific Training Activities in Increasing Ambulation Endurance and Balance Skills in the Elderly

Muscle Tension Versus Pain

042 Functional Distinction Between Neural Systems Involved in the Disabilities of Parkinson's Disease

Principal Investigator:	**Marjorie E. Anderson, Ph.D.**	
Status:	**Completed**	
Dates:	**October 1976-January 1980**	
Cost:	**Annual $977** **RT Annual $977**	**Projected Total $26,241** **RT % of Annual Total 100%**
Annual Report Reference:	**#18, Page 392, R-127**	

OBJECTIVES: To determine the tonic firing pattern of antidromically-identified nigro-striatal and nigrothalamic neurons during active postural stabilitation in awake monkeys. The hypothesis is that nigrothalamic neurons will show a regular tonic firing pattern in this paradigm and that nigrostriatal neurons will show a pattern that is sufficiently distinct such that they can be identified on the basis of this pattern.

METHODOLOGY: Juvenile monkeys (M.mulatta or M.fascicularis) will be trained to maintain a stable head position, in which a light beam from an overhead source is reflected by a skull-mounted dental mirror into an overhead photo-detector cell. Maintenance of this position for the required number of seconds results in delivery of an applesauce reward from a tube mounted in front of the animal, and colored signal lights and presence or absence of a tone indicate "on" vs. "off" position to the animal. The animal's food intake outside the training time is reduced during initial training, but he is not allowed to go below 80% initial body weight at any time, and after initial training, is fed enough to insure a normal growth rate for these immature animals.

At a later time, using a technique adopted by others (D. Bowden, E. Fetz) at the Regional Primate Center and satisfactorily tried by us in one preliminary monkey, stimulating electrodes can be positioned in an awake, behaving animal during recording from the structure under study. This kind of arrangement will be used to allow optimum positioning of electrodes for antidromic excitation of thalamic-projecting nigral neurons from VAmc and VLm, and of nigrostriatal fibers, as they course dorsolaterally in the vicinity of the sub-thalamic nucleus and along the medical border of the internal globus pallidus.

The activity of single neurons in the substantia nigra will be recorded with electrolytically-sharpened tungsten electrodes, insulated except at the tips, which are covered with electrolytically deposited iron particles to improve recording characteristics. The recording electrode is back-fed into a sterile hypodermic cannula, which is inserted through a calibrated R-O adapter, penetrates the silastic and dura, and extends to a position approximately 5-8mm. above the substantia nigra. The electrode is advanced through the cannula with a hydraulic micromanipulator, and the tonic activity of all isolatable units expected to be in the vicinity of the substantia nigra is recorded. Following acquisition of data during 1-2 minutes of stable, on-target behavior, a unit will be tested for antidromic activation from each of the stimulating electrodes described above. Criteria for antidromic activation will be:

(1) ability to respond faithfully to each stimulus in a train of 5 stimuli delivered at 500/sec.

(2) constant latency, using just supra-threshold stimulus intensities, and

(3) collision with "spontaneous" action potentials, such that failures will occur if the time between the "spontaneous" potential and the stimulus is less than the evoked potential latency plus the refractory period. Threshold stimulus intensities will be determined for each electrode and used to assess the probability of stimulus spread to the other (nigrothalamic or nigrostriatal) system.

Amplified neuronal activity, the output of a stimulus intensity monitor, and logic pulses indicating feeder delivery and "on" vs. "off" head position will be recorded on tape with an Ampex 1800 L analog record. Small electrolytic lesions and deposits of the plated iron particles will be made at known electrode tip depths relative to the top of the microdrive adapter in several tracks, to allow later reconstruction of recording positions for all neurons.

Following experimental procedures, animals will be anesthetized deeply with sodium pentobarbital and perfused with saline and formalin. The brain will be removed and fixed, frozen sections will be cut and stained with cresyl violet and with potassium ferrocyanide to elicit the Prussian blue reaction with the deposited iron particles. Recording positions will be reconstructed by reference to identified lesion-iron marks made at known positions and mapped on a standardized set of sections.

Firing patterns of neurons will be described in terms of interspike interval analysis done off-line with taped data using existing programs for the Honeywell DDP 516 computer.
This study will require 2-4 monkeys, depending on whether or not data can be collected bilaterally.

FINDINGS TO DATE: Data analysis for this project has been completed, and our results, obtained in the monkey, support the results published by others for the rat and indicate that substantia nigra neurons sending axonal projections to the thalamus as shown by antidromic activation, have high frequency tonic discharge patterns similar to those of the other basal ganglia output neurons, in the globus pallidus. This discharge pattern is quite different from that of the dopaminergic nigrostriatal neurons and can service to distinguish them in experiments designed to test their functional roles and pharacological properties, both of which are important to understand in developing effective therapeutic techniques.

APPLICABILITY: Parkinsonian patients would benefit from therapy based on an improved understanding of how the basal ganglia operate in assuring appropriate motor control.

043 Respiratory Function of Quadriplegic Individuals: Influenced by Glossopharyngeal Breathing Training and Periodic Long-Term Follow Up

Principal Investigator: Rosemarian Berni, R.N., M.N.
Status: Completed
Dates: December 1976-February 1980
Cost: Annual $9,700 — Projected Total Not Specified
RT Annual $9,700 — RT % of Annual Total 100%
Annual Report Reference: #18, Page 298, R-130

OBJECTIVES:

1. To compare assisted (with GPB) and unassisted vital capacity measurements generated by quadriplegic patient spinal cord injuries at C4-5, C5-6 and C6-7 respectively.
2. To compare change in unassisted vital capacity measurements which occur as one group of quadriplegic patients receives GPB treatment and another group of quadriplegic patients receives no treatment.
3. To compare assisted and unassisted vital capacity measures taken during long-term follow-up.
4. To describe personal respiratory maintenance program after discharge.

METHODOLOGY: All subjects included in this study were classified as quadriplegic due to functionally complete cervical lesions. No subject with known respiratory impairment other than related to quadriplegia was included. Twenty subjects were included in Group 1 (GPB treatment) and 20 subjects were included in Group 2 (non-GPB treatment). Both groups were matched according to sex, time since onset, age, and height. Quadriplegic patients included in the control group received GPB treatment prior to their release from the hospital; however, the initiation of their program was delayed until data was collected for the present study.

GPB treatment was delivered once daily for 20 minutes to subjects included in Group 1. Assisted vital capacity measurements and unassisted vital capacity measurments (the maximum measurement during three trials) were taken once weekly from the patients in the treatment group. Unassisted vital capacity measurements were taken once weekly from the control group. All measurements were taken in the supine position, since data collection began before some of the subjects were able to sit. Glossopharyngeal breathing treatment was terminated for subjects in the treatment group when the assisted vital capacity measurment did not improve more than 50 cc during a two-week time period. Data was collected from each control subject during a time interval equal to that spent by his or her matched treatment subject in the glossopharyngeal breathing treatment program.

Following discharge from the rehabilitation program, assisted and unassisted vital capacity measurments were taken at three-month intervals. At each interval, the quadriplegic person was asked to answer a questionnaire designed to explore his respiratory maintenance program, i.e., frequency of GPB activity, use of other respiratory maintenance programs or devices, frequency and severity of upper respiratory infections. The follow-up data was taken by a registered nurse trained by the primary treatment staff to reliably measure (.95) assisted and unassisted vital capacity.

Those patients in the study population who continued the respiration maintenance program and those who failed to continue the program were followed after discharge from the hospital.

The rehabilitation nurse obtained respiratory measurement with the subjects in recumbent and sitting positions. The best effort the patient obtained in any testing series was the value used for vital capacity.

The mean of ten consecutive tidal breaths was utilized for the measurement of tidal volume.

The study population was classified as quadriplegic due to spinal cord injuries rendering them as complete quadriplegics at C4-5, C5-6, C6-7, and with no known respiratory impairment other than that related to their quadriplegia.

At the University of Washington Hospital, glossopharyngeal breathing techniques are taught to quadriplegic patients by the speech pathology staff.

	Subject #	Pre-Training Vital Capacity	Post-Training Vital Capacity + Glosso-pharyngeal Breathing
	1	1570	3020
	2	780	2050
	3	2590	4770
C4-5	4	1100	1840
	5	1120	2190
	6	1150	2650
	7	1430	3040
	8	2840	3500
	9	1570	3640
	10	1940	3520
C5-6	11	1795	3560
	12	2070	3560
	13	2400	3150
	14	1520	2700
	15	2900	6500
	16	1770	2300
C6-7	17	620	2160
	18	1027	2775
	19	1120	1900
	20	1460	4060

FINDINGS TO DATE:

The experimental subjects learned the GPB procedure. Their training was begun within two months post-injury and lasted between 2½ and 3 months. Unassisted vital capacity measures were taken prior to the training phase and assisted (plus GPB) and unassisted vital capacity measures were taken at the conclusion of the training phase. The control subjects did not learn the GPB procedure prior to five months post-injury. The initial unassisted vital capacity measures were taken between one and two months post-injury and the final unassisted vital capacity measures were taken approximately 5 months post-injury.

Analysis of the data revealed that for all three groups of subjects (C4-5, C5-6, and C6-7), the final unassisted vital capacity measures were greater for the experimental subjects than for the control subjects. Specifically, the difference between the pre and the post unassisted vital capacity measure was greater for the experimental as compared to the control subjects by 275cc, 932cc, and 1020cc for the C4-5, C5-7, groups respectively. As would be expected, the mean post training assisted vital capacity was greater than the mean post unassisted vital capacity measures for all experimental groups.

The respiratory function of quadriplegic individuals influenced by glossopharyngeal breathing training was evaluated with a periodic long term follow-up. During hospitalization the mean post training assisted vital capacity was greater than the mean post unassisted vital capacity measures for all experimental groups.

1. 100% of the follow-up group were pleased to have the knowledge and skill in glossopharyngeal breathing because they had an ever present emergency respiratory aide.
2. Over a three-year period, only three significant respiratory complications occurred within the total study group.
3. Although most subjects did not continue their (GPB) regimen at home, most of group improved their vital capacities over discharge readings; some of these subjects could be tested in the sitting position only.

APPLICABILITY: The results of this study will assist members of the rehabilitation team as they seek and select training procedures designated to increase respiratory capacity of quadriplegic patients with various time of onset and various lesion levels.

Expected consumers' use of findings:

a. Better respiratory maintenance.
b. Better overall body system function.
c. Better potential for employment.
d. Better opportunity to prevent physiological and psychological deterioration and increased cost to the consumer or the taxpayer.

044 Determination of Basal Ganglia Influences on Other CNS Motor Systems: Development of a Model in Which Therapeutic Procedures Can Be Tested

Principal Investigator: Marjorie E. Anderson, Ph.D.

Status: Completed

Dates: October 1977-February 1980

Cost: Annual $10,150 — Projected Total $21,450
RT Annual $10,150 — RT % of Annual Total 100%

Annual Report Reference: #18, Page 400, R-133

OBJECTIVES: To determine, by carefully-controlled stimulation of the substantia nigra and intracellular and extracellular recording from neurons in the thalamus and superior colliculus, whether the synaptic effect of nigral axons terminating on these cells is excitatory and/or inhibitory.

METHODOLOGY: Cats utilized for these experiments will be anesthetized with sodium pentobarbital, alpha chloralose or halthane and nitrous oxide replaced with nitrous oxide after surgical procedures are completed. Because paralysis and artificial ventilation will be necessary to permit intracellular recording, care will be taken to insure that when only N_2O and O_2 are administered during recording, the arterial blood pressure remains stable and the pupils are slit as indicators of adequate analgesia. In addition, a long-lasting local anesthetic will be injected around stereotaxic pressure points and skin incisions.

Because neurons in the basal ganglia are particularly susceptible to the depressive effects of general anesthetics such as barbituates, a few experiments might be needed on animals without general anesthesia and with extensive, careful infiltration of wound margins and pressure points with long-lasting local anesthetics.

Suction will be used to remove tissue overlying the thalamus or superior colliculus as deep as the corpus callosum or the dorsal hippocampus. Recording microelectrodes filled with potassium citrate or potassium acetate saturated with fast green will be introduced stereotaxically into the thalamus or superior colliculus to allow intracellular and extracellular recording from neurons in these structures. Ususal procedures, such as pneumothorax, will be done to improve stability.

A stimulating array of 6-9 tungsten electrodes, sharpened electrolytically and insulated to within 0.5 mm of the tips, will be introduced into the substantia nigra and surrounding structures from an angle to avoid mechanical interference with recording electrodes in the ipsilateral superior colliculus (Yoshida, Rabin, and Anderson 1971, 1972). Stimulating electrodes also will be positioned caudally in the contralateral medial longitudinal fasciculus (MLF) so that we can determine whether the neurons studied can be activated antridromically from MLF levels at about midpons, where the axons of many collicular efferent neurons would be situated (Altman and Carpenter, 1961; Anderson, Yoshida and Wilson, 1971).

Intracellular recordings of postsynaptic potentials evoked by bipolar stimulation between adjacent electrodes will be taken and threshold stimulus intensities will be determined. The array will include control electrodes situated deep and superficial to the substantia nigra, and to further separate out any responses due to stimulus spead to non-nigral structures, stimulating electrode arrays will be moved with micromanipulators and stimulus threshold intensities for evoked responses will be measured in several neurons with the stimulating array at each stimulus depth to determine points of lowest stimulus threshold. If the data are ambiguous because of possible effects due to stimulus spread, especially to the medial lemnisci that lie just dorsolateral to the substantia nigra at some levels and to the cerebral peduncle just ventral to SN, it may be necessary in some animals to interrupt the pyramidal tract and medial limniscus fibers ipsilateral to planned SN stimulation early enough to allow them to degenerate before the acute experiments.

Intracellularly-recorded data will be supplemented by extracellular records, examining stimulus evoked effects on spontaneous activity or in a conditioning testing format in which the cells' response to a test stimulus such as a shock to the contralateral forepaw or to neck muscle nerves is evaluated when it is applied at various intervals relative to a conditioning stimulus to the substantia nigra.

Intracellularly and extracellularly-recorded potentials will be amplified by conventional techniques, photographed with kymograph film, and recorded on FM tape (Ampex 1800L; frequency range DC-5kHz). Averaging and peristimulus time histograms can both be done using existing programs for the Honeywell DDP 516 computer.

Recording sites will be determined by reference to spots made by fast green FCF deposited electrophoretically from the recording electrodes. Stimulus positions will be marked by electrolytic lesions. At the termination of the experiment, the brains will be perfused and fixed in formalin and recording and stimulating positions will be determined from frozen sections. The distribution of responses evoked from different stimulus positions will also be mapped for the superior colliculus.

About 20 cats will be needed for these studies.

FINDINGS TO DATE: Identification of branching nigrothalamic and nigrocollicular neurons and identification of pallidal afferents by horseradish peroxidase retrograde transport have been completed. Investigators are in the final phase of the experimental work.

It has been demonstrated that a significant proportion (greater than 40 percent) of the neurons in the substantia send axonal branches to both the substantia nigra and to the thalamus, and data from collision techniques has been used to show that the branch point for most neurons must be rather near the axon's origin at the soma. There seems to be no relative segregation within the nigra of neurons projecting to the thalamus and colliculus.

Having shown that neurons in the pedunculopontine nucleus (PPN) of the tegmentum are retrogradely labeled by horseradish peroxidase injected into the globus pallidus of the monkey, this has also been true for the cat, the response of cat pallidal neurons following electrical stimulation of the pedunculopontine nucleus have been recorded. Stimulation does produce excitation of pallidal neurons, but from extracellular recordings, it is difficult to determine if this is produced monosynaptically. Currently, researchers are recording intracellularly, and data collected thus

far show EPSPs following pedunculopontine stimulation that appear to be produced monosynaptically. It has been determined that the lowest threshold stimulus points for exciting pallidal cells by PPN stimulation correspond to the area where we found labeled neurons following horseradish peroxidase injection in the globus pallidus. Thus, data are consistent with the hypothesis that PPN provides an excitatory input to basal ganglia output neurons, and this probably occurs via a direct projection.

APPLICABILITY: Involuntary movement disorders, such as cerebral palsy and other choreoathetoid dyskinesias are a national problem with a large population currently not independent or employable. For example, cerebral palsy has an incidence of about 6 per 1,000. Rational approaches to therapeutic management of these disorders is hampered by our lack of knowledge regarding the relationship of the basal ganglia to subsequent neural "motor systems." The description of the "wiring diagram" for these systems would allow us to test pharmacological and other therapeutic methods for modifying or compensating for dysfunction in these systems.

045 Evaluation of a Circularly Polarized Microwave Diathermy Applicator

Principal Investigator: **Justus F. Lehmann, M.D.**

Status: **Completed**

Dates: **June 1977-June 1980**

Cost: **Annual $31,075** **Projected Total $79,496**
RT Annual $26,475 **RT % of Annual Total 85%**

Annual Report Reference: **#18, Page 168, R-134**

OBJECTIVES: To evaluate a recently designed diathermy machine which selectively heats muscle and joints covered with minimal amounts of soft tissue which will be compatible with federal safety regulations as set forth by the Bureau of Radiological Health.

METHODLOGY: A circular waveguide aperture-type applicator operating at a frequency of 915 MHz has been developed for use as a diathermy applicator.

Various tissue substitute models will be constructed using a new fabrication technique which is being developed in a related study (R-135). The models will be irradiated with the circular polarized applicator at high power for short periods of time. Thermograms will be taken and processed by computer to produce thermographs showing the temperature distribution throughout the model. From this data, the rate of absorption of energy (W/kg) in the various tissue layers can be calculated. This will allow the effectiveness of the applicator in heating various types of tissue to be determined. After the energy absorption pattern is determined in the model, human volunteers will be used to determine actual temperature distribution.

FINDINGS TO DATE: Several prototype direct-contact circularly polarized diathermy applicators were evaluated for possible clinical use. Three of them were 915 MHz applicators which were developed in-house:

1. An 11.1 cm diameter 915 MHz applicator.
2. An 11.1 cm diameter, non-homogeneously dielectrically loaded 915 MHz applicator.
3. An 8.9 cm diameter 915 MHz applicator.

At this point in the project, several results are apparent:

1. The three 915 MHz applicators developed in-house were found to produce depths of penetration of 2.6 to 3.0 cm in the planar model. The fat to muscle selective absorption rate (SAR) ratio varied from 0.4 to 0.5.
2. A Transco manufactured 2450 MHz applicator produced a depth of penetration of 1.8 to 2.0 cm in the planar model. Its fat to muscle SAR ratio was found to be 1.0.
3. The 915 MHz applicators produced circularly symmetrical heating patterns in a transverse plane of the planar model. The Transco 2450 MHz applicator produced an elliptical heating pattern.

4. When exposing the thigh-shaped models and the cylindrical model, the 915 MHz applicators were found to produce heating patterns which were independent of applicator orientation. With the Transco 2450 MHz applicator, the heating patterns produced were dependent on applicator orientation.

   Currently standards are being established for microwave diathermy which will define effectiveness of the applicator and limits of allowable stray radiation. The data discussed above, and the additional data determined in R-135, will be utilized to define applicator designs which will provide selective absorption in the tissue while producing minimal stray radiation, as well as aid in the setting of standards.

   The main clinical advantage of the 915 MHz applicator over the non-contact applicators is the less stray radiation compared with other direct contact applicators. There is no preferential stray radiation increase in the direction of the E field vector as documented in the linearly polarized applicators. The chances of inadvertantly exposing sensitive organs are reduced with this applicator as compared with circularly polarized applicators at 2450 MHz (Transco). The potential for deep heating to tolerance level, for instance, in musculature, is markedly enhanced.

   At the higher frequency level of 2450, high SAR values were found in subcutaneous fat. This in combination with the low specific heat of the fat produces significantly higher temperatures in the subcutaneous fat. These temperatures may not exceed tolerance level and therefore the temperatures in muscle remain relatively low.

   The applicators operating a 915 MHz produce a peak SAR and subsequently the highest temperature in the musculature and thus are more suitable for deep heating purposes.

APPLICABILITY: Diathermy is a type of therapy designed to treat the most severely disabling sequels of diseases leading to joint contractures. It is also anticipated that this may be of significance in the treatment of such serious disease entities as polymyositis. This treatment procedure is one that could be put into practice in hospitals throughout the United States.

046 Development of New Phantom Material for Testing Diathermy Applicators

Principal Investigator:	**Justus F. Lehmann, M.D.**	
Status:	**Completed**	
Dates:	**July 1977-July 1980**	
Cost:	**Annual $6,440** **RT Annual $5,060**	**Projected Total $49,000** **RT % of Annual Total 78%**
Annual Report Reference:	**#18, Page 175, R-135**	

OBJECTIVES: The objective of this project is to develop a new phantom fat tissue, eliminating interface problems, that could be used to test and evaluate any type of diathermy applicator over a large frequency range.

Once these models have been developed they can be built to duplicate certain parts of the body that are frequently exposed to electromagnetic radiation. While these models are being irradiated, power density measurements around the models can be made to determine the amount of stray radiation being produced by various applicators. This is important to know to insure the safety of the patient and operator.

These models would also yield patterns of relative heat so that energy absorption in them could be calculated. The heating patterns would also be used to identify areas of maximal heating which would be used to select the applicator that would heat the area of pathology.

METHODOLOGY: The initial design approach will be the development of a new phantom fat material to be placed at the interface of fat or bone models. This design approach addresses three problems. To eliminate the air gap at the fat interface, the new phantom material must be a compressible solid, (rubber foam or soft epoxy) or a viscous liquid material. Secondly, the material must adhere to the current phantom tissue. Finally, the thermal properties (specific heat) of the two materials should be approximately equivalent.

The electromagnetic properties of the new synthetic fat tissue must be approximately equivalent to the currently used synthetic fat. At a minimum, materials for each of diathermy frequency bandwidths must be developed (i.e. 13.56 MHz, 27.12 MHz, 40.68 MHz, 915 MHz and 2450 MHz). Ideally materials should be developed which could be used for any frequency between 10 MHz and 3 GHz.

When materials with acceptable mechanical and electrical properties have been developed, the modified phantom model must be tested using a thermographic technique developed by Guy. Briefly this procedure involves the following steps. A high power source is connected to a diathermy applicator. The applicator is then used to irradiate the phantom model for a short period of time (10 to 20 sec.). An infrared camera scans the model, recording the heating distribution in the model. Comparisons of theoretical and measured Specific Absorption Rates (SAR's) for several diathermy applicators will be used to verify correct heating in the model. SAR is defined as the rate of energy absorption per unit mass. The peak SAR's in the model should not vary as a function of applicator orientation on the model (i.e. the direction of the electric field vector with respect to the model interface should not affect the SAR in the model). Also, thermograms of heating induced by applicators with irregular field configurations will be made to insure that "hot spotting" is eliminated from the model.

FINDINGS TO DATE: A search has been continued for dielectric materials which would adequately substitute for fat tissue and overcome the discontinuity effects experienced when using split models. Best materials found for 915 and 2450 MHz were hexyl, heptyl and octyl alcohols. At 918 MHz the conductivity of fat tissue ranges from 55.6 to 147, with 66.5 being the median value. Conductivity was used as the criterion for matching, since the dielectric constant is usually low, while the loss tangent is high. Their product (conductivity being a function of the product of the two) is a reasonably good measure of power absorbtion in the tissue, hence it was chosen as the main criterion.

For 2450 MHz the conductivity of these ranges from 96.4 S/meter to 213 S/meter the median value being 117 S/meter. Hexyl alcohol has a conductivity at 2450 MHz of approximately 119 S/meter, which is the best of three. Octyl alcohol is approximately the same as heptyl alcohol being approximately 98 S/meter. This will be further verified by using a small square horn as an applicator to evaluate hexyl and octyl alcohols at 2450 MHz.

Thermograms were taken with both octyl alcohol and with neptyl alcohol on the planar model using a two-cm fat layer over a 10-cm muscle layer at 918 MHz using a 13 by 13 cm linear-polarized applicator. The two alcohols produced extremely similar results. However, octyl alcohol is the most convenient to use.

It is concluded that octyl alcohol will produce an effective interface at 2450 MHz and 918 MHz. At 27.12 MHz, propylene glycol saturate with NaCl was also concluded to produce an effective interface. With these materials and techniques, it was concluded that applicators with circular fields can be adequately tested on split phantom models.

APPLICABILITY: The development of the new phantom material will allow us to develop and test new diathermy applicators that can heat specific areas that need treatment and will also be safe to patient and operator by having the least amount of stray radiation.

047 Comparison of Methods to Reduce Shear and Displacement in the Use of a Reclining Wheelchair

Principal Investigator: C.G. Warren, M.P.A.

Status: Completed

Dates: June 1977-January 1980

Cost: Annual $4,025 | Projected Total $10,000
RT Annual $4,025 | RT % of Annual Total 100%

Annual Report Reference: #18, Page 201, R-145

OBJECTIVES: The objectives of the study are to quantify the effects of the three proposed mechanisms: 1. relocating the axes of rotation of the wheelchair. 2. incorporation of a powered sliding seat or 3. using a sliding back mechanism. From this information, the optimum method of reducing the displacement between the person's body and the seating surface may be established.

METHODOLOGY: The most important facor to be measured as a criterion for effectiveness of chair modification was found to be displacement of the body relative to the seating surface. To be able to make this measurement more accurately, a powered reclining wheelchair with a powered sliding seat was modified to incorporate a low friction counterbalanced sliding back. The chair was then instrumented to measure the angular change of the back relative to the seat to record displacement of the sliding back, the sliding seat and any motion of the subject's lower trunk or leg segment. This was accomplished using precision rotary and linear potentiometers. The extent of the displacement will be processed by an extant data acquisition system and computer. Quadriplegic persons for whom a powered reclining wheelchair might be indicated will be selected as subjects for the study. They will be placed on a standard cushion and positioned until they are satisfied that they are comfortable and in a normal position for them. The chair will be reclined 5° from the horizontal and held in this position for 3 to 4 minutes, then elevated to the 80° position. The patient will be repositioned if he feels it necessary and the procedure repeated. This process will be repeated 7 to 10 times with each of the various conditions of the chair controlled (i.e., fixed or sliding seat, fixed or sliding back, or both fixed). The data will indicate which mechanisms produce the least displacement of the body with respect to the chair. It will also be used to determine through geometric calculations the center of rotation of the body and the effect that altering the axis of rotation of the wheelchair may have on further reducing displacement.

FINDINGS TO DATE: The optimum path of the back of the chair with respect to the seat was determined for a sample of ten normals and eight persons with quadriplegia. Among the normals, there appeared to be a correlation with morphology. However, in the sample of persons with quadriplegia, factors other than morphology seemed to dictate the individual path the body took during the recline cycle. A four-bar linkage was designed which will follow the average curves of the groups of individuals evaluated.

A prototype mechanism using the four-bar linkage was constructed which was then instrumented to determine displacement vs. angle during recline. This mechanism was tested using 12 normal and 8 quadriplegic subjects. The mechanism, as predicted, was found to reduce displacement and shear to levels far below those produced with the conventional recliner.

After testing the mechanism with 8 quadriplegic subjects, it was concluded that the mechanism had been effectively optimized. In this case, use of the linkage has reduced displacement in the chair during recline from an average of 12 cm to 1.5 cm. The curve is biased slightly in the positive direction so that repeated cycling of the recline mechanism will not cause the person to be displaced lower in the chair with each use.

Information on the optimized mechanism has been disseminated to manufacturers of powered reclining wheelchairs to aid them in the design of improved units. One major manufacturer has already adopted the mechanism as a design priority in new product development. In response to individual clients who currently have reclining wheelchairs and have a need to resolve the shear and displacement problem, the linkage design is being developed as a retrofit package.

APPLICABILITY: This project has a distinct advantage in technology transfer, because it involves collaborating directly with the wheelchair industry to evaluate the optimum method to solve the problem. The findings, we believe, will be directly utilized by industry to produce a mechanism to resolve this problem for the severely paralyzed individual.

Determining which methods of eliminating shear and displacement for the severely paralyzed person would include quadriplegics, people with multiple sclerosis, post polio, congenital defects of the spine, etc. The improved reclining wheelchair may considerably modify the social and vocational rehabilitation goals of this category of patient.

048 Quantification of Non-Vocal Communication Performance

Principal Investigator: David R. Beukelman, Ph.D.

Status: Completed

Dates: July 1978-July 1980

Cost: Annual $9,125 — Projected Total $16,525
RT Annual $7,400 — RT % of Annual Total 81%

Annual Report Reference: #18, Page 314, R-150

OBJECTIVES: The aim of this study is to develop a system for quantifying non-vocal communication performance which is sensitive to frequency of communication, type of message, sender efficiency, receiver efficiency, sender fatigability, and system flexibility. The specific objectives will be to:

1. Develop data gathering and analysis procedures.
2. Quantify non-vocal communication performance in (a) a formal evaluation of specific communication tasks and (b) a variety of "natural" communication environments where extensive data can be collected over a period of several hours.
3. Monitor the **progress** and **generalization** of learning as non-vocal communicators improve their skill with a specific communciation system.

METHODOLOGY: **Phase I:** The first phase of this study will be to develop a data collection and analysis system which is capable of quantifying non-vocal communication performance, is sensitive over a wide range of communicative ability levels and applicable in a variety of communication settings.

Since the capability of data collection over long periods of time in a variety of settings is a primary objective of this study, Phase I will also include development of recording techniques which will permit accurate and reliable data collection by the "receivers" in a specific "sender's" environment. The requirements of the data collection system will be (1) minimal interference with the frequency and type of communication, and (2) accurate, reliable recording of message content, message frequency, device employed, receiver identity, and environmental identification. Preliminary work in this area indicates that a paper-pencil system or recording is inadequate. Therefore, a portable cassette tape-recorder system which will permit receiver to signal the duration of the message in real time and provide specific information requirements provided above is being investigated. This information will then be taken from the tape by a research technician.

A second aspect of the data collection in Phase I will be development of formal evaluation tasks of three different types: (1) input-output tasks will be used to measure sender efficiency and accuracy; (2) picture or situation description will be used to assess ability to formulate messages on a specific device and to permit quantification of content as well as efficiency of communicative effort; (3) fatigability drills will be used to quantify communication rate. A character (letter or word designation) per minute measure will be calculated to determine changes in communication rate over time thus illustrating the effects of fatigue.

During Phase I, the performance of 10 non-vocal communicators will be evaluated by methods similar to those above. These communications will represent a wide range of communicative ability, devices, systems and environments. Data will be used to finalize the data collection and quantification systems which have been described above. Some of these communicators will have their own devices and systems. Others will use systems recently purchased by the Department of Rehabilitation Medicine (Zygo 100 square and Lapboard Strip Printer).

Phase 2: Five non-vocal communicators who have recently received new communication systems or systems modified from those that they previously used will be followed so that their learning and generalization of system use can be analyzed. Performance of these communicators will be quantified (four times during the learning phase) with the methods developed in Phase I. The exact recording dates will depend upon the rate with which their skills on their respective communicative systems progress. Performance will be analyzed to determine changes in variety of communications partners, frequency of communication initiation, type of message, frequency of communication, receiver efficiency per communication exchange, and variety of communication environments.

FINDINGS TO DATE: The data collection and analysis system for quantifying non-vocal performance in a variety of settings has been completed and field tested. Data has been collected for sixteen non-speaking individuals. As a result, modifications in communication augmentation systems, additional training programs for communication partners, and the modifications in postural control and seating have been recommended.

APPLICABILITY: The results of this study have been used in the clinical decision-making processes of three hospitals and one school for handicapped children. The performance evaluations of four of the non-vocal communicators have resulted in some modification of their training programs, equipment, or education of their communication partners.

049 Electromyographic Analysis of Postural Adjustment During Movement of the Upper Extremities

Principal Investigator:	**Marjorie E. Anderson, Ph.D.**	
Status:	**Completed**	
Dates:	**February 1978-December 1980**	
Cost:	**Annual $16,100** **RT Annual $8,050**	**Projected Total $24,000** **RT % of Annual Total 50%**
Annual Report Reference:	**#18, Page 410, R-152**	

OBJECTIVES:

1. To determine the normal patterns of EMG activity in shoulder, trunk, and leg muscles during a movement (raising and lowering the arm in a standing individual) that will require postural adjustment to support a displacement of mass.
2. To determine the variability in these patterns between different individuals who do not have neurological or musculoskeletal disorders.
3. To determine the critical task variables that influence the pattern of muscle activity. In particular, we will compare EMG patterns when the arm movements are made at different velocities, when they are self-paced vs. stimulus triggered, and when the required response is randomly varied between the right and left arm.

METHODOLOGY: Subjects were 30 volunteers, ages 20 to 80, who had no history of neurological or musculoskeletal disorders. During testing, they wore clothing that allowed access to muscles acting at the hip, knee, and/or ankle, paraspinal muscles, and muscles around the shoulder girdle. The latter muscles gave timing of activity in the prime movers for the arm movement, and the former are expected to be muscles that provide postural support.

Subjects stood in stocking feet or flat shoes in a comfortable position, with weight distributed on both feet. They faced a panel of lights, and silver-silver chloride surface EMG electrodes (Beckman) were taped to the skin overlying up to 12 muscles (or groups of muscles) at a time. Differentially-recorded signals from each muscle were amplified by high input impedance, variable filter amplifiers with input stages mounted near the subject, and amplified signals from 5 muscles at a time were transmitted via isolation units to the recording apparatus.

Arm positions were recorded via a low-torque potentiometer aligned with the axis of shoulder rotation and coupled via a universal joint and slide rod to a tube strapped to one arm, with velcro attachments above and below the elbow to keep the elbow straight.

In the initial experimental trials the subject was asked to raise his/her arm from an initial position at the side to a horizontal position as a self-paced (raise: hold: lower: hold) movement with no external trigger signal. For one set of trials the subject was requested to make the movement as rapidly as possible, and in other sets, he made the movement at slower rates.

Finally, in an additional set of trials the subject was asked to raise either the right or left arm, depending on whether the right or left signal light appears in a random sequence.

Data were recorded on FM analog tape. Raw data were filmed from an oscilloscope face on moving kymograph film and projected for measurement of relative EMG timing and amplitude of movement. A digitizer was used to measure EMG onset and offset for each muscle relative to the time of movement onset. The digitizer arm was positioned at the movement or EMG onset or offset of the projected film image, and the X-Y coordinates of the arm position were entered into a computer file as amplitude or time measurements, relative to the onset of the movement. These values could then be used for graphic and statistical analysis.

Using these data a sequential profile of EMG activity in different individuals during arm movements of a few selected velocity ranges can be established. EMG lead or lag times relative to the movement onset for individual muscles during movements at several different velocities and under different task conditions (i.e., triggered, random, self-paced, etc.) can be plotted.

FINDINGS TO DATE: Thirty subjects were studied, five in each decade age group from 20 to 80. Right deltoid, right and left paraspinal, and right and left biceps femoris activity was recorded during four different paradigms in which subjects were to raise their right arms and arm position was recorded using an electrogoniometer.

The data would suggest that basically different muscle recruitment patterns exist for fast and slow movements and that fast movements are preceded by rather consistent patterns of EMG activity in back and hip muscles, perhaps reducing the displacement caused by the movement torque. Subjects may "choose" between these patterns when they are asked to make slow movements, and the linear correlation between mean arm velocity and mean EMG onset time for the population as a whole may result from the proportion of times in which individual subjects used "fast" or "slow" muscle sequence patterns.

APPLICABILITY: Evaluation of the normal pattern of postural adjustment in simple tasks performed by normal individuals will give us a basis for evaluating how this process is disrupted in several types of patients. This information will be used to improve motor retraining or compensation strategies.

050 Determining the Incidence of Carpal Tunnel Syndrome Uremic Patients on Renal Dialysis

Principal Investigator:	**Susan Halter, M.D.**	
Status:	**Completed**	
Dates:	**June 1979-June 1980**	
Cost:	**Annual $6,325** **RT Annual $2,300**	**Projected Total $15,000** **RT % of Annual Total 36%**
Annual Report Reference:	**#18, Page 365, R-156**	

OBJECTIVES: Most of the previously reported studies of CTS in uremic patients on dialysis are anecdotal and include small numbers of patients. None of the studies, as reported, has met rigid electrodiagnostic criteria for evaluation of CTS. Our experience to date suggests that uremic patients have a higher incidence of carpal tunnel syndrome than previously thought. The purpose of this study is to determine the incidence of CTS in the Seattle VAMC population of uremic patients on renal dialysis, using standardized electrodiagnostic techniques and recording hand and forearm temperature. Patients will be selected from a population of uremic patients who have been on renal dialysis for various lengths of time, the majority for greater than five years.

METHODOLOGY: The majority of patients complaining of symptoms which might correlate with CTS have been on dialysis 5 years ± 4 months. The total VA population of renal dialysis patients is 100, and 38 of these have been on dialysis 5 years ± 4 months. Of the 38, one has transferred to Tennessee, and six have had renal transplants and are eliminated from the study. We will attempt to test all of the remaining 31 patients. Twelve of the 31 have symptoms which might be found in CTS, and 19 are asymptomatic.

Any symptomatic patients who have been on dialysis less than 5 years ± 4 months will also be tested. In addition, a random sample of 10 asymptomatic patients who have been on dialysis for varying times less than five years will be tested.

A DISA will be used for all testing. Rectangular pulses of 0.1 to 0.5 msec will be used with supramaximal stimulus intensity to 99 milliamps. Temperature will be measured at the midflexor wrist crease and thenar eminence using a Rochester Electromedical Thermistor with surface probe after the subject has been in the room for 15 minutes.

Median and ulnar standardized NCV techniques described by Melvin (12, 13) will be used. For median motor conduction studies, the active electrode will be placed over the opponens pollicis, half the distance between the MCP joint of the thumb and the mid-point of the distal wrist crease. The ground electrode will be placed on the dorsum of the hand and the reference electrode on the distal phalanx of the thumb. The cathode will stimulate the median nerve 8 cm from the active electrode near the wrist and again at the antecubital fossa, just medial to the maximum pulsation of the brachial artery. The distance between the cathode stimulation at the wrist and elbow will be measured with a flexible metal tape. Motor latency at the wrist will be measured from the onset of stimulus to the first deflection. NCV and residual latency will be calculated.

For ulnar motor studies, the active electrode will be placed over the abductor digiti quinti, half the distance between the MCP joint of the 5th finger and the distal wrist crease over the ulnar nerve. The ground electrode will be placed on the dorsum of the hand and the reference on the distal phalanx of the 5th finger. The cathode will then stimulate the ulnar nerve 8 cm from the active electrode and again just below the ulnar groove at the elbow. The distance between cathode stimulation at the wrist and elbow will be measured with tape. Motor latency at the wrist will be measured as for the median nerve. NCV and residual latency will also be calculated.

Orthodromic sensory stimulation will be used to obtain sensory potentials for the median and ulnar nerves. Digital nerves will be stimulated with a flexible metal ring electrode placed at the base of the digit being tested. A similar reference electrode will be placed 4 cm distally on the digit in order to maximize the sensory potential. The 2nd digit will be stimulated to record median nerve potentials and the 5th digit stimulated for ulnar nerve potentials. A dry 4x4 gauze pad will be placed between the digit being tested and other digits to reduce possible cross contamination from other digital nerves. The ground electrode will be placed on the dorsum of the hand. Nerve action potentials will be picked up by electrodes held over the appropriate nerve at the wrist. Latency from the stimulus to the highest point of the negative peak will be measured.

A 1½ inch Teflon coated monopolar EMG needle will be used to test the opponens pollicis, abductor pollicis brevis, first dorsal interossei, flexor carpi radialis, and cervical paraspinal muscles for evidence of membrane instability, analysis of MUAP configuration and recruitment pattern.

FINDINGS TO DATE: Of 48 patients tested, 15 (31%) had symptomatic CTS confirmed by electrodiagnosis. Seven of these patients had bilateral CTS. Twelve patients subsequently had surgical flexor retinaculum release resulting in relief of symptoms. Thirty-seven of the 48 patients tested, including all 15 with CTS, had peripheral neuropathy. Fifty-seven percent of patients who had peripheral neuropathy and were on dialysis greater than 5 years also had CTS. Slowing of ulnar nerve conduction velocity across the elbow was found in 11 arms, including 3 with CTS. The high incidence of CTS in this renal dialysis population appears to be related to nerve compression secondary to a thickened transverse carpal ligament. Increasing time on dialysis was related to an increased incidence of CTS. However, the presence of forearm access (AV fistula or cannula) was not crucial to the development of CTS. CTS is treatable and should be considered in the differential diagnosis of hand-and-arm symptoms in chronic dialysis patients.

APPLICABILITY: Findings may be utilized by physiatrists and nephrologists across the nation. Patients may benefit directly by the alleviation of uncomfortable symptoms and the prevention of possibly severe limitation of hand function. Because of this study, an uncomfortable and potentially harmful condition may be identified and treated more readily.

051 Program on the Quantitation of the Effects of Electromagnetic Energy on Human Tissue

Principal Investigators: Arthur W. Guy, Ph.D.
Chung-Kwang Chou, Ph.D.
Akira Horita, Ph.D.

Status: Continuing

Dates: June 1976-March 1984

Cost: Annual Not Specified
RT Annual $34,500
Projected Total Not Specified
RT % of Annual Total 1%

Annual Report Reference: #18, Page 130, R-5

OBJECTIVE: To advance the existing knowledge on the quantitative effects of electromagnetic radiation on the human body and to provide realistic guidelines for safety standards of human exposure.

METHODOLOGY:

1. Establish quantitatively the electromagnetic field patterns both in and exterior to the tissues of human subjects and test animals due to external sources of energy.
2. Expose the test animals to the various CW and modulated electromagnetic sources at both thermal and lower levels while monitoring the energy of the tissues.
3. Observe the physiological and behavioral characteristics of the animals before, during, and after exposure to electromagnetic radiation.
4. Determine the time and power density thresholds for cataract production in animals exposed to microwave radiation.
5. Determine what levels of fields mankind can be safely exposed to, taking into proper account the source, configuration, frequency, and location.
6. The theoretical analysis involves solution of Maxwell's equation for the absorbed power by biological systems for a host of different geometries.
7. The experimental studies involve controlled exposure of test animals to selected sources of electromagnetic energy with the aim of quantifying observable effects and changes on the biological systems.

FINDINGS TO DATE:

Substudy 5b: Neurophysiological and Behavioral Effects of Microwave Radiation: Due to the eviction of the project from facilities in the Department of Psychology in December 1979, the inability to find adequate space to continue this research until June 1979 and the departure of the principal investigator from the University, this year's efforts concentrated solely on determination of the possible behavior effect of chronic exposure to 915 MHz microwaves squarewave modulated at 11 Hz.

During 1976, rodents had been exposed to chronic 918 MHz square wave modulated microwaves during one 3-month period and a second 2-week period. Following these exposures, the animals were tested on the acquisition of a shuttlebox avoidance response. In both instances, marginally significant changes in performance were seen.

As replication of this earlier work, we again this past year exposed two groups of rats, one group for 3-months the other for 4 weeks, and following completion of this regimen, tested the animals on the shuttlebox performance task. No significant differences between the exposed and sham-exposed subjects were discernible.

An ancillary study investigated possible pulsed-modulated effects on acquisition of a more cognitive learning task, i.e., T-maze alternation. However, this study also provided no significant indication that such exposures affected the behavior of the rats.

Substudy 5h: Biological Consequences of Pulsed Versus Continuous Wave Radiofrequency Radiation: Previous studies have demonstrated the sensitivity of certain tumor-host relationships in expressing either impairment or enhancement of the immunological system of the mouse. Thus, by appropriate selection of a tumor-host model where the immunological capacity of the host is in delicate equipoise with the tumor, slight alterations in the immune competence of the host are reflected by quantifiable changes in the behavior of the tumor. Such alterations may be measured by a comparison of various parameters of the RF-exposed host and its tumor with suitable sham-exposed controls. Those parameters that have been most useful are the tumor latent periods, tumor growth rates, maximum tumor volumes, the number and rate of tumor regressions, and the survival time of the tumor-bearing hosts. The data reported are largely derived from the above parameters. Negative findings indicate that exposure of the mice to RF radiation has not influenced the animal's immunocompetence as detectable by this sensitive system. The detection and measurement of either impairment or enhancement of the immune system in mice exposed to RF radiation, in comparison with the sham-exposed controls, suggest that either the RF energy, or some characteristic of the exposure techniques have brought about an alteration in the host immune system.

Substudy 5i: Fabrication of 2450 MHz Chronic Exposure System for Exposing Mice: A complete waveguide system has been installed in the FAA laboratories in Oklahoma City and is performing satisfactorily.

Substudy 5k: Chronic Low-Level Effects in Rabbits Exposed to 2450 MHz Microwave Radiation: Two groups of sixteen male New Zealand rabbits were exposed to 2450 MHz CW microwave fields in two experiments of 90 days each. The incident power densities of the first and second experiment were 0.5 and 5 mW/cm^2, respectively. During each study, 16 animals were adapted to a miniature anechoic chamber exposure system for 2 weeks, then half of the animals were exposed for 7 hours/day, 5 days/week for 13 weeks, and the other 8 animals were sham-exposed. Each rabbit was placed in a plexiglass cage and dorsally exposed individually in the anechoic chamber. Thermographic data showed a maximum SAR of 5.45 W/kg in the head and 7 W/kg in the back of the rabbit, for the 5 mW/cm^2 incident power density. After each 7-hour session, the animals were returned to their home cages. Body mass and food consumption in the exposure chamber were measured daily. Blood samples were taken before exposure and monthly thereafter for hematological, morphological, chemical, protein electrophoresis, and lymphocyte blast-transformation studies. Eyes were examined for cataract formation. Finally, pathological examinations on 31 specimens of organs and tissues were performed. Statistically, there was only a significant decrease ($p < 0.01$) of food consumption at the 5 mW/cm2 level and all other parameters were not significantly different.

Substudy 5m: Effects of Long-Term Low-Level RFR Exposure on Rats (Phase I): After the construction of 200 waveguides and approximately 15 spares, and the installation of the waveguides in the 10 specific pathogen free alcoves in the two T-wing rooms in the division of Animal Medicine last year, work continued on the design and construction of the power distribution system and the computerized data acquisition system. All of these hardware aspects of the project have been completed. The three-month pilot program for evaluating the system and training technicians has been successfully completed. As a result of the pilot program, a number of modifications for improving the experiment have been implemented. Laboratory technicians and helpers for the full-scale project have now completed training and are now involved in the screening and testing of animals for the full-scale experiment.

Substudy 5n: Neurological and Behavioral Effects of Microwave Exposure: Three pilot projects and one study have been completed during the first quarter of the contract. In the completed study, it was found that pulsed microwaves interact with the drug state in ways that affect the normal appetite stimulating properties of the drug and the sedative effects. Pilot studies have suggested the drug does indeed affect the rats' thermoregulatory system and a study is underway to assess the synergistic effects of pulsed microwaves.

Open-field/exploratory activity is being assessed in animals that have developed behavioral tolerance to the drug and following three weeks of microwave treatment. Preparations are nearing completion to begin shuttlebox and operant chamber testing by September 1 as planned.

Substudy 5o: Fabrication of 918 MHz/2450 MHz Chronic Exposure System: Construction work and calibration work is complete. Hardware has been shipped to the contractor, the Walter Reed Army Institute of Research.

Substudy 5p: Determination of Electric Current Distributions in Animals and Humans Exposed to 60 Hz Electric and Magnetic Fields: Prolate spheroids and spheres were exposed in a uniform electric field and the experimental SAR's (specific absorption rate) agreed with theory. Three scaled man models (SF: 3.95, 5.95) were exposed and the maximum SAR and induced current values were compared. The maximum induced current densities within the body were located in the neck, knee, and ankle for each model. We verified that the induced current density was independent of the model size.

Semi-prolate spheroids were exposed on the ground plane and data was compared to the free space exposures - the thermograph results show equivalent SAR patterns for the ground plane exposure.

Substudy 5q: Immunological and Hematological Effects of Microwave Power Transmission from a Satellite Power System: Mice are being exposed in the circular waveguide system at the Fred Hutchinson Cancer Research Center. The mice have shown no temperature change. The minature anechoic exposure chamber is being modified to expose the mice to 2450 MHz CW to produce an average SAR of 14 W/kg. This change in power means redesigning the chambers. Twin-well calorimetry tests will be performed to find the optimum locations for similar average SAR in all the animals.

Substudy 5r: Fabrication of 2450 MHz Circular Waveguide: New Project.

APPLICABILITY: Applicable to improved clinical techniques such as diathermy and certain newly possible uses in medicine of microwave. The use of microwave energy in industrial, scientific and medical applications have increased the population at risk to unknown side effects. The close contact of our laboratory with federal authorities and the international collaboration of scientists will make the setting of standards possible.

052 Mechanism and Treatment of Muscle Contracture in Disabling Diseases—B. Soleus Immobilization Contracture in the Baboon

Principal Investigator:	**Walter C. Stolov, M.D.**	
Status:	**Continuing**	
Dates:	**1971-1982**	
Cost:	**Annual $20,290** **RT Annual $14,540**	**Projected Total $170,000** **RT % of Annual Total 71%**
Annual Report Reference:	**#18, Page 450, R-24**	

OBJECTIVES:

1. To determine the location and nature of changes that occur in muscle that has undergone contracture (i.e., mechanism) such that its ability to lengthen with external tension is reduced, limiting joint range of motion.

   Specifically: To determine the course of development of contracture in the immobilized soleus by frequent monitoring of the range of motion of the ankle during immobilization, and determining the natural course of recovery from contracture by monitoring the ROM of the ankle at frequent intervals during unassisted recovery.

2. Once the mechanism is determined, to specify a treatment(s) likely to reverse the process or preventive measures which will inhibit the process.

Specifically: To determine the effects of chronic increases in vascularity induced by deep heating with shortwave diathermy and chronic positioning of affected muscles in an elongated posture upon the recovery patterns of baboon soleus muscles that have undergone contracture. Parameters examined will include ankle range of motion, total muscle belly length, muscle fiber length, length of tendon aponeuroses, sarcomere size, number of sarcomeres per fiber, and overall muscle architecture.

METHODOLOGY: The animal will have one leg immobilized by external plaster casting with the ankle in full plantar flexion. Range of motion of the ankle will be measured prior to the immobilization, at weekly intervals (at which point the cast must be removed and then replaced) during the five-week immobilization period, and frequently during the recovery phase (up to two months).

Soleus immobilization contracture in the baboon: Mature animals, those that have already undergone their rapid growth phase, will be used to minimize the effects of growth.

Included in the initial phase is the development of a leg model (phantom) that will allow for the accurate monitoring of energy deposition during shortwave diathermy treatment analogous to the experimental animal protocol. Each animal will have one leg immobilized for five weeks. At this point, the immobilized leg will be recast in an adjustable cast that allows for variable positioning of the ankle. In addition, this cast will be fitted with shortwave diathermy coils to allow for 6-8 hours of chronic deep-heating daily. The recovery pattern, as judged from improvements in the ROM of the ankle, will be monitored until either a normal ROM is achieved or sufficient time has elapsed for normal, unassisted recovery.

The soleus muscle will be dissected out and the following parameters ascertained by gross physical examination of the whole muscle; weight, total length, length of tendon aponeuroses of origin and insertion, length of muscle fibers and thickness and width of the muscle. The muscle will be sectioned to ascertain sarcomere size, fiber length, and number of sarcomeres per fiber. Comparison of the muscle that has undergone contracture and the contralateral control will determine the architectural rearrangement that adult muscle undergoes following contracture.

FINDINGS TO DATE: This study was run using a total of three adult male baboons. The first animal was primarily run to develop and perfect the techniques used in this study. Contracture was produced which indicates that after five weeks immobilization there was an average effective reduction in the range of motion of the ankle by 48%. This reduction in the range of motion of the ankle is accompanied by an average of only 10% reduction in the total length of the soleus muscle belly. When viewed from the posterior surface approximately 70% of the change in belly length is due to fiber shortening and 30% due to shortening of the insertion aponeuroses. From the anterior surface, approximately 40% of the muscle belly length change is due to fiber shortening and 60% due to shortening of the origin aponeuroses. In the baboon soleus, however, with the length of the aponeuroses being six to eight times that of the length of the muscle fibers, the 10% change in muscle belly length reflects a 5% change in aponeuroses length and a 33% reduction in fiber length, suggesting again the effect of immobilization contracture is primarily due to alterations in active metabolic structures.

As of the preparation of this report, Part 1 of the methodology is in progress. An adult male baboon has had his right leg immobilized in a plaster cast with the ankle in full plantar flexion. Following the development of contracture the case was removed. The range of motion of the ankle during recovery is being monitored.

APPLICABILITY: Muscle contracture secondary to positioning is best reversed by chronic positioning of the muscle in the elongated posture. Tendon lengthening procedures should be very carefully considered in the face of muscle contracture. In all growing patients with conditions productive of contracture, meticulous periodic posturing of the offending muscles in the elongated posture should inhibit the development of contracture and subsequent loss of functional ability.

053 Control of Spasticity with EMG Biofeedback in the Incomplete Spinal Cord Injured Patient

Principal Investigator: Jeffrey C. Steger, Ph.D.

Status: Continuing

Dates: April 1975-November 1980

Cost: Annual $9,947 — Projected Total $25,000
RT Annual $9,372 — RT % of Annual Total 94%

Annual Report Reference: #18, Page 259, R-119

OBJECTIVES: To determine the efficacy of surface electrode EMG feedback for decreasing spasticity in incomplete spinal cord lesions (where control may be possible).

METHODOLOGY: The effects of biofeedback will be determined by (1) monitoring surface EMG activity near the site of the spasm and providing visual or auditory feedback designed to enhance increased muscle relaxation in that area, (2) measuring spasticity (mean clonic frequency assessed in a standardized procedure—see methods) before and after feedback training to evaluate the extent of its change associated with decreased surface level EMG activity, (3) examining personality characteristics and mood before and after feedback training to determine the psychological impact of learning this self control procedure, and (4) correlating changes in mood and personality characteristics with objective changes in EMG readings, spasticity by the patient, and objective changes in range of motion, ADL capabilities, and activity levels.

FINDINGS TO DATE: This study has been fully implemented and four spinal cord injured individuals have been run through the treatment paradigm. In addition, normative data has been collected on four non-injured subjects regarding gastrocnemius and anterior tibialis EMG activity as correlated to plantar-flexion. Also, the plantar-flexion assessment device (PFAD) has been validated for use with SCI Ss and verified as a clinically useful measure of lower extremity spasticity. The following specific findings have been made:

1. EMG activity in the gastrocnemius is most consistently correlated with PFAD measurements of plantar-flexion (r = .61 to .88, depending upon conditions).
2. Gastrocnemius EMG activity is not necessarily an accurate indicator of plantar flexion : i.e., the correlation between PFAD levels and gastrocnemius EMG can be as low as .15 in certain conditions.
3. The PFAD system is highly reliable in measuring the angle of plantar-flexion with one cm of needle deflection (on the high strip chart recorder) corresponding to one degree of plantar-flexion, with an error rate of less than 1%
4. Twelve 90 minute sessions (20 minutes of EMG feedback per session) of biofeedback allowed three incomplete SCI patients (2 paraplegics and 9 quadriplegic) to significantly reduce the intensity and duration of their lower extremity spasticity as measured by the PFAD.
5. These same three patients (the fourth one is dropped out due to transportation difficulties) also demonstrated significant reductions in the duration and frequency of spasms outside the laboratory by implementing home practice of the feedback techniques.
6. All gains were maintained at one month follow up.

APPLICABILITY: This research may be of real benefit for spinal cord injured who suffer from the secondary disability of spasticity. Spasticity interferes with transfer ability and ability to concentrate on work tasks therefore interrupting vocational and educational goals, and plans. Frequently, the only method available to control the frequent spasms in the legs is heavy medication which causes loss of alertness. A simple treatment technique such as this one, if effective, might be most helpful in helping spinal cord clients return to work.

054 Rehabilitation Indicators: A Method for Enhancing Accountability

Principal Investigator: Wilber E. Fordyce, Ph.D.

Status: Continuing

Dates: October 1974-October 1983

Cost: Annual $3,575 — Projected Total $750,000
RT Annual $700 — RT % of Annual Total 20%

Annual Report Reference: #18, Page 482, R-125

This project, RSA funded, appears nominally within RT-1. Work on the project is centered in RT-1, RT-3, VA Hospital, Brecksville, Ohio, and University of Georgia.)

OBJECTIVES: To develop a set of multi-dimensional (ADL, vocational, social) rehabilitation indicators that will be applicable to a broad range of disabilities (physical, sensory, MR, psychiatric), and in many types of settings (VR, medical rehab, VA, sheltered workshops, etc.).

To enhance accounting for the multi-phasic nature of rehabilitation services by developing indicators that can be used at various points in time.

METHODOLOGY: Rehabilitation indicators will be developed by each of three factor relevant task forces (ADL, Vocational, Social) that meet the following criteria:

1. Items are to be behavioral descriptors,
2. relevant to goals of clients and rehabilitation settings,
3. graded, scalable and potentially measurable,
4. potentially modifiable (behaviors have 'range'),
5. generalizable across sets of clients, not idiosyncratic.
6. The placement of each item must be defined within the hierarchy of the branching system, and
7. the behavior described by the item must be consistent and reproducible.

Rehabilitation indicators may be used to develop client profiles, from which a weighting system may be derived. This proposed weighting system would assist in defining severity of disability functionally and also in helping to develop a weighted closure system.

The developmental phase of the Rehabilitation Indicators project is in its final stages. Two indicator Sets, Social/Leisure and ADL-Mobility, have been completed. The former has been receiving extensive field testing with RT-3 during the past year. Two additional sets, Vocational, and Environmental Status Indicators, are nearing completion.

FINDINGS TO DATE: Working with the RT-1 staff, a linkage system has been developed by which frequency values from each of the three API forms can be equated with the others. This now makes it possible for us to pool our data from a spectrum of disability groups.

Additional work has been done with the API and RT-1 which will not be reported here. The API-F Form has been factor analyzed in the current year, based on some 400+ cases spread among male and female pain patients and male and female spouses.

The factor analytic process yielded 23 factors or item clusters which account for significant amounts of the variance pool and which will be used in subsequent studies. These are: household chores, work, child care, walking, family, self care, friends, academic, financial, observing children or sports, entertainment, auto repairs, home fixup, organization/club, letter writing/receiving, business phoning, escorting or observing children, visiting doctors, bathing - visits by social workers, and visiting.

Individual items not falling within factor item clusters were individually correlated with each factor cluster score. This process has had the effect of identifying items which might be added to a given factor and of identifying items which function as 1-item factors. This latter point is illustrated by the item, frequency of resting/napping. It does not accrue a heavy weighting in any single factor. But it does discriminate among the four criterion groups with great power. In effect, it is a 1-item factor.

APPLICABILITY: The product of this project will be responsive to the increasing demand for accountability, demand based within federal mandates, third party payers, consumer groups and individual clients.

The product will be relevant to providers of services in meeting the demand, in that present accounting systems are inadequate in justly describing input, process and outcomes of rehabilitation.

055 Quadriceps Pacing, Phase III: Relative Effects of Dynamic and Static Exercise Programs on Maximal Isometric Strength and Motor Unit Synchrony

Principal Investigator: Barbara J. DeLateur, M.D.
Status: Continuing
Dates: July 1977-December 1981
Cost: Annual $26,500 — Projected Total $67,000
RT Annual $22,475 — RT % of Annual Total 84%
Annual Report Reference: #18, Page 470, R-126

OBJECTIVES: The first objective is to compare the increase of static strength resulting from different training conditions.

1. a fatiguing task, mixed (dynamic with a hold) versus no exercise
2. a fatiguing task, mixed, versus a nonfatiguing (paced) dynamic task of equal mechanical work
3. a fatiguing task, mixed, versus a fatiguing static task (decay of tension to 80% of initial force)
4. two fatiguing static tasks (decay of tension to 80% of initial force versus decay of tension to 40% of initial force)
5. a fatiguing pure dynamic task versus no exercise
6. a nonfatiguing brief maximal static force versus no exercise

A second objective is to compare the effects of the above types of exercise on the synchrony of motor-unit firing, and to establish whether there is a correlation between the increases in muscle strength with the increases in synchrony.

METHODOLOGY: Sixty subjects will be randomly selected from a population of healthy, sedentary young adult males. Subjects will be chosen who are not in an active physical training program.

At the beginning of the study and every two weeks thereafter for twelve weeks, the maximal isometric force of each quadriceps will be measured on a strain gauge. Subjects will be divided into six groups of five and will perform the tasks listed above. Since subjects are assigned randomly from a relatively homogenous group, this should eliminate major initial differences between groups. However, the most conservative comparisons are from leg to leg within the groups. These latter will be the principal base for comparison.

The dependent variable in all cases is the rate of change of maximal isometric force and the rate of change in the synchronization ratio. Maximal isometric force on both sides will be measured at 90, 60 and 15° flexion on days 1, 11, 21, 31, 41, 51, 56, 57, 58, 59, and 60. This is every ten days sessions during training and on the final five days when there is no training. Motor unit synchrony will be measured on days 1, 28 and 55 (the beginning, midpoint and end of training).

FINDINGS TO DATE: The results indicate very little positive transfer from dynamic programs to maximal isometric strength. There appears to be considerable specificity of training. For example, group three, when tested at 90 degrees of knee extension, showed greater isometric strength on the isometric-trained side than on the dynamic-trained side, but at the other levels (60 and 15 degrees of the fibula from horizontal), the dynamic-trained side did better; apparently actively going through that level in the range of motion was more important than the type of exercise.

The biggest increases in strength (day one of testing compared to the final tests on the last five days) were in group 1 at 60 degrees (dynamic side greater than nontrained side); group 3 at 90 degrees (static side greater than dynamic side); and group 6 at 90 degrees (side trained on the test task greater than the nontrained side).

When one compares the groups 1 and 5, a very important outcome is observed. Both groups 1 and 5 were dynamic, but group 5 was pure dynamic (i.e., had no hold) whereas group 1 was a 7-second dynamic (i.e., includes a full 5-second hold in full extension). Thus there is a substantial isometric component to group 1. Group 5 showed a slight overall average decrement in maximal isometric force, whereas group 1, which had a significant isometric component, showed a large percentage increase at 60 degrees and 15 degrees.

Further replications of the study are needed for the following reasons. 1. Additional equipment: an isokinetic exerciser is now available to us to use for additional outcome measurement. This will not only substantiate the isometric measurments made on the strain gage, but will allow measurement of dynamic torque throughout the range at various speeds which will greatly add to the knowledge of the specificity of the different types of exercise. 2. Additional measurements: some individual measurements have tended to skew the data inexplicably. Further measurements will either substantiate this variability or permit data on these widely different individuals to be discarded. (For example, one subject in group 5 showed a decreased maximal isometric strength over the twelve weeks of the study.) 3. Muscle biopsies: the third reason is that techniques such as closed needle biopsy have now become available to us so that we can make comparisions of actual muscle changes, not simply comparisons of performance.

APPLICABILITY: The single largest amount of time in any spinal cord injured patient's rehabilitation program is spent on strengthening exercise, with the intent of giving patients not only strength but also skills they need for their daily living demands.

It is not known whether there is any exercise program with applicability to all the tasks required of spinal cord injured patients. There is evidence in the literature both for some degree of specificity and some degree of interchangeability in exercise programs. Current practice is to prescribe dynamic exercise (high forces or low) as if it were universally applicable. In order for the patient to learn most efficiently to perform given tasks, it would be useful to know how specific a given exercise program is; at the same time training for each and every task would be expensive and time consuming. The information learned from this study will help the physiatrist to prescribe the most effective type of exercise.

056 Modification of Speech Patterns of Normal and Dysarthric Speakers as a Function of Four Rate Control Strategies

Principal Investigator:	**David R. Beukelman, Ph.D.**	
Status:	**Continuing**	
Dates:	**December 1976-June 1981**	
Cost:	**Annual $10,900** **RT Annual $10,900**	**Projected Total $33,124** **RT % of Annual Total 100%**
Annual Report Reference:	**#18, Page 290, R-128**	

OBJECTIVES: The objectives of this study are to determine the durational, intonational, and stress pattern changes of normal and dysarthric speakers, who are instructed to control their speaking rate through four strategies (1) external pace stimulus provided by the experimenter (2) concurrent external pace stimulus provided by the speaker (3) momentary pause between each word and (4) completion of an utterance within an allotted time. The relationship between speech intelligibility of dysarthric speakers and rate control strategies will be studied.

METHODOLOGY:

1. Normal adult speakers and dysarthric speakers, who speak with less than normal intelligibility, will be included in this study. Ten normal speakers will be included in the first phase of the study, and twenty dysarthric speakers in the categories of ataxic dysarthria and hypokinetic dysarthria will be included in the second phase of the study.
2. During the first phase of the study each speaker will be audio recorded as he produces four sample sentences under one control and four experimental conditions. During the control recording session the speakers will be instructed to read sentences in their habitual conversational manner. The criterion rates under each experimental task will be 60 words per minute, 100 words per minute, and 140 words per minute. During each of the experimental recording sessions, the speakers will be instructed to control their rate according to one of the specific rate control strategies listed under

the objective section of this proposal. (1) **External pace stimulus** (2) **Concurrent external pace stimulus provided by the experimenter** (3) **Momentary Pause** (4) **Time Allotment.** Speakers will be permitted to practice various speaking rates with material other than the target material of the study. When they are speaking at criterion rates, the target sentences will be presented and recorded. Each of the four experimental recording sessions will occur on a different day, so that the learning effects on the speaking performance of the subjects will be reduced. The order of the speaking rates under each experimental conditions will be randomly selected.

Speech samples will be selected such that each potentially will include a unique stress or intonation pattern. Stress and intonation patterns planned are (1) primary stress first word of sentence (2) primary stress last word of sentence (3) sharp raising intonation last word of sentence and (4) gradual rising intonational pattern throughout the sentence.

All speech samples will be recorded on an audio tape recorder, with the microphone placed 10" anterior to the lips of each speaker. The primary acoustic analysis will be completed by an experimental program on a PDP 11 computer. This program simultaneously analyzes fundamental frequency (pitch), intensity (loudness), and the durational aspects of speech and silence during an utterance. From these data the following observations will be taken. (1) Speaking rate, (2) percentage of total utterance time given to pauses, (3) percentage of total utterance time given to articulation, (4) description of the fundamental frequency (intonation) countour and (5) description of the loudness contour.

Phase Two of the study which includes dysarthric speakers from the ataxia and the hypokinetic groups will be very similar to Phase One with the following exceptions: (1) The rate conditions (60, 100, 140 words per minute) may not be required of all patients. An attempt will be made to have the dysarthric person speak at as many of these rates as is possible. Also, they will be asked to speak at approximately 60 and 40 percent of their conversational rate. (2) The speech intelligibility of each dysarthric speaker for each sentence recorded will be judged on the 7-point scale developed by Darley, Aronson and Brown (1969). The types will be rated by three judges.

The entire tapes of two normal speakers, two ataxic, and two hypokinetic dysarthric speakers will be acoustically analyzed a second time and the tapes of two ataxic and two hypokinetic dysarthric speakers will be rated for intelligibility a second time for reliability purposes.

FINDINGS TO DATE: Data has been collected from 30 normal speakers and computer analyzed for fundamental frequency (pitch), intensity (loudness), and duration. Composite performance profiles for these 30 speakers (one profile for 15 males and one profile for 15 females) have been developed. These profiles wil be used as a "norm" against which the performance of dysarthric speakers will be prepared.

Data has now been collected from eight ataxic dysarthric speakers, four spastic dysarthric speakers, and four hypokinetic dysarthric speakers. During the past year data analysis has focused primarily on the performance of the ataxic dysarthric speakers. As a group, these individuals improved their speech intelligibility considerably when speaking rate was controlled (reduced). However, increase in the bizarreness and unusualness of the fundamental frequency and intensity patterns was observed during certain rate control conditions. When "external pace stimulus" and "momentary pause" strategies were used, the bizarreness of the patterns was greater than when the "concurrent external pace stimulus provided by the examiner" and the "time allotment" strategies were used. Clinically, it was necessary to instruct these individuals to de-emphasize adjustments in intensity and fundamental frequency to signal stress. Rather they were instructed to signal stress using adjustments in duration of pauses and speech sounds. Analysis is currently focusing on the hypokinetic dysarthric and the spastic dysarthric speakers. Additional performance samples from these two groups are being collected.

Excellent acoustic analysis systems have been developed. These Analysis systems allow for the collection of both normal and dysarthric data with a completeness that has never been possible before.

APPLICABILITY: The treatment plan of most dysarthric patients include a modification of speech rate, although many authors recommend that the speech rate of certain dysarthric speakers be reduced, and some authors suggest strategies to achieve this purpose. Information about the effectiveness of this strategy has not been determined. The information gathered in this study will be used extensively to select treatment strategies designed to modify the speaking rate of dysarthric speakers.

057 Measurement of Musculature Blood Flow Induced by Microwave Diathermy

Principal Investigator:	**Justus F. Lehmann, M.D.**	
Status:	**Continuing**	
Dates:	**August 1976-April 1981**	
Cost:	**Annual $45,400**	**Projected Total $119,595**
	RT Annual $41,950	**RT % of Annual Total 92%**
Annual Report Reference:	**#18, Page 154, R-134**	

OBJECTIVES: To ascertain the quantitative relationship between doses of microwave diathermy and deep musculature blood flow increase and rate change.

METHODOLOGY: The utilization of clearance rate of radioisotopes from tissue beds as an index of their blood flow has long been done both clinically and experimentally. In the present study the wash-out of injected Xe^{133} a method particularly useful in the measurement of skeletal muscle blood flow 2, 3, 4, 5, will be employed using the human thigh for the diathermy paradigm. The geometrical dispersion of the injected Xe^{133} depot will be imaged by means of a gamma ray camera interfaced with an on-line computer having disk memory allowing replay of the depot clearance event and separate analysis of different regions of interest in time and space. The wash-out image coupled with the measurement of the radioactive clearance by means of scintillation counter will give a quantitative picture of the thigh blood perfusion rate. In addition, the microwave diathermy process comprising both the absorbed energy distribution and the responding blood flow field will be modeled with a finite element digital computer thermal analyzer to define the range of most probable models describing the physiologic response of the thigh to this process. This computer model will consolidate information from a) previous and ongoing tissue substitute model energy deposition experiments, b) transient human thigh temperature data obtained **in vivo** during diathermy application, c) anatomical details regarding the thigh's geometrical distortion under the weight of the direct contact diathermy applicator; those details obtained from cadaver thigh specimiens and d) the aforementioned Xenon blood clearance experiments.

Blood Flow Experiments:

The blood flow measurements will be performed under a variety of conditions and as such the overall study is divided into the following eight experiments. Each injection of the isotopic Xenon solution (Saline and Xe^{133}) will be performed with a very fine hypodermic needle (27-31 gauge) and the volume will, in each case, be 0.1 ml, with a radioactivity (specific activity) of approximately 1 millicurie per cc. All measurement sessions will be preceded by a rest period in which the subject will be recumbent and rested comfortably for a period of 30 minutes.

Exp. 1. ***Preliminary Xe133 Washout Measurements***

Injection of the radioisotope will be performed at a depth of 1.5 cm in the upper third of the anterior aspect of both resting thighs with the subject supine. Both legs will be monitored for isotope wash-out, one by gamma camera and the other by scintillation probe. The wash-out decrement (Slope of the log-plotted count rate vs. time) of these instruments will yield the local value of blood flow rate at the respective sites of injection. The clearance rate will be monitored to determine the time period over which a significant gamma ray count can be detected (not to exceed one hour) One or two deeper injection depots will also be employed in identical experiments to ascertain the effect of tissue attenuation on the maximum useful (i.e. measureable) wash-out period.

exp. 2. **Xe133 Washout with Diathermy Heating and Air Cooling**

This experiment is identical to the preceding Exp. 1 with the following exception: after approximately 15 minutes of imaging/counting the thigh under the camera will be cooled for five minutes (with the camera removed) with an air-cooled direct contact diathermy applicator and subsequently heated with this device (with concurrent cooling) for 20 to 30 minutes or until such time that subject discomfort warrants cessation of heating. Immediately after this diathermy application the gamma camera will be repositioned over the thigh and the wash-out site monitored for blood flow as long as it remains measureable. The opposite thigh will be continuously and simultaneously observed by scintillation probe during the entire experiment to provide a control

measurement as well as an opportunity to study the contralateral perfusion effects of diathermy performed on the opposite limb.

Exp. 3. **Washout with Diathermy Heating Only**
This part is identical to the methods used in Exp. 2 except that no pre-cooling or cooling during diathermy application will be done.

Exp. 4. **Washout with Cooling Only**
This experiment is identical to Exp. 2 except that there will be no heating phase.

Exp. 5. **Simultaneous Measurement of Blood Flow and Tissue Temperatures**
The **in vivo** measurement of the temperature distribution in a subject's thigh will be done by means of temperature sensors (thermistors) mounted on the tips of long thin hypodermic needles which will be inserted laterally into the thigh such that the sensors underlie the centerline of the diathermy applicator at varying depths in the tissue. Four to six of these sensors will be positioned with the aid of X-ray examination so that the sites of temperature measurement are known. All such experiments employing invasive temperature probes involve the implantation of such probes in only one thigh of each subject. Prior to insertion of these temperature probes Xe^{133} solution depots will be injected in both thighs as described in Exp. 1; the subsequent wash-out will be measured periodically to determine the effect of the probes on the thigh blood perfusion field.

Exp. 6. **Blood Flow and Temperature Measurement with Diathermy Heating and Cooling**
This experiment employs the methods described in parts 2 and 5 concurrently in order to gauge the effect of diathermy heating and cooling on the simultaneous blood flow and temperature fields underlying the diathermy applicator. This method will provide a significant advantage over the previous experiments in that the observed temperature levels will provide a means by which the scintillation counter(s) can be positioned for wash-out determinations at moments of particular interest in the diathermic blood flow response; for example, at the moment of peak flow. This method will also provide a means of investigating whether or not the microwave diathermy process can be utilized to override the cooling effect of augmented blood flow and thereby establish the feasibility of controlling the tissue temperatures such that they are maintained in the "therapeutic range."

Exp. 7. **Blood Flow and Temperature Measurement with Heating Only**
The methods of Exp.'s 3 and 5 will be combined to study the effect of heating only on temperature and perfusion rates.

Exp. 8. **Blood Flow and Temperature Measurement with Cooling Only**
The methods of Exp.'s 4 and 5 will be combined to study the effect of cooling on temperature and perfusion rates.

II. INSTRUMENTATION AND MATERIALS

A. A dual probe, NaI (sodium iodide) crystal scintillation counter will be used to measure tissue gamma ray emission levels which are proportional to the concentration of Xe^{133} at the injection depot. These measurments yield local blood flow rates.

B. A high resolution, circular field gamma ray camera and companion imaging system will be used to image and count XE^{133} wash-out in the thigh. This system is connected to a disk memory on-line computer as previously described.

C. A 915 MHz air-cooled direct contact diathermy applicator that has been designed and tested in our laboratory will be used to heat the thigh. A 915 MHz General Electric Magnetion has been adapted to allow the operator to vary the output microwave power level from 5 to 100 Watts. The power level used in the experiments will be approximately 40 Watts net. The direct contact applicator has a cold air supply/pump system that permits the operator to select and maintain the desired temperature and flow rate of cooling air. This air system is also instrumented to continuously show the relative humidity of the air stream.

D. A CDC 6400 Digital Computing System and a heat transfer thermal analyzer program developed in conjunction with the University of Washington Department of Mechanical Engineering will be employed in the computer modeling of the thigh diathermy process.

E. Radioisotope: Xenon 133, a very weak-emitting, low energy (gamma ray) radioisotope which has been safely and routinely used for years in clinical and experimental blood flow and volume

measurements will be injected in saline solution at specific activity levels of approximately 1 millicurie/cc. It will be injected into the quadriceps through very thin (27-31 gauge) hypodermic needles, too small to cause significant bleeding. The half-life of this isotope is 5½ days, though the Xe^{133} is expelled from the body in a matter of minutes through the lungs.

FINDINGS TO DATE:

I. HUMAN DIATHERMY BLOOD FLOW EXPERIMENTS EMPLOYING SIMULTANEOUS INVASION TISSUE TEMPERATURE MEASUREMENTS:

A. A period of 15 minutes after the Xenon injection is required to insure that the local hyperemic reaction due to the injection will have subsided; a longer period of recovery from the trauma of the insertion of the temperature probe catheters, while expected, was not indicated by the data.

B. Contrary to previous thinking as implied by the protocol outlined in the Exp. 5 description, it was found that the microwave field had minimal heating or perturbing effects on the scintillation counter. This finding enabled MBF to be continuously monitored throughout the cooling and diathermy processes rather than requiring an interruption of counting during the heating periods as was previously done for Exp's 1-4.

C. A "critical temperature" (CT) behavior is always seen during localized diathermy (if sufficient power is employed) such that MBF's remain at or near resting levels until a certain temperature threshold is exceeded (in the neighborhood of 42°C) at which time peak blood flow responses are precipitiously induced bringing tissue temperatures down markedly.

D. The relationship of these peak MBF values to their respective "triggering" temperatures appears to be approximately linear; this is to say that the vasodilatory response seems to increase in proportion to CT level.

E. Peak MBF's of approximately 40 ml/min/100g have been measured, these slightly higher than previous estimates of maximum possible MBF responses.

F. It has been found that it is possible to override, to the degree desired, the heat dissipation effects of perfusion after the onset of peak CT blood flows, i.e., tissue temperatures may be brought back up into the "therapeutic range" of 42-45°C by judiciously increasing the microwave power. At the current level of knowledge it is only prudent to attempt this "override" when deep tissue temperatures are being monitored.

II. COMPUTER MODELING OF DIATHERMY

The blood flow/temperature measurement experiments just described were performed with great attention given to maintaining a high level of quantitative control over the thermal and geometrical aspects of the treatments; this effort toward the end of thoroughly defining the energy interactions in the limb. The quantitative aspects of the blood flow/temperature or blood/power-dose relationship are, as mentioned in "Methodology", to be checked and explored further via thermodynamic computer models of specific human diathermy experiments. Toward this goal (a) the necessary modifications in the parent thermal analyzer program have been made, sample hypothetical problems have been tested, systematically studied (see Figure 4 and 5) and reported in the literature[13] and (b) three numerical models of specific experiments have almost been completed. In addition, (c) the basic thermodynamic and heat transfer principles applicable to the energy analysis of diathermy and thermotherapy in general have been defined and also presented in the literature[14]. The tissue surrogate models needed for the determination of the microwave energy deposition patterns for these specific computer models are now also near completion.

APPLICABILITY: The information that will be obtained can be used by engineers to design improved applicators, to test their designs and also by physiatrists and physical therapists to prescribe and carry out more effective diathermy treatments.

058 Quantification of Biomechanical Function of Ankle-Foot Orthoses in Hemiplegia

Principal Investigator: Justus F. Lehmann, M.D.

Status: Continuing

Dates: December 1977-August 1980

Cost: Annual $17,595 — Projected Total $43,300
RT Annual $13,340 — RT % of Annual Total 75%

Annual Report Reference: #18, Page 185, R-136

OBJECTIVES: To evaluate the biomechanics of ankle-foot orthoses and their effect on the gait of persons with upper motor neuron paralysis and/or hemiplegia. The first phase of the evaluation will measure the moments and forces required to maintain the paralyzed foot and ankle in a functional position throughout the gait cycle. The second phase will determine the effect of these forces on knee stability throughout the gait cycle by measuring the moments developed around the knee. This will allow us to establish design parameters for ankle-foot orthoses and to relate these to the function provided by orthoses currently manufactured. With this information, a method may be developed to prescribe orthoses according to a discrete set of quantitative criteria.

METHODOLOGY: We will measure the ground reactive forces, the forces carried in the orthoses and the kinematics of the gait cycle. All of these variables will be measured through the entire gait cycle, i.e. from heel strike to heel strike. The ground forces will be measured by a force platform which is standard equipment in our laboratory. This system measures the orthogonal components of force applied to it, from which the location and magnitude of the force vector leaving the platform can be calculated. The forces in the orthoses will be determined using strain gauge transducers to measure the moments in the uprights throughout the gait cycle. The kinematic data will be measured by using a 35 mm motion picture camera to record the position of the limb in space, with markers identifying the axis of rotation of the knee and specific locations of the foot. These spatial data will be synchronized with measurements of the ground reactive forces and the moments in the orthoses. Kinematic data will also include stride length, cadence and phase of gait. Flexion angle of the knee is also recorded.

With the ground reactive force data and the kinematic data, the total moments in the leg and orthosis can be calculated. Then, by subtracting the moments measured in the orthoses from the total moments, the moments in the limb can be calculated. In addition, using the vector calculated from the ground reactive forces and the kinematic data describing the position of the knee axis, the flexion-extension moments at the knee can be calculated. Other measurements such as stride length, cadence and phase of gait are used as control variables.

The measurements described will be made on ten hemiplegic patients with varying degrees of spasticity. We will determine the ranges of force necessary to maintain the patient's foot in function positions during the stance and swing phase. We will then apply an orthosis which provides only the force defined in the measurement, re-evaluate his gait for knee stability and specific kinematics.

FINDINGS TO DATE: The second series of experiments with hemiplegic patients have been concluded. The evaluations included several versions of the Seattle orthosis, the Rancho orthosis, the Teufel orthosis, and two versions of the Engen orthosis. At this point, total data reduction for 2 normal and 7 hemiplegic subjects has been completed. Preliminary evaluation indicates that the different orthoses have varying and possibly predictable effects on the angular control provided at the ankle complex. A trend in the amount of ankle angle control provided by each type of orthosis seems to be apparent and may provide a method of evaluating the relative stiffness of the orthoses. Differences are also shown by the data representing the effects of the orthoses on knee moments; the various orthoses have different effects on the control of the position of the knee center and the location of the ground reaction forces on the sole of the foot. The orthoses also affect the timing factors of the gait, such as lengthening or shortening of the midstance phase depending on the plantar-dorsiflexion stiffness of the orthosis. For a more detailed analysis, further data reduction is required and is currently in progress.

APPLICABILITY: The ability of the hemiplegic patient to walk can most significantly alter his ability to integrate into the community. This study aims at the development of a more sophisticated approach to bracing the patient. By quantification of the loss of function as well as the degree of function which is restored by various designs of orthoses, the needs of each hemiplegic patient can be met more selectively, and the danger of over or underbracing the patient will be lessened.

A large segment of the population would be affected, since the information would apply not only to the 2 million stroke victims but also to other patients with upper motor neuron lesions.

059 Investigation of Predictors of Change or Treatment Progress in Behaviorally-Based Treatment Program for Selected Cases of Chronic Pain

Principal Investigator: Wilbert E. Fordyce, Ph.D.

Status: Continuing

Dates: July 1977-October 1982

Cost: Annual $26,950 — Projected Total $70,850
RT Annual $10,850 — RT % of Annual Total 40%

Annual Report Reference: #18, Page 228, R-139

OBJECTIVES: Among patients identified as having significant amounts of operant pain and selected for a behavioral-based treatment program, the study will assess relationships among a series of measures of change in patient performance or activity level at the beginning and end of treatment and at selected follow-up points; relationships between medical descriptive data, MMPI scores and pretreatment activity baseline measures, on the one hand, and amounts of change and durability of change through follow-up, on the other, in order to identify predictors of amounts of treatment gains; and changes between pre-and post-treatment estimates of health care utilization costs.

METHODOLOGY:

Subjects: The population studied will be persons with chronic pain problems who have been accepted for treatment in the operant pain treatment program in the Physical Medicine and Rehabilitation Service. These are persons 20-70 years of age who have a chronic pain problem of at least six months' duration which interferes significantly with their functional activity level. In addition, these patients have a significant component of operant pain; i.e., there is a learning component to the pain problem - as evaluated by a psychologist experienced in the evaluation of operant pain, as well as one or more physicians experienced in evaluating pain problems.

Materials: The Pain Data Protocol, Activity Diaries, physician evaluation data, and the Minnesota Multiphasic Personality Inventory (MMPI), and daily records of physical and occupational therapy activities will be used.

Procedure: Patients who are selected as potential participants in the Operant Program are brought into the hospital on the Physical Medicine and Rehabilitation Service. For 7-10 days there is a "baseline" period where baseline levels are taken for activity in physical and occupational therapy and, if necessary, there may be further evaluation of the pain problem. During this period patients will be given their usual medication on an "as needed" basis, with records kept of amount given and time pattern usage. At the end of the baseline period a treatment program will be drawn up, the program will be explained to the patient and his/her significant family member or friend, and, if accepted by the patient and friend, treatment will begin.

The inpatient treatment phase generally lasts 6-8 weeks, during which the patient participates in physical and occupational therapy activities which start out in small amounts and increase daily, vocational counseling and job station activities, programmed recreational activity, sessions with psychologists. Medication is put into "cocktail" form; i.e., put into a cherry syrup, vehicle is given on time-contingent basis, and amount of medication in the vehicle is gradually reduced. Patients are positively reinforced for increased activity for recreation activities, for socialization. Pain complaints and nonverbal indications of pain are given neutral responses.

At the end of the inpatient phase, a one-to-two week outpatient program goes into effect. The patient initially maintains his/her inpatient schedule but lives outside the hospital and comes in daily. This is gradually generalized to include more away from the hospital activities.

Data during treatment will be collected as follows. Activity diaries will be completed by the patient daily and collected weekly throughout the inpatient and outpatient phases of the program. Physical and occupational therapy activities will be recorded at each session and records will be kept. An MMPI will be completed by the patient at discharge.

Follow-up data will be collected at three months, six months, one year and two years post-discharge. At three months', one-year and two-year follow-up, a week of activity diaries will be completed by the patient, and the follow-up section of the Pain Data Protocol will be administered to the patient (including data on health care utilization, income, activities). At those times, the Social/Leisure Form and a brief questionnaire recording vocational or employment status will also be completed.

Data Analysis: The continuous score variables can be assessed by correlational analysis.

Variables yeilding non-continuous data are likely to require non-parametric methods for analysis. The precise methods to be used will in turn be influenced by the size of the "n" and by sex distribution considerations. Statistical consultation will be drawn upon to assist in selecting the most appropriate methods for analysis of those data.

Such items as number of hospitalizations, number of surgeries, number of physician contacts, will require non-parametric item tally comparisons. Other measures such as days in hospital and dollars for medications, and dollar measures derived from estimates of costs of the various health care utilization activities can be analyzed by simple t tests, comparing pre- with post-treatment data.

FINDINGS TO DATE: A combination of factors has resulted in further delay in accumulation of sufficient data to complete this process. The principal delay stems from intense competition for beds within the hospital. The result has been that the patient flow rate has been significantly lower than anticipated. As of this writing, 51 patients have entered the "pipe-line" on whom there are adequate data but only 21 have completed one or two years of follow-up. Part of the attrition results from the eight-month gap in data collection because of budgetary limitations reported last year. But, since then, it has been a problem of competing with demand for beds from spinal cord injury patients and other disability groups. Effective 7/1/80, administrative reorganization within the hospital ensures a more steady flow of patients into the operant program and therefore of data flow.

In addition to continuing to accumulate data from patients selected and undergoing treatment, as well as follow-up on discharged patients, the work on analysis of elements of the PDP reported in Projects R-125 (Rehabilitation Indicators) and R-140 (Relationships among a Set of Behavioral Measures of Chronic Pain) have contributed to this project. Most software procedures are now complete for data analysis. The data reduction process of the API-F form now makes it possible to assess more succinctly and descriptively the changes in family activity patterns as a consequence of treatment.

APPLICABILITY: The emergence and now rapidly widening acceptance of behavioral methods in both the evaluation and treatment of chronic pain suggests the importance of developing reliable and valid measures of the behavioral phenomena associated with chronic pain and of assessing the relationships between measures of those phenomena and other patient characteristics such as medical findings, history of treatment, and demographic and social variables.

060 Relationships Among a Set of Behavioral Measures of Chronic Pain

Principal Investigator:	**Wilbert E. Fordyce, Ph.D.**	
Status:	**Continuing**	
Dates:	**July 1977-October 1982**	
Cost:	**Annual $14,375** **RT Annual $6,325**	**Projected Total $73,250** **RT % of Annual Total 44%**
Annual Report Reference:	**#18, Page 240, R-140**	

OBJECTIVES: To study the inter-correlations of a set of behaviorally-based measures by using a "comparable form" reliability assessment strategy. This objective can help to assess the utility of behavioral measures and to identify redundancies in measurement.

To study the relationships between the behavioral measures and pertinent other information about the patients. This objective can help clarify the nature and extent of relationship between medical and behavioral measures and between personality test patterns and behavioral measures in the chronic pain patient.

METHODOLOGY: All subjects will be patients referred for evaluation of chronic pain problems. Each patient will be examined by one or more physicians. Data are obtained from a combination of patient and interview recording. Patients record responses to the MMPI; record body position, medication consumption and pain ratings on the diary forms; and complete checklists and activity pattern forms under supervision of an interviewer. In addition, an interviewer will record from interview data on treatment history and demographic variables.

Eventually some form of multivariate analysis is anticipated. But the present proposal is limited to inter-relationships; accordingly, the major statistical approaches used have been selected according to whether the measures under consideration are ordered into nominal scales, dichotomous variables, or more or less continuous data.

FINDINGS TO DATE: Data collection has continued during the past year. Since 10/1/79, 55 cases have been added to the data pool, bringing the total to 446 patients and 193 spouses, on which there are complete Pain Data Protocol's (except for the medical form), MMPI's, and diaries. In addition, these data have been entered into the computer and analysis is underway.

APPLICABILITY: There are not as yet available precise numbers indicating the rate or percentage of adults having chronic pain problems. The evidence seems clear that there are many and that they present a major burden in suffering, in health care utilization costs, and in expenditure of wage replacement funds. Moreover, the load is particularly high in the labor force, the population which is of particular interest in rehabilitation.

This project addresses itself to one of the basic problems in the management of chronic pain; namely that of identifying the score and extent of the problem and of how to assess treatment programs.

061 Feedback Treatment of Flaccid, Spastic, and Ataxic Dysarthric Speakers

Principal Investigator:	**David R. Beukelman, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1978-September 1982**	
Cost:	**Annual $16,375** **RT Annual $13.500**	**Projected Total $48,500** **RT % of Annual Total 82%**
Annual Report Reference:	**#18, Page 305, R-149**	

OBJECTIVES: The general objective of this study is to develop and evaluate treatment procedures for flaccid, spastic, and ataxic dysarthric speakers. The specific objectives are to:

1. Add to our evaluation capability by developing a system designed to objectively measure and visually display the status (timing and position) of the "valves" of the speech mechanism during speech activity.
2. Develop procedures for teaching (a) coordination of the respiratory system and other speech mechanism activity, and (b) improved respiratory support for speech.
3. Develop procedures for teaching coordination of vocal vibration (phonation) initiation and cessation during speech.
4. Develop procedures for improving articulatory (jaw, tongue, velopharyngeal mechanism) coordination and movement during speech.

METHODOLOGY: The Department of Rehabilitation Medicine has authorized the purchase of basic laboratory equipment which will permit measurement of the following parameters: air pressures (air flow rates, acoustic wave forms, and some movement parameters).

Phase I: In Phase I of the current study, the system to measure air pressures will be secured and organized to measure neurophysiological events which occur during the speech act. The speech samples and data interface decisions worked out such that the system can reliably and comfortably gather data from dysarthric speakers and display data on-line for feedback purposes.

Phase 2: In Phase 2, 30 flaccid, spastic and ataxic dysarthric speakers will be followed closely as they are involved in speech treatment programs. The current research will be directed toward development of feedback treatment procedures which will be used to supplement the more traditional procedures. Initially, the following will be attempted.

1. Respiratory control.
   a. Visual feedback of respiratory volume level, so that patients can coordinate respiratory activities and upper airway activity during speech.
   b. Visual feedback of the level of intra-oral air pressure obtained in the oral cavity during non-phonated segments (in that situation, oral air pressure equals air pressure below the vocal folds) for a period of five to ten seconds. In this way patients will receive practice in maintaining air pressures necessary for speech in the presence of an air leak (a tube placed in the lips) and thus simulate the respiratory requirements during speech.
2. Laryngeal and respiratory control.
   a. Visual display of the acoustic wave form and respiratory volume level data to assist the patient in the coordination of phonation and respiration.
   b. Visual display of the presence or absence of acoustic wave form for aphonic dysarthric patients.
   c. Visual display of the volume velocity of air flow through the oral tract as an indicator of lack of proximal contact of the vocal folds, and thus breathy voice quality.
3. Velopharyngeal port.
   a. Simultaneous, visual display of oral air pressure and nasal air flow during non-nasal speech sounds. If velopharyngeal closure is adequate for these sounds, the volume velocity of nasal air flow should be zero or near zero in the face of intraoral air pressure.
   b. Proper fitting of palatal lifts in dysarthric patients based on intraoral air pressure and nasal air flow data.
4. Articulation.
   a. Visual display of the initiation and release of intraoral air pressure associated with consonant sounds in relationship to other parameters of the speech mechansim (respiration or phonation or velopharyngeal closure).

During the treatment of these patients, data will not only be taken with the system described in this project, but the following information will also be collected: speaking rate, speech intelligibility, articulation accuracy as well as the analysis of the acoustic parameters of speech which were developed for R-128, i.e. intonation, stress and duration of words and pauses.

FINDINGS TO DATE:

1. Phase I of the current study has been completed; that is, the system described in the project has been purchased and assembled to measure physiological speech events. Feedback information can be delivered to patients through the visual mode. Permanent write-out capability has been integrated into the system.
2. Five patients have completed the respiratory control and the laryngeal-respiratory coordination aspects of the program. The response of three of the five patients has been very encouraging. Improvement in respiratory pattern and improvement in respiratory phonatory coordination has been clearly evident and has generalized to conversational speech. The fourth patient was able to modify his reflexive respiratory patterns and to improve the coordination between respiration and phonation while attached to the feedback system, but demonstrated minimal ability to generalize. The fifth patient was unable to tolerate this type of treatment and became agitated to the point where the treatment program was discontinued.

3. Four patients have completed the feedback program to modify velopharyngeal port function. All of these patients were dysarthric speakers. None of the patients successfully modified their nasal emission patterns to the extent that their speech was not noticeably improved. Three of these patients went on to have a palatal lift fitting. The physiological speech evaluation system was used to monitor the steps in the fitting process. The fourth patient had very mild velopharyngeal port dysfunction and rejected the offer of a palatal lift.
4. One patient has completed a feedback program designed to increase mandible excursion during selected speech efforts. The results of this program were positive in that jaw excursion was increased. The room for tongue activity during speech was improved. The improvement in speech pattern was generalized beyond the treatment setting.
5. One patient is currently involved in a training program to coordinate phonatory-articulatory activity so that phonation does not occur during voiceless sound production and does occur during voiced sound production. The feedback from a microphone shown visually on the oscilloscope is useful in illustrating performance patterns to the patient. Some generalization from the feedback condition to non-feedback training in the treatment session has occurred.

APPLICABILITY: The results of this project will improve dysarthria treatment procedures by increasing the amount and detail of feedback provided to speaker and clinician.

062 Interpersonal and Vocational Consequences of Head Injury

Principal Investigator: Edward J. O'Shaughnessy, M.D.

Status: Continuing

Dates: April 1978-May 1981

Cost: Annual $17,250 — Projected Total $32,000
RT Annual $10,350 — RT % of Annual Total 60%

Annual Report Reference: #18, Page 489, R-154

OBJECTIVES:

1. To survey a specific population of patients with closed head injuries to determine if there exists in this population sufficient cognitive deficits to impair post-trauma interpersonal and vocational relationships.
2. To determine, if such cognitive deficits do in fact exist, whether they warrant interventionary services.

METHODOLOGY: The patient population will be identified from the daily hospital admission sheet at Harborview Medical Center and will consist of those head injured patients who, for at least 24 hours following injury, demonstrate lethargy, mental confusion, unconsciousness, amnesia, or disorientation, who were employed at the time of the traumatic event, and who were discharged from the hospital to their own care within two weeks.

Patients will be interviewed and tested within one week of injury using sub-tests of WAIS (information, comprehension, arithmetic, similarities, digit span, digit symbol, picture completion, and block design) and the Wechsler Memory scale using the paired associate learning test. In addition, the Edwards Personality Inventory will be used. Data related to the patient's premorbid demographic social, educational, and vocational levels will be elicited from significant others using selected sections of the Regional Spinal Cord Injury Center data protocol forms and the social leisure forms from the Rehabilitation Indicators Project.

Testing will be accomplished again at six months post injury by the psychometrist who will visit the patient and significant others in their home. Analysis of data will be by a descriptive and correlational format. The performance on intelligence tests obtained soon after injury will be correlated with indices of severity of disability and need for services.

"Severity of Disability" and "Need for Services" will be defined on the basis of the social, vocational, demographic, and personality indices of change in a negative direction, e.g., significant loss of income, breakup of the family, loss of job, reduction in academic achievement, reduction in social leisure activity and the absolute magnitude of rated change on the Edwards Personality

Inventory. As these will be individuals having experienced relatively mild brain injuries, it is also expected that the absolute change in intelligence test scores will be a useful index of severity of injury. That is, the greater the discrepancy between intelligence test performances the more severe the damage. This too will be correlated with Severity of Disability and Need for Services.

FINDINGS TO DATE: Fifty patients have now been initially evaluated. There are still fourteen patients to be evaluated at the end of six months. Where this has been completed the data will be subjected to analysis. It is anticipated that this study should be completed by March 1981.

APPLICABILITY: If the objectives are attained as proposed, this would result in a valid basis for construction of vocationally oriented interventions.

063 Relationship of Skin Surface, Subcutaneous and Deep Tissue Temperature on Nerve Conduction Velocity in Normal Subjects

Principal Investigator: **Eugen Halar, M.D.**

Status: **Continuing**

Dates: **June 1978-December 1980**

Cost: **Annual $8,625** **Projected Total $27,000**
RT Annual $0 **RT % of Annual Total 0**

Annual Report Reference: **#18, Page 356, R-155**

OBJECTIVES:

1. To determine the effects of skin surface, subcutaneous and deep tissue temperature on tibial, peroneal motor and sural sensory nerves.
2. To determine an equation from which NCV's at a standard skin temperature of 32°C could be calculated from obtained NCV's taken at various temperatures.
3. To determine whether skin surface temperature could be reliably used to correct NCV values.
4. To determine the effect of aging on the different tissue temperatures, measured NCV's, and NCV temperature relationships.
5. To determine the effect of limb temperature variation on actual terminal latencies and "residual" latencies.

METHODOLOGY: Twenty-five healthy subjects (10 males, 15 females) ranging in age from 19-87 years (mean = 33.6, SD-21.1) were tested for NCV of tibial motor and sural sensory nerves using standardized methods described in the literature. Concomitantly, measurements of skin, subcutaneous and intramuscular temperature were determined, first at ambient temperature and then at three different skin temperatures (26, 28, and 30°C), produced by cooling of the lower extremity for 20 minutes.

Each subject's calf length was measured from the distal popliteal crease to the medial malleolus and divided into three equal parts. The sight for both intramuscular and subcutaneous temperature measurements, site 1, was as at the upper/middle third point of the calf length, which was usually over the medial head of the gastrocnemius muscle. Skin temperature was monitored at site 1, and at site 2, the middle/lower third point of the leg, which was usually 15 cm above the medial malleolus and site 3, at the level of the medial malleolus.

All NCV's were determined using supramaximal stimulus of 0.2 msec duration with EDX-1 electromyograph. Subcutaneous and intramuscular tissue temperatures were recorded using a Honeywell Visicoder Light Oscilloscope (Model 906B) with a paper recorder and a specially designed thermistor bead implanted in a 20 gauge needle. Skin surface temperature was monitored with a Telethermometer (Yellow Springs Instrument Co).

The second part of this study was carried out on a group of 20 healthy subjects (11 male, 9 female) ranging in age from 21-72 years (mean = 44, SD 17) who were tested concomitantly for peroneal NCV, skin surface and near nerve temperatures bilaterally. Peroneal motor NCV's were performed

at ambient temperature (mean = 26°) and tissue temperatures were determined after cooling of the LE. below the knees, in a water bath (14-24°C) for 20 minutes to a skin temperature of about 26°C. The subject's legs were then allowed to warm gradually to approximately 28 and 29° for the third and fourth set of NCV's and temperature measurements.

Skin temperatures were monitored at three sites, just anterior to the lateral malleolus, 15 cm above the lateral malleolus (which was usually at the midpoint of the leg) and over the head of the fibula. Near peroneal nerve temperature was measured at 15 cm above the lateral malleolus, placing the thermocouple as close as possible to the peroneal nerve.

An additional 20 normal (10 male, 10 female) subjects ranging in age from 21-72 years (mean = 42,SD 18) and 20 diabetic patients (15 male, 5 female) ranging in age from 21-65 (mean = 53, SD 13) were serially tested three times at 7 to 10 day intervals. Each testing session included measurements of bilateral peroneal NCV's and skin temperature monitored at 15 cm above the lateral malleolus. In those diabetic patients (n = 12) who were willing, near peroneal nerve temperature was also recorded. The diabetic patients did not have clinical signs and symptoms of neuropathy and were treated with insulin (n = 10), oral agents (n = 5) and diet alone (n = 5). After each NCV determination, two different sets of NCV's were calculated for each subject; nontemperature corrected NCV and temperature corrected NCV using the correction formula developed in this study.

Peroneal NCV's were determined with supramaximal stimulus of 0.2 msec duration using a DISA 1500 electromyograph. Near nerve and skin temperatures were determined using a DISA 14G05 biotemperature unit (DISA Electronics, Marina Del Ray, CA 90291).

FINDINGS TO DATE: In the first part of this study, the relationship between skin, subcutaneous and intramuscular temperature with tibial and sural NCV and H-reflex latency was investigated. Twenty-five normal subjects were tested.

NCV, skin, subcutaneous and intramuscular temperatures were measured first at ambient temperature and then at skin temperatures of approximately 26, 28, and 30°C produced by cooling of the lower extremities. Results revealed a linear correlation between skin, subcutaneous and intramuscular temperatures ($p < .025$). Changes in NCV correlated significantly with the corresponding changes in skin, subcutaneous and intramuscular temperatures ($p < .001$). H-reflex latency did not significantly correlate with temperature.

We recommend that tibial and sural NCV's be corrected from skin temperature measured 15 cm above the medial malleolus to a standard skin temperature of 32°C using the following equations found by regression analysis:

Tibial NCV correction: NCV corrected = 1.1 (32-skin temp°C)+(NCV m/sec)
Sural NCV correction: NCV corrected = 1.7 (32-skin temp°C)+(NCV m/sec)

In the second part of this study we tested 20 normal subjects for peroneal NCV's, skin and near nerve temperatures bilaterally at ambient temperature (mean = 26.6°C) and then at skin temperature of 26, 28, 29°C obtained by cooling of the lower extremities for 20 minutes. Secondly, we tested serially peroneal NCV's concomitantly with skin temperature measured at 15 cm above the lateral malleolus in 10 normal and 10 diabetic subjects. The testing was done three times every 7-10 days, using the same technique. The results show a linear relationship between skin temperature and near nerve temperature ($p < .001$) measured 15 cm above the lateral malleolus. Both skin and near nerve temperature correlated significantly with NCV of peroneal nerve ($p < .001$). Peroneal NCV was altered 2.0 m/sec per °C change in skin and nerve temperature ($p < .001$). Using the formula:

Peroneal NCV corrected-2.0 (32-skin temp°C)+(NCV m/sec) for temperature correction of peroneal NCV to 32°C revealed that temperature corrected NCV's were not different when compared to noncorrected NCV's in normals, while temperature corrected NCV's were less variable in diabetic patients ($p < .05$). These results indicate that temperature correction of NCV's should be used routinely in clinical NCV testing.

Futher studies are currently being done to determine temperature correction formulas for the median and ulnar nerves.

APPLICABILITY: Since temperature corrections are used in the every day practice of the electrodiagnostician, standardizing NCV's to a temperature of 32°C would reduce variation in NCV reporting in clinical and research application.

These findings would be used in our laboratory, at the University of Washington, and nationally in other electrodiagnostic laboratories. Also, information about the effect of age on NCV will be provided to electrodiagnostic laboratories in this country.

The findings would enable the electrodiagnostician to standardize his NCV's to reduce the variability in NCV reporting. In this way an NCV could better be judged as abnormally slow.

064 Special Project in Multiple Sclerosis Rehabilitation

Principal Investigator: George H. Kraft, M.D.

Status: Continuing

Dates: October 1978-September 1981

Cost: Annual $188,852 — Projected Total Not Specified
RT Annual $5,175 — RT % of Annual Total 3%

Annual Report Reference: #18, Page 552, R-157

OBJECTIVES:

1. To establish coordinated relationships among the Washington State Department of Vocational Rehabilitation, local chapters of the National Multiple Sclerosis Society and the University of Washington's Department of Rehabilitation Medicine and Multiple Sclerosis Clinic.
2. To identify the services necessary for the optimal vocational adjustment of individuals with multiple sclerosis.
3. To explore the rehabilitation needs unique to individuals with multiple sclerosis.
4. To increase the number of multiple sclerosis clients seen by VR counselors in Washington State and to increase the number of those clients successfully rehabilitated.

METHODOLOGY: Activities planned for the project will be in the areas of (a) research, (b) education and (c) service coordination.

Research: The focus of project research is the "Questionnaire on Medical and Social Service Needs of Individuals with Multiple Sclerosis, 1979." Hospitals, clinics, physicians, and local chapters of the NMSS have contacted MS patients from their records requesting them to participate in the study. Patients wishing to do so are sent the questionnaire and asked to fill it out and return. Data will be checked, coded and analyzed. Due to MS symptoms which may prohibit patients from satisfactorily completing the questionnaire, some patients will be interviewed.

The questionnaire will give data relating disability levels and symptomatology to medical, social service and vocational needs of a population of MS patients and enable researchers to select individuals for further study in an effort to determine the vocational and psychological adjustment to MS. Project staff will consult with other Center researchers in the area of MS speech pathology, occupational therapy, bioengineering, and bowel and bladder management.

FINDINGS TO DATE: Activities undertaken to accomplish the objectives include meetings and discussions with agencies, educational efforts aimed at improving the knowledge of rehabilitation professionals who serve multiple sclerosis clients, conducting research into the medical and social needs of multiple sclerosis clients, following MS clients through the vocational rehabilitation process so as to become more aware of their special needs, collecting baseline data on vocational rehabilitation services received by MS clients, and providing medical services through the University of Washington Multiple Sclerosis Clinic.

Project related research efforts have been directed into two related areas: application of existing knowledge of MS to rehabilitation and the search for new knowledge which can improve MS rehabilitation. Development and revision of the **Handbook on Multiple Sclerosis Rehabilitation** has been one outcome.

Preliminary research information was compiled by conducting a survey. The questionnaire is

currently being sent to MS patients in western Washington. Data will aid in understanding the specific medical and social service needs of MS patients, their vocational decisions, the extent of disabilities produced by MS, our ability to predict the future course of the disease in individual cases. The survey of MS patients may also provide the impetus for developing an MS patient registry and will also serve as the basis for selecting patients to study. Follow-up studies are currently being planned.

APPLICABILITY: From this project a model plan for MS rehabilitation may be developed. This plan would have as its components effective cooperative arrangements between public and private agencies and knowledge of the services necessary for optimal vocational adjustment of MS clients. Data gathered in the study should make it possible to determine the cost-effectiveness of vocational rehabilitation in MS. The project will be a demonstration of how a cooperative arrangement can be worked among different public and private agencies concerned with the same problem. More individuals with MS will have a greater access to VR, medical and other patient services which are expected to meet the needs of MS patients more nearly than those presently offered.

065 Evaluation of Low-Cervical, High-Thoracic Orthoses

Principal Investigator:	**Justus F. Lehmann, M.D.**	
Status:	**New**	
Dates:	**June 1978-December 1980**	
Cost:	**Annual $11,500** **RT Annual $10,350**	**Projected Total $20,000** **RT % of Annual Total 79%**
Annual Report Reference:	**#18, Page 189, R-147**	

OBJECTIVES: The objective of this study is to compare in normal individuals the various available orthoses used for stabilization of low-cervical, high-thoracic fractures including the one now used by the University of Washington to determine which of the orthoses prove to be the most effective in each of the following areas: (1) ability to minimize vertebral displacement and rotation, (2) ease in donning and doffing, (3) good hygiene, (4) ease in checking for pressure problems.

METHODOLOGY: The general approach of this study involves fitting each of the three subjects with each type of orthosis to be evaluated, using the fitting criteria suggested by the orthosis manufacturer and measuring the orthosis' ability to stabilize the low-cervical, high-thoracic spine. The three orthoses to be evaluated are: (1) the Peterson orthosis, (2) the CAMP orthosis, and (3) the University of Washington orthosis with the SOMI superstructure.

For the purposes of this study, the orthoses will be modified by removing the pads from their supporting framework and inserting a piezoelectric, triaxial force transducer between the pads and the support framework. The vertical and fore-aft shear force components measured by the transducer are outputed to an X-7 oscilloscope via two charge amplifiers.

FINDINGS TO DATE: The three orthoses to be evaluated have been changed to (1) the Four-Poster, (2) the standard SOMI, and (3) the University of Washington bi-valved body jacket with the SOMI superstructure. The decision to change from the Peterson and CAMP orthoses to the Four-Poster and SOMI orthoses was made after it became apparent that there existed greater clinical use and acceptance of the latter two orthoses.

After a long exchange with the University Radiation Safety Committee, the radiological technique was decided upon.

The changes in the protocol must also be reviewed by the Human Subjects Review Committee to approve the changes. Final approval from both committees is still pending. In the meantime, the new subjects have been recruited, fitted with the orthoses, and are ready and waiting to participate as soon as the approvals are received.

In a randomly selected order, the subjects are instructed to don an orthosis and apply either a flexion or extension load to the orthosis until a predetermined load level of 25 pounds vertical force and zero pound fore-aft shear force is reached. They are then instructed to maintain that load level while an x-ray is taken of the vertebra of the low-cervical—high-thoracic spine (vetebra C3 to T10) from a lateral view. The subjects will rely on the output display of the oscilloscope for visual feedback to monitor and maintain the load levels at the predetermined values.

The subjects were then instructed to apply a load to the orthosis in the opposite direction (either flexion or extension) until the same predetermined load level is reached and maintain that load while another x-ray of the cervical-thoracic spine is taken.

The x-rays from these tests will then be evaluated by measuring for each orthosis the amount of displacement and rotation of the vertebrae which occurs from C3 to T10, as seen while loaded in flexion as compared to that seen while loaded in extension. The data on the spinal movement allowed by each orthosis will then be used to "rate" the orthosis as to its ability to minimize spinal movement.

APPLICABILITY: If this study should show none of these orthoses to be effective, it should be made known to avoid endangering the progress of the patient. If, however, this study shows any (or all) of them to be safe and effective, it will be a great boon to the management of patients with low-cervical—high-thoracic fractures. Such an orthosis would allow the patient to be up in a wheelchair and take a more active part in his/her rehabilitation earlier than with the more conventional methods of stabilization.

066 Development of an Engineering Applications Program at RT-3

Principal Investigator: C.G. Warren, M.P.A.

Status: New

Dates: January 1979-January 1983

Cost: Annual $14,950 — Projected Total $49,000
RT Annual $3,450 — RT % of Annual Total 23%

Annual Report Reference: #18, Page 206, R-158

OBJECTIVES: The short range objective is to continue the development of an engineering applications program, including staff development, developing in information resource, increasing the equipment on hand for evaluation and trial by clients, increasing service delivery, and expanding educational efforts so that disabled people can become more aware what benefits technology can provide them in terms of increased quality of life. Services delivered are being documented extensively so that a viable fee-for-service schedule can be developed, allowing the program to become self-sufficient. The long range objective is to make the engineering applications program an integral part of the rehabilitation team so that technology can be applied optimally to resolve problems of people who are disabled.

METHODOLOGY: In order to provide engineering services to disabled people, five categories of resources are being developed: An information source, equipment for evaluation, a component stock, fabrication facilities, and sufficient manpower to run the program. The information source consists of a system which provides a comprehensive access to equipment and information. It includes catalogs of available adaptive equipment, a reference to all manufacturers of systems and devices for the disabled, publication reports, personal communications with manufacturers and consultants, as well as documented in-house solutions to specific problems. This information is computerized, allowing specific information on any category of adaptive equipment to be accessed through the use of key words.The equipment resource consists of a growing stock of equipment for mobility, environmental modification and communication, on which patients are evaluated prior to selecting specific equipment to meet their individual needs. The component stock includes fabrication materials, a large variety of switches and switching equipment, and adaptive equipment to allow interfacing of the patient with the equipment selected. The fabrication facilities include a well-equipped machine shop.

Members of the community are being encouraged to contact anyone in the rehabilitation team or the engineering applications program to discuss preliminary feasibility. At that point, a referral is

made to the rehabilitation outpatient clinic. The physician takes responsibility for the referral and determines what other rehabilitation services should be considered in conjunction with the engineering applications consultation. Very few consultations are performed without the assistance of at least an occupational therapist.

Three categories of consultations have been developed to establish the expectations of clients, therapists and counselors. These classifications are the feasibility evaluation, the task evaluation, and the comprehensive evaluation. The feasibility evaluation is designed to familiarize the patient, therapist, client, or counselor with the state of the art in systems for the disabled, to learn what types of solutions to problems are available and to allow them to experience the various equipment. In the task evaluation, the individual has defined a specific task or tasks he wishes to accomplish. At this point specific systems and devices are recommended and modifications are defined to allow the individual to accomplish the desired tasks. In the comprehensive evaluation, the engineering applications program is utilized as an integral part of the total rehabilitation process. Feasibility and task evaluations are then performed as needed in the comprehensive rehabilitation process.

The next stage of the process is to implement the solution to accomplish the desired tasks. This can be accomplished in three ways: (a) utilize off-the-shelf equipment when this will meet the needs of the client, (b) modify or adapt off-the-shelf equipment to meet the specific needs of the client, (c) develop new systems or equipment to meet the defined needs when this is cost effective. When there is no apparent solution, or where it would be prohibitive to develop new systems or equipment, the problem is then identified as a specific need to be addressed by research and development.

FINDINGS TO DATE: During the past year 157 individual consultations were provided to clients residing in the state of Washington and to those from Oregon, Alaska, Idaho who were referred to the center for comprehensive rehabilitation. The program has rapidly evolved to the point where the University of Washington Hospital System will accept it as a regular rehabilitation service. A portion of the program is soon scheduled to become self sufficient on a fee-for-service basis, which will gradually replace grant support for the development of service delivery. We are continuing to upgrade the information retrieval system which currently contains over 700 entries, allowing immediate access to a continuously-updated library of catalogs and information on all types of systems, devices and materials which may be useful to people who are handicapped. A great deal of effort has gone into developing an awareness in the rehabilitation, medical and vocational communities of the technical services which could be provided to disabled individuals.

Staffing patterns have been modified to accommodate the needs of clinical intervention. The current technique is to utilize an engineering technician to interface with the occupational therapist, speech pathologist and vocational counselor. This interface is backed up by an engineer who manages the program and an office assistant. The Engineering Applications team currently functions as a division of the Department of Rehabilitation Medicine, delivering service to clients through both the in-patient and out-patient services of the University of Washington Hospitals. Use of the service has been encouraged through the last year by contributing consultation and implementation at no charge to the client. However, the associated rehabilitation cost, equipment and materials utilized were provided by third party payers. In documenting solutions and costs, the services provided by the engineering application program were basically a small part of the total cost of rehabilitation. Therefore it is anticipated that when the fee-for-service structure is implemented that the third party payers will be amenable to paying for this new rehabilitation service.

APPLICABILITY: Most people who are disabled have not had significant access to existing and developing technology to help increase their quality of life. A program which makes this technology available to aid them with their specific problems has great potential in allowing them to become active and capable members of society.

067 Development of a Clinical Measurement System

Principal Investigator: C. Gerald Warren, M.P.A.

Status: New

Dates: September 1979-September 1980

Cost: Annual $8,050 — Projected Total $13,000
RT Annual $4,025 — RT % of Annual Total 50%

Annual Report Reference: #18, Page 211, R-159

OBJECTIVES: To design a micro processor based clinical measurement system and to develop it as a prototype for evaluation and use by clinicians. This system will utilize standard inputs such as potentiometers for range of motion measurement, force transducers for measurement of strength and switches that will provide a measurement of frequency of events. The unit would be self contained and allow calibration, limit and zero setting, perform frequency counting, provide memory for control and storage of data and limit detection of range of motion. Output functions of the system include display of the limits of any of the three measured activities, as well as frequencies and ranges. It will provide digital and analog output to other systems such as data loggers. In addition, the analog and digital signals can be used to drive such output devices as visual displays, and tones that can provide feedback to the patient and the clinician.

METHODOLOGY: Criteria for design of the system will be determined through consultation with members of the rehabilitation team, with the following general specifications. The measurement system will have three main input sections. The first section will allow selection of up to four individual potentiometers. Each potentiometer will have thumbwheel switches to set upper and lower boundaries for potentiometer movement about a zero point. The operator sets this point simply by positioning the potentiometer to a zero location and pressing the "zero" button for that potentiometer.

The second section will allow selection of up to four pressure sensors. As before, thumbwheel switches will set upper and lower limits for the input signals. The third input section will allow selection of up to four switch inputs. LED's will light to show the open or closed conditions.

The first two input sections will have one option which generates an audible tone when any selected input goes over or under a certain range. The third section will generate tone for each specific switch condition the operator selects.

The measurement system will include a display section. Appropriate selection of the data display option will show the desired data on alphanumeric readouts. The options will include frequency, time and amplitude measurements. As examples, the display could show how many times potentiomenter #1 went over its upper limit, the longest time switch #3 was open, or the maximum pressure exerted on sensor #2.

The control section of the measurement system will let the operator set up test parameters and start and stop the test. Controls will be provided for reading or storage of test data on cassettes and will output data to a CRT terminal. A manual system reset will also be included. A method of patient feedback will include both audio and visual output.

The system will be based on large-scale integrated-circuit technology, which will greatly reduce design time, parts count, size and power requirements, thus providing considerable cost savings and a system which can be easily tailored to future requirements. The key element of the system is the programmable memory which will allow flexibility and ease of functional modification. This will provide a valuable developmental tool for the clinician. The project will be implemented as part of the thesis requirement for a student in electrical engineering.

FINDINGS TO DATE: During the past year the design cirteria were established through the combined input of physical therapists, occupational therapists, clinical psychologists and engineers. These criteria were modified several times as design concepts for the control panel and simulated functions of the measurement system were modeled on paper. The internal design of the equipment was completed and the measurement system was facricated as shown in figure 1. Several sets of transducers are being utilized in the piece of equipment as it is being functionally tested. This will be completed well in advance of the completion date of the project and the equipment will be ready for clinical evaluation by the practicing therapist by September of 1980.

APPLICABILITY: Developing a clinical measurement system will allow standardized measurement of the capabilities of disabled people. This will not only be a significant aid for the clinician in determining the extent and specific nature of each disability, but also will allow the clinician to judge treatment efficiency and measure specifics of outcome. This project will be of value to any patient whose disability can be quantified by the use of sensors measuring movement, force, or events.

068 Effect of Vibratory Information Feedback on Head Movements of Individuals with Traumatic Brain Injury

Principal Investigator:	**Brenda Moore, Ph.D.**	
Status:	**New**	
Dates:	**September 1979-September 1981**	
Cost:	**Annual $28,950** **RT Annual $25,500**	**Projected Total $60,000** **RT % of Annual Total 88%**
Annual Report Reference:	**#18, Page 272, R-160**	

OBJECTIVES:

1. To determine the effectiveness of vibratory feedback for retraining head control in individuals suffering from traumatic brain injury.
2. To continue development of an objective, prototype system for measuring head movements and the effect of feedback training.

METHODOLOGY:

Participants

This study will involve 10 patients from the inpatient unit of the Department of Rehabilitation Medicine. They will be selected according to the following criteria:

a. Men and women between 16 and 35 years of age
b. Recent brain-injury due to trauma (no more than two years post-injury)
c. Were in good health prior to the injury
d. Lack of functional head control as determined by the attending physician and therapists
e. Physical condition is sufficiently stable and under medical control so as to allow participation in feedback training as determined by the attending physician
f. Informed patient consent or assent by the legal guardian or party responsible for the patient's care

Any participant who responds adversely to the training procedures by crying, resisting or otherwise expressing discomfort or pain will be dropped from the study. Attempts will be made to replace these individuals.

Experimental Design

An intrasubject reversal design which is basically a variation of a repeated measures design will be employed. For each eligible participant in the study, a preliminary assessment over a one week period will be done to determine reactions to vibration, i.e., what type of vibration frequency patterns each patient responds to best, areas most feasible for detecting vibratory stimulation, positive reinforcers for motivating head control, optimum frequency ranges of vibration and baseline measures of head movement.

Subjects will be randomly assigned to two groups. One group will follow an A-B-C sequence and the other group will follow an A-C-B sequence. For each participant, the study will extend over a six-week period including the week of pre-assessment.

The schedule will be:

	Group I	Group II
Week 1	Preassessment	Preassessment
Week 2	A-Baseline (no treatment)	A-Baseline (no treatment)
Week 3-4	B-Standard Occupational Therapy Treatment	C-Standard Occupational Therapy Treatment plus Vibration Feedback Treatment
Week 5-6	C-Standard Occupational Therapy Treatment plus Vibration Feedback Treatment	B-Standard Occupational Therapy Treatment

There will be daily baseline probes during the treatment weeks (weeks 3-6). During the A phase, baseline measures will be taken. Head position and movements will be recorded without either standard occupational therapy treatment or vibratory treatment. The B phase of treatment will consist solely of standard occupational therapy treatment procedures of head control. These may include proper positioning, neurodevelopmental and/or neurophysiological techniques and functional activities with or without adaptive aids. The C phase of treatment will consist of vibratory feedback in **addition** to conventional occupational therapy treatment. Baseline probes will be taken at the beginning and end of each daily training session. This design permits comparisions to be made between B and C treatment conditions and baseline (no treatment) measures. By using two randomized groups, control for treatment sequence will be achieved.

Treatment Procedures

Participants will receive B or C treatment daily for ½-hour sessions. The entire treatment phase sequence will last four weeks for each participant.

Prior to treatment each participant will be positioned into a sitting posture as upright and comfortable as possible. The B treatment phase will consist of conventional therapy treatment techniques for re-training head control. The following will be utilized in various combinations to meet the individual patient's needs as determined collaboratively by five registered occupational therapists in the Seattle area.

a. proper positioning
b. active and passive exercise
c. prosthetic, orthotic and adaptive aids (mirrors, mouth and head sticks)
d. functional activities - eating, communication and personal hygiene
e. behavior modification
f. sensory stimulation (application of neutral warmth, stroking or tapping)
g. handling to facilitate head righting and equilibrium reactions
h. proprioceptive neuromuscular facilitation techniques (traction, approximation and resistance)

The C treatment phase will employ the vibratory feedback procedure in addition to the B phase procedures. Wherever possible the two types of treatment will be integrated, again as prescribed by the five registered occupational therapists. For example, if the prescribed occupational therapy treatment is for functional activities in the sitting position using audiovisual curing and/or behavior modification, the vibratory information identifying head position will be given simultaneously. However, if the type of conventional occupational therapy treatment does not lend itself to simultaneous vibratory feedback then the experimental procedure will be implemented alternately. The feedback information will be administered no less than 15 minutes total during each C phase session. There will be rest periods interspersed as needed.

The principal investigator will train the treating therapist and research assistant in the precise treatment procedures to be followed for each individual patient. The prescribed program will remain consistent throughout each phase.

FINDINGS TO DATE: Personnel recruited for the study include an engineer, computer programmer and research assistant. The sensor system monitoring head position was redesigned and is in the process of being constructed. The sensor consists of an electric motor driven gyroscope which is supported by gimbals and which allow it to rotate freely in any direction. The gyroscope spins with its axis vertical and because of the gimbals will maintain this orientation regardless of head position. The angle of rotation sensors at appropriate points on the gimbals provide a voltage proportional to the angle between the gyroscope reference and the patients' head for side to side movement and front to back movement. The enclosure for this device is approximately a three and a half inch cube. Total weight is under eight ounces.

The electromagnetic vibrator feedback device has not yet been constructed. It will be configured much like and operate on the same principle as the driving mechanisms in a loud-speaker. Each of four vibrators will be approximately one inch in length and diameter.

In summary, the first project has been directed at personnel recruitment, instrumentation redesign and development, extensive collaboration and planning by all project personnel and the evaluation, specification and deliberation on the inclusion of a computer for data acquisition, processing, analysis and control of instrumentation.

APPLICABILITY: Functional head movment is a common concern among all members of the rehabilitation team. It is often pre-requisite to eating skills, communication, social interaction, physical, mental and emotional well-being, gross and fine motor activities and self-care. Vibratory feedback may facilitate the retraining of purposeful head movements and prove to be an important adjunct to the existing treatment approaches in rehabilitation. Furthermore, as the numbers surviving traumatic brain injury increase, improved methods for objective documentation of therapeutic outcome will be required by insurance and other legal agencies. Rehabilitation must be prepared to meet the increasing demands of accountability.

069 A Study of Third Party Payer Response to Purchase Request of Communication Augmentation Equipment

Principal Investigator:	**David R. Beukelman, Ph.D.**	
Status:	**New**	
Dates:	**October 1979-October 1982**	
Cost:	**Annual $10,522** **RT Annual $8,797**	**Projected Total Not Specified** **RT % of Annual Total 83%**
Annual Report Reference:	**#18, Page 321, R-161**	

OBJECTIVES: To document third party payer response to requests for purchase of communication augmentation equipment for impaired communicators with various etiologies.

METHODOLOGY: Data on third party payer response to request for purchase of communication augmentation equipment will be collected using a questionnaire. Prior to the data collection phase, professionals serving communication impaired persons will be contacted through the newsletter of the Pacific Northwest Non-Vocal Communication Group. The mailing list of this group contains approximately 500 names and includes almost all professionals in the Pacific Northwest who are involved in the service of non-vocal individuals. Each participating professional will be asked to complete a form for each consecutive request made to a third party payer for the purchase of communication augmentation equipment. When 100 completed forms are returned to the principal investigator, the data collection phase of this project will be terminated.

FINDINGS TO DATE: The data collection and consent forms have been developed and approved by the University of Washington's Human Subjects Review Committee. Thirty-two centers in the five state area have agreed to collect data for this study. Data have been collected from 14 requests for third party purchase of communication augmentation systems.

APPLICABILITY: Findings from this study will be incorporated immediately as funding sources for communication augmentation equipment are sought. The findings will also be utilized as background information in discussions with agencies who apparently have policies not to fund communication augmentation equipment requests.

070 Computer Analysis of Word and Phrase "Vocabularies" Used by Non-Vocal Adults

Principal Investigator: David R. Beukelman, Ph.D.
Status: New
Dates: July 1979-September 1981
Cost: Annual $12,305 — Projected Total $25,000
RT Annual $11,155 — RT % of Annual Total 90%
Annual Report Reference: #18, Page 326, R-162

OBJECTIVES: The aim of this study is to develop a technique for selecting word and phrase "vocabularies" for use in the develc ment or modification of non-vocal communication augmentation systems for adults.

METHODOLOGY: In the first phase of this study, extended sample of communication output will be obtained from five non-vocal adults with a diagnosis of either traumatic brain injury or degenerative neurological disease. All subjects will use an alphabet-based non-vocal communication system as their primary means of communication. There will be no other restrictions as to the type of system used. In the second phase, a computer will print the frequency of occurrence for each word and any number of preselected phrases and sentences chosen by the operator.During the third phase, the frequency data derived from the computer analysis will be reviewed in order to determine the sample size necessary to reliably obtain an estimate of word and phrase frequency. Since 10,000 words is an extensive sample and probably not practical in a clinical setting, the question can be raised whether or not the same data can be obtained with smaller samples. Individual word frequency data will also be analyzed to determine what percentage of each non-vocal communicator's output was included in a 1,000; 2,000; 3,000; 4,000; 5,000; 6,000; 7,000; 8,000; 9,000; and 10,000 word sample. A word list containing the 100 most frequently occurring words of 5 letters or longer will also be generated for each non-vocal communicator.

FINDINGS TO DATE: Phase 1 of this study has been completed, in that extended communication samples have been collected from five non-vocal adults. All of these samples were collected as the subjects communicated with the Canon Communicator. Arrangements have been made with major communication augmentation system service program in California and Oregon to continue the collection of samples from children with cerebral palsy as well as with adults with cerebral palsy. Phase 2 of the study is also completed. The computer programs have been written which will accept transcripts from a satellite terminal, create individual files for each non-vocal communicator, and analyze each file or combination of files to determine the frequency of occurrence for each word and a number of selected phrases and sentences.

APPLICABILITY: It is hoped that the technique developed in this project for collecting and computer analyzing communication samples will make it possible to adapt non-vocal communication systems so that they will better meet the specific communication needs of their users.

071 Adaptation of Microcomputer as Non-Vocal Communication Equipment

Principal Investigator: David R. Beukelman, Ph.D.
Status: New
Dates: October 1979-October 1981
Cost: Annual $12,535 — Projected Total $27,000
RT Annual $11,385 — RT % of Annual Total 90%
Annual Report Reference: #18, Page 331, R-163

OBJECTIVES: The purpose of this study is to program and field test "home microcomputers" as a communication augmentation system for severely physically impaired individuals.

METHODOLOGY: Specifically (1) the microcomputer will be programmed to store a vocabulary of phrases and words which will be displayed onto a video screen with two key strokes on the terminal keyboard. (2) The microcomputer will be programmed such that symbols are scanned

across the video screen and can be selected by activation of a single switch. (3) The computer will be programmed to drive a speech synthesizer so that computer generated speech will become one output option. This option will join the video screen option and the hard copy print option which are currently available. (4) The programming listed in the objectives above will be field tested with non-vocal individuals in their communication settings.

FINDINGS TO DATE: A Microprocessor (TRS-80 Radio Shack System) has been programmed to store a vocabulary of words and phrases which can be retrieved onto a video screen with 1-to-3 keyboard strokes. The scanning program has been developed and laboratory-tested. The rate of character presentation is under the control of the operator. The operator can use the scanning system to retrieve complete messages as well.

A speech synthesizer and a printer compatible with the TRS-80 system have been purchased. Message retrieval programs which allow the system users to retrieve the synthesized messages which have been outputted through the synthesizer have been developed. The same is true for the printer. The authors have synthesized approximately 2000 words to form a base vocabulary for the development of synthesis message retrieval programs. In conjunction with this objective, the authors have received an algorithm designed to convert standard orthographic English into synthesized speech (from Professor Maggs at the University of Illinois). The computer memory requirements of this program are so extensive that it has not been used as an active communication system. However, the flexibility offered by this algorithm will encourage us to attempt such an implementation during the last year of the project.

Field testing of the equipment and programs is currently underway. In the past, we have laboratory-tested each program developed for the microprocessor system. Normal and non-vocal subjects have been involved in these laboratory tests.

APPLICABILITY: Adults with cerebral palsy, degenerative diseases, brain injury as well as selected strokes may be unable to communicate verbally or communicate in such a limited fashion that they need to have some type of communication augmentation system. Systems developed to date have helped many of these people to move away from silence. However, these systems usually do not provide speed or the output options which are necessary for conventional education or vocational activities. Microprocessing capabilities may well allow these individuals to continue their rehabilitation programs in a way that can enhance their education and vocational potential. The development of microcomputer technology for communication also allows the option using the same equipment for a variety of recreational, social and vocational needs.

072 EMG Needle Electrode Parameters
A—Monopolar Needle Electrode Parameters, with and without Subject Usage
B—Voluntary Motor Unit Action Potential Analysis
C—Single Fiber Electromyography

Principal Investigator: Walter C. Stolov, M.D.

Status: New

Dates: July 1979-December 1981

Cost: Annual $4,050 — Projected Total $12,000
RT Annual $2,875 — RT % of Annual Total 70%

Annual Report Reference: #18, Page 372, R-164

OBJECTIVES:

A. To help establish criteria for quality control and standardizations, eight groups of 5 monopolar EMG needles each, available from 6 manufacturers, were studied for (1) Exposed surface area at tip; (2) Needle impedance and phase angle; (3) Insulation capacitance; (4) Continuity of shaft insulations; (5) Changes in these parameters upon repeated sterilizations.

All parameters, except capacitance, were examined upon receipt from the manufacturers and after each of 5 sterilizations. Capacitance was measured after the last sterilization. The needles were all purchased using routine ordering procedures. They were not used on patients or subjects.

B. This study is intended to gather normal values for the motor-unit action potentials in the biceps brachii using monopolar needle electrodes with the classical technique of manually reading action potential recordings. These values will be compared with those obtained from concentric needle electrodes as analyzed by the on-line ANOPS computer. Both the values themselves and ease, reproducibility, and time consumption of the two techniques will be compared so that the one most amenable to a clinical setting may be chosen.

C. Single fiber electromyography differs from routine clinical electromyography in that the electrical potentials of the individual fibers rather than the whole motor unit are sampled. It is our desire to obtain normal study values for the "jitter" that exists when the time lapse between the discharge of any two individual fibers of a single motor unit is recorded.

To obtain normal values (means, standard deviations, and ranges) for the jitter in the extensor digitorum communis muscle in young adults ages 20-40.

METHODOLOGY:

A. Nine groups of five 1½" monopolar needle electrodes each will be analyzed upon receipt and at the end of each of 5 sterilizations.

1. Surface area: The tip of each electrode will be immersed in a small volume of 0.9% saline solution. A small DC current will be passed through the electrode/electrolyte interface. Using an ocular micrometer, the area will be determined by measurement of the area in which gas bubbles develop.

2. Phase, angle and impedance: Measurement of phase angle and impedance for the frequency range of 5HZ to 10,000 Hz will be made with a Hewlett-Packard 4800A Vector Impedance Meter.

3. Insulation capacitance and continuity: Capacitance of the insultation will be determined by burying the tip of the needle in a block of nonconductive material and determining the phase angle and impedance as above. Continuity of insulation will be determined by measuring the DC resistance along the needle shaft.

B. The subject will lie down on a table on his back with his upper extremities exposed. A standard monopolar needle electrode that has been sterilized will be introduced into one muscle and a concentric needle electrode into the contralateral muscle. The subject will then be asked to produce mild contractions of this muscle. The electrical activity so produced will be recorded by the needle electrodes. The activity will be recorded by recording of the tracers on light-sensitive paper and then analyzed manually for the nonpolar needle and with the ANOPS coupler for the concentric needle.

C. The subject will lie down on the table or sit in a chair with his upper extremity exposed. A single surface electrode which serves as a ground electrode will be applied to the skin of the arm with electrode paste. A special single fiber needle electrode that has been sterilized will be introduced through the skin into the extensor digitorum communis muscle in the upper forearm. The subject will be asked to extend his fingers. The needle will be moved around within the muscle searching for discharges of a single fiber of a motor unit and one of its neighbors. Twenty such pairs will be searched for within the muscle as the needle is moved to different sites.

FINDINGS TO DATE:

1. The variability amongst manufacturers suggests that an electromyographer will be more successful if he always works with the same needle even for qualitative electromyography.

2. Knowledge of amplifier input resistance and capacitance (differential mode) can help determine if, with a particular needle, Z(amp)/Z(needle) may be too low, particularly after repeated sterilization, and particularly for the higher frequencies. A less complete recording of the high frequency components of an action potential may result. In this connection a lower shaft insulation capacitance can improve recording of high frequency components.

3. The high number of needles that developed insulation discontinuities suggests that tests of the insulation continuity along the shaft and hub should be routinely done before each use. Discontinuities at hub are tolerable if needles are not fully buried. Those with shaft discontinuities should be discarded.

4. Needle tip inspections at 40X magnification should also be carefully considered in view of wide variations in the surface area, and the tendency in some to lose insulation at the tip.
5. Manufacturers should periodically examine their fabrication processes and provide the potential buyer with appropriate specifications. Three small but useful modifications include distinctly colored Teflon, parallel hub and shaft axes, and a packaging system that protects and isolates the needle during sterilization.
6. A re-examination of monopolar needle electrode parameters that includes effects of actual use on a patient is also needed.

B., C.: Activity to date: Volunteer normal subjects have been recruited (male, 20-40 years of age) and the initial phase of the study is underway.

APPLICABILITY:

A. Electromyography is used in the diagnosis and treatment followup of neuromuscular diseases subject to disability such as muscular dystrophy, traumatic nerve damage, amyotrophic lateral sclerosis, and peripheral neuropathies, to name a few. The Food and Drug Administration (FDA) is now considering medical devices such as those used in electromyography for inclusion under its jurisdiction. The FDA is also inviting the medical community to help establish standards. At the present time, data concerning nonpolar needle electrodes is unavailable.

B. Quantitative analysis of voluntary motor unit action potentials will allow for more definitive diagnostic criteria to be developed for a host of neuromuscular trauma and disease conditions. Rehabilitation proceeds in the most expeditious manner when early and accurate diagnosis can be performed.

C. Single fiber electromyography is a technique by which the microphysiology of the single fiber motor unit and myoneural junction can be examined in detail. Improved diagnostic abilities in the areas of myasthenia gravis, muscular dystrophy, and myasthenic syndrome, to name a few conditions, will benefit the rehabilitation community.

073 Nerve Conduction Study of Ulnar Nerve Compression Syndrome at the Elbow

Principal Investigator:	**Eugen Halar, M.D.**	
Status:	**New**	
Dates:	**July 1979-July 1981**	
Cost:	**Annual $8,825** **RT Annual $5,025**	**Projected Total $22,000** **RT % of Annual Total 46%**
Annual Report Reference:	**#18, Page 383, R-165**	

OBJECTIVES:

1. First objectives of this study are to evaluate the effect of elbow position on ulnar nerve conduction velocity, and to standardize the technique of nerve conduction velocity (NCV) measurement across the elbow.
    a. To determine the magnitude of nerve length variation across the elbow at various degrees of flexion.
    b. To determine optimum elbow position for peak rate nerve conduction.
    c. To standardize elbow position and distance measurement technique for the elbow segment of the ulnar nerve for use in routine clinical NCV determination.
2. To determine the value of sensory NCV measurements in evaluation of ulnar nerve entrapment at the elbow.
3. To develop a method whereby stimulation of the ulnar nerve at different sites of the elbow at predetermined degrees of flexion, would be sufficient to discriminate between nerve compression at the ulnar groove, cubital tunnel or processus supracondylaris humeri.

4. To compare preoperative, operative and postoperative changes of nerve distance, latency time and amplitudes of evoked potentials for the supracondylar, ulnar groove and cubital tunnel segments.
5. To determine the effect of ulnar nerve transposition and cubital tunnel decompression surgeries on the recovery of the nerve by serial NCV testing postoperatively.

METHODOLOGY: Thirty healthy normal subjects, ranging in age from 18 to 70 will be divided by decades into three different age groups (18-30, 30-50, 50-70). There will be an approximately equal number of males and females. Normal subjects with no history of alcoholism, diabetes, renal failure, or other conditions which could cause peripheral neuropathy will be selected. The elbow in extension, motor and sensory NCV's of distal and proximal segments, of equal length, will be performed. Also a constant distance from right and left proximal and distal segments on the same subject will be maintained during all NCV testings. Thirty subjects with ulnar compression syndrome will be tested. This group will include those patients with ulnar compression syndromes of sufficient magnitude to warrant surgical intervention. All patients referred to the electrodiagnostic unit with suspected diagnosis of ulnar nerve entrapment neuropathy at the elbow will have a complete NCV testing performed bilaterally. Those patients, who upon recommendation of their surgeon to undergo surgery on the ulnar nerve, will be included in the study. First the ulnar nerve will be stimulated at the wrist 8 cm proximal to the motor pickup electrode, below elbow, which is 5 cm distal to the central point of the medial epicondyle, and then above elbow equidistant to W-BE length. Following NCV determination, sensory NCV will be performed at the same sites of stimulation as used for motor NCV, thus sensory NCV will be obtained antidromically. All motor and sensory NCV will be tested at extension, 45, 90° and full flexion in the normal population only. Patients will be tested in one elbow position as determined by the peak velocity study in the normal group.

FINDINGS TO DATE: Preliminary findings indicate a significant correlation between NCV's and degree of flexion. Further studies will be conducted to determine elbow position of peak velocity. The accuracy of NCV technique in discrimination of compression at the ulnar groove versus cubital tunnel will be analyzed by comparing preoperative, operative and postoperative NCV findings, obtained by testing ulnar nerve NCV's at the three elbow sites. A comparison will also be made between NCV findings immediately before and after surgical decompression of the ulnar nerve to prove the compression site. Serial NCV's taken postoperatively will be correlated to determine the effect of surgery on ulnar nerve recovery.

APPLICABILITY: The ulnar nerve is a mixed nerve composed of both sensory and motor fibers. It supplies nearly all of the small muscles of the hand with the exception of the two lumbricals, and two and a half of the muscles of the thenar eminence. Sensation in a large portion of the hand is mediated by this nerve. Because of this extensive innervation in the hand, lesions of the ulnar nerve may have significant effect on fine hand movements, thereby greatly compromising hand function. Compession of this nerve causes a great deal of patient discomfort due to paresthesia, pain and numbness, and may result in disability in later stages with wasting and weakness of hand muscles. Early detection and treatment of ulnar nerve lesions is important in order to avoid significant muscle fiber loss.

Current methods of measuring nerve conduction velocities across the elbow are not standardized in regards to the degree of elbow flexion. Nerve conduction velocity may vary widely with changes in elbow position as tension is increased or decreased along the nerve. This study will investigate the effects of elbow position on nerve conduction so that a standardized technique of NCV determination for this segment of the ulnar nerve can be established. Early and accurate diagnosis of ulnar nerve compression is essential so that appropriate measures can be taken to prevent permanent damage to the ulnar nerve itself. Investigations of sensory NCV's may enhance our ability to depict the accurate site of ulnar nerve compression at the elbow level.

Recognition of cubital tunnel versus ulnar groove compression syndrome is important because simple operative decompression is likely to be successful for cubital tunnel compression, rather than the more traumatic anterior transposition. NCV lesion localization techniques may prove to be a valuable aid in localizing lesions in conjunction with direct surgical observations.

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Comparison of electrophysiological measurements to those done intraoperatively will enhance the accuracy of ulnar NCV measurement technique. Followup studies of patients post-operatively will reveal valuable information regarding transposition and decompression procedures as to the rate and course of recovery from ulnar nerve compression synarome.

074 Influence of the Basal Ganglia on Different Aspects of Motor Performance

Principal Investigator: **Marjorie E. Anderson, Ph.D.**

Status: **New**

Dates: **June 1979-June 1981**

Cost: **Annual $19,580** **Projected Total $39,000**
RT Annual $9,775 **RT % of Annual Total 50%**

Annual Report Reference: **#18, Page 416, R-166**

OBJECTIVES:

1. To locate neurons in the globus pallidus whose discharge shows a relationship to arm movement in a reaction time task.
2. To determine whether phasic changes in pallidal neuron discharge are particularly related to specific aspects of the reaction time task, especially early EMG changes in proximal muscles.
3. To determine the effect of pallidal stimulation on sequential EMG activity during an arm movement reaction time task.
4. To determine the effect of reversible and permanent pallidal lesions on sequential EMG activity during an arm movement reaction time task.

METHODOLOGY: Chaired monkeys **(M. fascicularis)** will be trained to depress a lever mounted slightly above the waist level. Lever depression will activate, after a random delay period, one of six lights mounted behind transparent buttons in a 2 x 3 array on a panel in front of the animal. Digital logic circuitry will be used to control the maximum time during which the animal must depress the lighted button to activate a feeder that delivers a small amount of applesauce through a tube mounted near his mouth. The experimenter can select which of the buttons will be lit, thus controlling the distance and direction of movment form the lever to the button.

After training, EMG electrodes will be inserted in a number of sequentially activated muscles. Next, a silastic-sealed chamber will be implanted over a craniotomy that will allow angled access to the globus pallidus on the side contralateral to the moving arm. Through this we first will insert recording electrodes to localize the globus pallidus by identifying the appearance of cells with high tonic discharge rates encountered after the relatively silent area identifiable as the putamen (Anderson, 1977). Activity of individual neurons can be recorded to determine whether they show changes in discharge that are temporally related to any aspects of the paradigm (lever release, button contact, EMG in any of the muscles studied). When we find units that seem to show activity changes that are temporally correlated with behavior in the paradigm (on-line evaluation can be done using a pattern or the motor behavior (reaction time, movement time) in any way and, if it does, to see whether the effective stimulus time is related to times when the cells in the vicinity are silent, for example.

After the recording and stimulating phase of the project are completed, we will evaluate the effect of lesions in the globus pallidus on the same behavioral paradigm and EMG activity sequence. Our objective is to make reversable lesions, using either a cooling probe (Brooks, et al., 1973; Berger, et al., 1978) or an infusion of local anesthetic applied through a cannula inserted into the globus pallidus through the same chamber used for insertion of the recording stimulating electrodes. Again, our objective will be to determine whether a lesion here interferes with any aspects of the EMG sequence or behavioral paradigm.

Finally, we will make a permanent lesion in the same pallidal area using electrocoagulation or the injection of kainic acid (Schwarcz and Coyle, 1977) and we will examine EMG and motor activity in the reaction time paradigm until it has reached a (new) steady state level.

EMG and single unit signals will be amplified and recorded, together with stimulus pulse and behavioral logic signals, on a seven channel Ampex FM tape recorder and used for subsequent off-line quantitative analysis. Statistical tests such as the t-test can be used to compare individual variables (reaction time or paraspinal EMG onset time, for example) during the control behavioral periods and during the periods of stimulation or lesioning.

FINDINGS TO DATE: Two monkeys have been studied during the current grant period. In each animal we have made a lesion in the globus pallidus on one side with kainic acid, applied after the microstimulation studies were completed. In the first, in which histological examination verified that most neurons in the caudal half of both pallidal segments were destroyed with no apparent damage to the internal capsule, subthalamic nucleus, hypothalamus, or thalamus, the animal's movement also slowed after lesion. However, the characteristics of the slowing, which can be described more completely when EMG analysis is completed, seemed to be different than those seen during microstimulation. EMG buildup may not have been altered as much as was the continuation of ongoing EMG activity that normally would have been halted prior to the movement.

During the next year the project will concentrate on data analysis and on the examination of pallidal activity and the changes produced by microstimulation on different types of tasks, with different requirements for motor programming.

APPLICABILITY: Basal ganglia damage is the primary pathology in Parkinson's disease, Huntington's disease, and some forms of cerebral palsy. Motor defects are prominent in these diseases and some unifying concepts have been proposed as to the basic motor function of the basal ganglia. This study would let us test some of these hypotheses and apply the results to developing better treatment techniques.

075 The Temporal Course of Reflex Recovery Following Spinal Transection in Adult Cats

Principal Investigator: James W. Little, M.D., Ph.D.

Status: New

Dates: November 1979-December 1981

Cost: Annual $10,925 — Projected Total $32,000
RT Annual $4,025 — RT % of Annual Total 37%

Annual Report Reference: #18, Page 423, R-167

OBJECTIVES:

1. To develop quantitative electrophysiological techniques to monitor long-term changes in reflexes after spinal cord transection.
2. To use this technique to determine the time course in changes in the monosynaptic reflex elicited via muscle afferents with low thresholds to electrical stimuli and the polysynaptic reflexes initiated by high threshold muscle and cutaneous afferent fibers.
3. To compare electrophysiologic reflex testing to the results obtained by semi-quantitative clinical evaluations in the same animals over the same time course.

METHODOLOGY: Silastic cuffs with embedded electrodes to be used for chronic nerve stimulation and recordings will be implanted around peripheral nerves of adult female cats. During daily recording sessions, stimulating pulses from a constant current stimulator will be gradually increased in intensity until a just-detectable potential is recorded with the proximal recording electrodes. The current necessary to elicit this just-detectable response for each nerve will be considered threshold for that day. At the end of the session, the stimulating current for the muscle nerve will be increased to a value supra maximal for a maximum amplitude M response, and the area of this response will be used to normalize the reflex responses for that session. Care will be taken to apply stimuli with the limb in a standardized position, since it is known from the locomotion literature that reflex transmission, especially for polysynaptic reflexes, is a function of limb position.

After several days of stable baseline reflex responses, a spinal cord transection will be performed aseptically at T6. Electrophysiological testing as described above will be continued daily for a minimum of 15 days or until reflex response amplitudes have stablized.

Taped data will be analyzed by initially full-wave rectifying the EMG response, and if necessary integrating it slightly to smooth the response. After transection, multiple trials can be made for each reflex test each day, but prior to transection, we probably will be forced to evaluate only the low threshold, non-noxious stimuli.

FINDINGS TO DATE: To date, nerve cuff electrodes have been implanted in three cats. Long-term stimulation and recording of spinal reflexes was accomplished in two of the three animals.

Preliminary analysis of nerve cuff-elicited reflexes following spinal transection reveals a temporal course similar to that observed for natural stimulation and similar to that described following other nervous system injuries. Both the common peroneal and the saphenous nerve elicited reflexes, the former a presumed monosynaptic H-reflex and the latter a presumed polysynaptic reflex, showed the previously described late recovery at two-to-four weeks associated with overshoot (Murray and Thompson, 1957; Little, 1976). Overshoot is a transient increase in response amplitude lasting several days which exceeds the ultimate reflex amplitude recorded chronically. The temporal course for these late reflex changes is seemingly reflex-dependent; thus late recovery of the ipsilateral cutaneous elicited reflex appears before the crossed reflex. The temporal course for the ipsilateral reflex elicited by paw electrical or pinch stimulation was comparable to that recorded for nerve cuff stimulation, indicating that the late changes do not merely reflect changes in nerve cuff electrode properties.

An early recovery was noted at four days for saphenous nerve cuff elicited reflexes, both ipsilateral and crossed. Likewise, reflex amplitude increased to paw electrical and pinch stimulation at four days. Such early recovery has been described previously following CNS injury (little, 1976; Cannon and Haimovici, 1939).

APPLICABILITY: First, it may well provide a theoretical basis for the appropriate use of physical therapy in maximizing voluntary motor control following incomplete spinal cord and other CNS injuries. Second, it will hopefully yield theoretical guidelines for attempting to limit the appearance of unwanted clinical symptoms, such as spasticity and autonomic dysreflexia following CNS lesions. Such studies may have major implications for our use of physical therapies for cord injury and other CNS insults.

076 Physiological Characterization of Newly-Identified Afferent Inputs to the Globus Pallidus: A Possible Site for Therapeutic Intervention in Huntington's Disease, Parkinsonism, and Some Forms of Cerebral Palsy

Principal Investigator:	**Marjorie Anderson, Ph.D.**	
Status:	**New**	
Dates:	**July 1979-December 1980**	
Cost:	**Annual Not Specified** **RT Annual Not Specified**	**Projected Total Not Specified** **RT % of Annual Total Not Specified**
Annual Report Reference:	**#18, Page 431, R-168**	

OBJECTIVES: To use electrophysiological techniques to determine what, if any, synaptic action is exerted on basal ganglia output neurons in the entopeduncular nucleus (ENTO) of the cat by neurons in the pedunculopontine nucleus (PPN).

METHODOLOGY: Cats will be anesthetized and surgically prepared for stimulating the thalamus and PPN and recording extracellularly or intracellularly, from neurons in ENTO. The several thalamic and PPN stimulus points will be stimulated in parallel while the recording electrode is inserted stereotaxically and online identification of entopeduncular neurons will be made by virtue of antidromic excitation from the thalamus (Anderson and Yoshida, 1977, 1979). When the discharge of ENTO neurons is thus identified, the response of the same neurons to stimulation of each of the PPN stimulus sites will be determined.

The stimulus position from which the response can be evoked with lowest stimulus intensity and response latency will be determined for each PPN electrode by moving the array vertically and

placing it at different A-P positions. Lesions made through each of the stimulating electrodes at the most effective stimulus points will be used to compare the effective positions with the location of neurons labeled by HRP injected into ENTO in the experiments described above.

Data will be filmed from the oscilloscope with a Grass kymographic camera and projected for measurement of response latency, variation of latency or number of spikes with one **vs.** multiple stimuli, and configuration of the PSP's recorded.

FINDINGS TO DATE: Stimulation of the PPN, in which neurons are labeled retrograde by horseradish peroxidase injected into the ENTO nucleus (feline globus pallidus), results in the excitation of neurons in both the entopeduncular nucleus and the globus pallidus, the feline equivalent of the primate external pallidal segment. With extracellular recording, multiple shocks usually are necessary to evoke ENTO neuron discharge, and the latency from the last shock necessary to elicit a response is about 5 msec. Although this seems a bit long for a monosynaptic innervation by axons traveling only about 10 mm (i.e., about 2 m/sec), the small amount of intracellular data we were able to obtain indicates that the latency of the EPSP does not change as the stimulus intensity is changed, consistent with a monosynaptic pedunculopontine-ENTO connection in which spatial summation at an interneuron is not necessary to elicit the EPSP. The lowest threshold stimulus points in PPN from which the response can be evoked are the same points at which HRP-labeled neurons are found when HRP is injected into the entopeduncular nucleus and transported retrogradely to fill neurons whose axons terminate in ENTO. ENTO neurons also are excited antidromically from the PPN region, and thus a reciprocal PPN-ENTO connection may exist.

This PPN-ENTO excitatory connection could be at least partially responsible for the high tonic activity of ENTO neurons in awake animals. The pharmocological characteristics of this projection are not known, but they should be investigated as a possible mechanism for treatment in some involuntary movement disorders.

APPLICABILITY: Basal ganglia damage is the primary pathology in parkinsonism, Huntington's disease and some forms of cerebral palsy. Effective pharmacological treatment provides a temporary way of managing parkinsonism, but L-Dopa treatment becomes less effective with time, and there are no specific pharmacological agents useful for the treatment of the latter disorders. The proposed project would be one step toward developing such therapy.

077 Motor Point Blocks Phase IV

Principal Investigator: Barbara J. DeLateur, M.D.

Status: New

Dates: August 1979-August 1981

Cost: Annual $7,750 — Projected Total $16,500
RT Annual $5,750 — RT % of Annual Total 74%

Annual Report Reference: #18, Page 461, R-169

OBJECTIVES: The objective is to use the radiofrequency technique in patients with spinal-cord transection of 6 months' duration or longer who need blocks of the gastrocnemius. In subjects needing blocks bilaterally, the radiofrequency technique will be used on one side and the phenol motor-point block technique on the other to compare the duration of relief resulting from each type of block. (An attempt will be made to produce the same amount of relief. See methods.) If patients are inappropriate for bilateral comparisions, they will be randomly assigned to radiofrequency or phenol groups. Longitudinal followup of the duration of improvment will then be made.

METHODOLOGY: To prepare patients for the radiofrequency procedure, the skin will be sterilized with Betadine. Although spinal-cord injured patients would not require anesthesia for comfort, the skin and fascia lata will be anesthetized with 1% lidocaine to decrease flexor responses to probing. The motor point of the muscle will be located by electrical stimulation with a chronaxiemeter, using a 16-gauge hollow Teflon-coated needle, with the tip exposed, as the exploring electrode. After the motor point is located, the 16-gauge needle will be disconnected from the chronaxiemeter, but left in the skin, and the 22-gauge radiofrequency temperature-monitoring electrode will be inserted into the 16-gauge needle. The needle will then be pulled back, out of contact with the noncoated tip of the temperature-monitoring electrode, and the muscle will be restimulated to verify that the temperature-monitoring electrode is on the motor point. (The RFG-3AV lesion

generator is capable of stimulating, as well as heating. It is necessary to first locate the motor point with the 16-gauge needle since the temperature-monitoring electrode, in order to heat evenly, has a blunt hemispherical tip, and is not designed to be pushed through tissue such as muscle, which offers mechanical resistance.) The minimal number of volts needed to stimulate is recorded. After stimulation, the lesion generator is switched to its heating mode, and the motor nerve is heated at 70 degrees C for 60 seconds. The lesion generator is then used to stimulate, and additional lesions may be made if the stimulation voltage remains low.

For purposes of the study, subjects will be chosen who have complete spinal-cord transections of at least 6 months' duration. In subjects who require blocks bilaterally, the radiofrequency technique will be used on one side and the phenol motor-point block technique will be used on the other. In subjects in whom bilateral comparisons cannot appropriately be made, subjects will be randomly assigned to the radiofrequency treatment or the phenol block treatment for the involved side on which a block is to be carried out. Longitudinal followup of the duration of the improvement will then be made.

Radiofrequency lesions can be graded to the same extent that phenol motor-point blocks can, that is to say they are graded by the number of peripheral branches blocked and not by the degree of the lesion made, since in either case an attempt is made to have a complete denervation of the branch blocked. In patients in whom there are bilateral blocks, the blocks will be made comparable by choosing comparable anatomic sites, i.e., so many centimeters from a given bony landmark. The method would be to determine, cutaneously, the major motor points on one side, e.g., the right side, and then determine these distances from suitable bony landmarks. The motor points then used on the left side would be the same geometric distances from those landmarks. In the next patient, the opposite side would be used to determine the cutaneous motor points, etc.

Subjects will be evaluated shortly before and after the procedure, and monthly thereafter until return to the baseline occurs. Appropriate evaluations will be done by the principal investigator (a physiatrist), by a physical therapist, and by a research technologist. The principal investigator will do nerve conduction tests, the physical therapist will evaluate mobility, and the research technologist will evaluate joint range of motion and spasticity.

Mobility tests for patients in wheelchairs include the time required to travel 100 feet, the time required to transfer from bed to wheelchair, and the time required to transfer from wheelchair to bed. For patients not in wheelchairs, the time required to walk 100 feet will be measured.

A rotational joint apparatus (RJA) will be used to evaluate the spasticity and range of motion of the joint affected by the blocked muscle(s). As an example of this procedure, when the gastrocnemius and/or soleus muscles of the calf are blocked, the patient's ankle range of motion is tested by having him lie prone on a table with his leg extended over the end. The foot is placed in a sandal which is mounted on the RJA and the axis of motion of the ankle and that of the RJA are aligned. The foot may then rotate from 30 degrees of plantar flexion to 20 degrees of dorsiflexion, depending on the individual's range of motion. The RJA has a motor which can rotate the foot at rates of from 20 to 80 degrees per second. There are also strain-gage torque transducers which measure the torque generated about the ankle joint, and potentiometer "pick off" measuring the degree of angular displacement. Since spasticity is defined as a rate-dependent increased resistance to passive stretch of a muscle, this device provides a valid, objective measurement of spasticity.

Measurement of range of motion will be done separately from the rotational joint apparatus, also. Standard manual goniometric procedures will be used with specification of position of additional joints which any two-joint muscle may cross: for example, for knee extended for measurement of range of motion for dorsiflexion. In addition, a hand-held myometer will be used to record the force required to obtain the stated passive range of dorsiflexion.

Lidocaine diagnostic blocks are done in all subjects prior to any type of long-lasting block, whether phenol or radiofrequency.

FINDINGS TO DATE: In mid-1980 the rotational joint apparatus was donated to the Department of Rehabilitation Medicine by Eaton Laboratories. Because this machine quantitatively assesses spasticity, it is possible to use the radiofrequency technique on all patients who would benefit from permanent blocks; previously only subjects who required blocks bilaterally were appropriate for the study. With the rotational joint apparatus, the joint can be compared with itself, before and at various times after the treatment, and not just with the contralateral joint.

Prior to arrival of the rotational joint apparatus, two patients were studied. They were a C7 quadriplegic who required bilateral paravertebral blocks of the second lumbar spinal nerve to control spasticity of hip flexion and adduction; and a patient who was severely brain damaged and on a respirator, who had developed severe fixed plantar flexion contractures, so that bilateral blocks of the gastrocnemius muscle were required. Each patient received a radiofrequency block on one side, and a phenol block on the other. The quadriplegic patient experienced adequate relief of spasticity bilaterally, when evaluated five days following the procedure. The brain-damaged patient showed some decrease in tone evident bilaterally, but both sides had such severe fixed plantar flexion contractures that it was difficult to evaluate the improvement.

APPLICABILITY: If the option of long-duration motor-point block becomes available to handicapped patients, it will mean that they can achieve relief without having to return for repeat blocks every four to six months, interrupting their work and other activities. Benefits include improved ambulation; release of voluntary function in the antagonistic muscles, allowing effective application of assistive devices or training procedures; and improved ease of nursing care.

078 Psychological Correlates of Traumatic Head Injury and Recovery of Function

Principal Investigator: Sureyya Dikmen, Ph.D.

Status: New

Dates: September 1979-March 1983

Cost: Annual $25,440 — Projected Total $1,000,000
RT Annual $25,440 — RT% of Annual Total 100%

Annual Report Reference: #18, Page 493, R-170

OBJECTIVES: Information regarding head injury and the individuals injured will be gathered and related to various cognitive, emotional and psychosocial outcome measures over an 18-month period in order to determine the following:

1. What type of cognitive-intellectual and adaptive ability impairments are seen soon after injury, and at 12 and 18 months following injury; ascertain if there is evidence that indicates that certain areas of functioning are more affected than others; and find out if the nature of these difficulties vary as a function of severity of head injury, degree of initial neuropsychological loss, age, and educational level of head-injured patients.
2. The extent to which head-injured patients as a group show recovery in various areas of neuropsychological functions. Also if there is evidence to indicate differential time course of recovery in various areas of functioning.
3. Specific variables such as age, educational background, initial neuropsychological deficits and characteristics of the injury, and their combination that may predict patients who would be likely to show complete or nearly complete recovery vs. those who will continue to show significant psychological residual deficits. From the above attempt to discover what implications these findings have for length and type of rehabilitation intervention and type of patient that should receive treatment.
4. How various sequelae of head trauma relate to each other in interfering with the vocational adjustments of individual patients; if early identification of these factors is possible and how this information can be used in formulating preventive rehabilitation programs.

METHODOLOGY: The study will require sixty head-injured and sixty normal control subjects. The head-injured subjects will be acute head trauma patients recruited primarily from the neurological surgery services of the University Hospital and Harborview Medical Center of the University of Washington. These subjects will be examined on an extensive battery of neuropsychological measures soon after the injury. This battery of measures will be repeated on the same subjects at 12 and 18 months after the initial testing. Operationally, using the Glasgow Coma Scale, they must be able to spontaneously open their eyes, obey commands requiring a motor response, and be oriented in the verbal response areas. This tends to correspond to the time of discharge from the hospital. These subjects will be enrolled in the first 15 months of the study. With follow-up examinations at 12 and 18 months intervals, the entire study would require approximately 30

months to complete. A normal control group comparable in age, education, and socio-economic status to the head-injured group will be selected and tested once. The testing of these subjects will take place in the first 15 months of the study.

FINDINGS TO DATE: Progress to date includes establishing collaborative arrangements with Neuro-surgery (service from which the head-injured patients are recruited), developing evaluation forms for recording the independent (neurological status, indices of severity of head trauma), and dependent variables (neuropsychological, psychosocial, and vocational), and completing testing on ten head-injured patients.

APPLICABILITY: If the results provide answers to the objectives specified, the information will be used in the general management and treatment of head-injured patients. If this information stands the tests of cross-validation, it has strong implications for patients that should receive treatment, the nature of the treatment, and for testing treatment effectiveness in the rehabilitation of head trauma patients.

079 Development of an Assessment Tool for Measuring Sensorimotor Maturation, Motor Performance, and Management Characteristics of Persons with Cerebral Palsy and Aged Birth to Twenty-One Years

Principal Investigator:	**JoAnn McMillan, R.P.T., M.S.**	
Status:	**New**	
Dates:	**July 1980-June 1981**	
Cost:	**Annual $7,475** **RT Annual $2,875**	**Projected Total $7,500** **RT % of Annual Total 38%**
Annual Report Reference:	**#18, Page 510, R-171**	

OBJECTIVES: Revision and refinement of an existing tool developed by project personnel in collaboration with a local study group of physical therapists specialized in pediatric therapy.

METHODOLOGY: Revision of the test instrument will be planned to assure inclusion of appropriate incremental measures to reflect a range of performance characteristics from subtle differences in quality of movement and posture to the more obvious acquisition of major motor milestones. Information also will be obtained about characteristics of therapy management. Convenience of scoring and compatibility of procedures with data input and analysis format will be a primary concern.

A revised version of the tool will be distributed to members of the study group for review and critique, and additional modifications will be made as a result of their input. Project personnel will field test the instrument and conduct preliminary reliability trials. Additional adjustments will be made to improve identified deficiencies. Preliminary data will be gathered to provide an opportunity for pilot testing data analysis procedures. Additional revisions will be made on the basis of these findings. The final version will be subjected to reliability testing, with continued refinement of manual instructions until the criterion for acceptable reliability is reached. The final version will be reproduced and made available for general distribution at cost of duplication.

FINDINGS TO DATE: New project, none to date.

APPLICABILITY: Development of a comprehensive tool for assessing an individual's motor performance and management characteristics over a span of time from birth to adulthood would provide a basis for planned eventual cross-sectional and longitudinal studies. This type of data should be valuable information to clinicians to allow improved delivery of services to individuals within the cerebral palsy population. Also, availability of this type of descriptive data could improve design of future experimental studies to further delineate significant influences on independence measures.

080 Social, Psychological and Intellectual Functioning in Two Groups of Patients with Multiple Sclerosis

Principal Investigator: JoAnn Brockway, Ph.D.
Status: New
Dates: September 1979-August 1982
Cost: Annual $9,890 — Projected Total $20,000
RT Annual $9,200 — RT % of Annual Total 93%
Annual Report Reference: #18, Page 564, R-172

OBJECTIVES: The first is to provide specific information on some of the social, family and psychological problems of persons with multiple sclerosis. The second is to determine whether there are significant group differences in social, psychological and intellectual functioning between persons whose multiple sclerosis can be characterized as benign or exacerbation/remitting and persons whose multiple sclerosis is progressive.

METHODOLOGY:

Subjects: Two groups of 30 volunteer subjects will be used in the proposed study. Both groups will consist of individuals who have been diagnosed as having multiple sclerosis. Group I will consist of those persons whose multiple sclerosis can be classified at the time of the study as being benign or exacerbation/remitting. Group II will include individuals whose disease process can be characterized as progressive at the time of the study. Subjects will be classified as belonging to group I or group II on the basis of their responses to the Multiple Sclerosis Project questionnaire. Groups I and II will be matched for age, sex, education, degree of disability and marital status on the basis of their responses to the Multiple Sclerosis Project Questionnaire.

Instruments. The following assessment devices will be used in the study: (1) Activity Pattern Indicator (API), (2) Minnesota Multiphasic Personality Inventory (MMPI), (3) Wechsler Adult Intelligence Scale verbal subtests and Picture Completion, (4) Selective Reminding (SR), (5) Marital Adjustment Inventory (MAI), (6) Beck Depression Inventory (DI).

Data Analysis. Groups I and II will be compared on various measures using a t test for independent groups.

FINDINGS TO DATE: New project, none to date.

APPLICABILITY: Results of the proposed study may be used to provide those working with persons with multiple sclerosis with more information regarding intellectual function and psychological and social adjustment of persons with different courses of M.S. This information can be used in planning rehabilitation services for persons with multiple sclerosis.

081 Effect of Exercise in Multiple Sclerosis: 1. Quantitative Changes in Strength and Endurance; 2. Effects on Functional Measures

Principal Investigator: Barbara J. DeLateur, M.D.
Status: New
Dates: October 1979-October 1981
Cost: Annual $3,220 — Projected Total $10,000
RT Annual $2,530 — RT % of Annual Total 78%
Annual Report Reference: #18, Page 572, R-173

OBJECTIVES: The objectives of this study are to determine, by means of a contolled study: (a) whether muscle strength and endurance can be increased in multiple sclerosis: (b) whether the multiple sclerosis patient's aerobic capacity can be increased: and (c) whether such increases, if they occur, have a beneficial effect on selected measurable functions. The key feature of the methodology of this study is the variable baseline design. All patients in the study will receive the treatment (sooner or later), which solves the ethical problem of withholding potentially beneficial treatment programs for control groups. The outcome measures (dependent variables) will be: (a) changes in muscle strength and endurance, measured every two weeks, using the Cybex

dynamometer; (b) changes in aerobic capacity, measured once a month; (c) changes in a selected mobility activity, such as walking 100 feet, or wheeling a wheelchair 100 feet, turning it around and returning, or doing a wheelchair-to-plinth transfer. Over a period of two years, 64 patients with established multiple sclerosis will be studied. Subjects will be randomly assigned to one of 16 subgroups of four subjects each. Subjects will train three to five times per week during training weeks, and will be tested every two weeks.

METHODOLOGY: The key feature of the methodology is the variable baseline design. All patients in the study will receive the treatment (sooner or later), which solves the ethical problem of withholding potentially beneficial treatment programs for control groups. The outcome measures (dependent variables) will be:

a. Changes in muscle strength and endurance, measured initially and every two weeks thereafter, using the Cybex dynamometer;

b. Changes in aerobic capacity, measured initially and every four weeks thereafter, using a mass spectrometer;

c. Changes in a selected mobility activity, measured initially and every two weeks thereafter; the activity will be walking 100 feet; wheeling a wheelchair 100 feet, turning it around and returning; or doing a wheelchair-to-plinth transfer.

Over a period of two years, 64 patients with established multiple sclerosis will be studied. Subjects will be randomly assigned into 16 groups of four subjects each: 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, 5B, 6A, 6B, 7A, 7B, 8A, and 8B.

The study will last twelve weeks for all subjects. Subjects will train a maximum of five and a minimum of three days per week during training weeks. The muscle groups trained will be selected for appropriateness in terms of the individual patient's residual voluntary function. For example, in patients who will be tested on an ambulation task, quadriceps, hip extensors, and hip abductors will be trained. In patients who will be tested on wheelchair-to-plinth transfers, shoulder depressors and triceps will be trained.

Groups 1A and 1B will be measured on dependent variables (a) through (c) initially and will then immediately begin their training programs. Group 1A will be given twelve weeks of a standard exercise program designed to increase strength and endurance. During the last two weeks (11 and 12) this group will also receive specific skill training for the test task. Group 1B will be given twelve weeks of specific skill training for the test task, and during weeks 11 and 12 this group will receive the strenght-and-endurance training.

Groups 2A and 2B will be measured on dependent variables (a) through (c) on weeks 0 and 2, but will do their respective skills or strength training programs during weeks 5-12. Group 2A will begin the skill training program at week 5 and the strength training program at week 11. Group 2B will also begin the skill training program at week 5, but will begin strength training at week 7.

Groups 3A and 3B will be measured on dependent variables (a) through (c) on weeks 0, 2, and 4, but will do their training programs during weeks 7-12. At that point group 3A will begin strength training (and will start skills training at week 11); group 3B will begin skill training at week 7 and strength training at week 11.

Groups 4A and 4B will be measured on dependent variables (a) through (c) on weeks 0, 2, 4, and 6, but will do their training program during weeks 9-12. Group 4A will do strength training (and will start skills training at week 11); group 4B will do skills training (and will start strength training at week 11).

For those subjects who had a strength/endurance program (groups 1A, 3A, 4A), there is a skills training program during the final two weeks of the study. For those subjects who have a skill-training program (groups 1B, 2A, 3B, 4B), there is a strength-endurance program during the final two weeks of the study.

Groups 5A, 5B, 6A, 6B, 7A, 7B, 8A, and 8B will be patterned just like groups 1-4, A-B, except that they will also have an aerobic training program (the Monark Renab Trainer) added from week 0 in all cases.

Thus, the study will determine the relative effects of muscle strength/endurance training versus skills training versus general conditioning (aerobic training) on functional measures in the multiple sclerosis patient.

No invasive techniques or drugs are required in this study.

FINDINGS TO DATE: At present two subjects have begun training.

APPLICABILITY: Multiple sclerosis is a disease characterized by exacerbations and remissions. This makes it extremely difficult to evaluate various therapies, since what is attributed to treatment may in fact have been due to spontaneous improvement. Exercise is a treatment modality which is applied in a haphazard fashion in multiple sclerosis. Some clinicians utilize it, on general principles, to try to improve the strength of the patient. Others avoid it, for fear of unduly fatiguing the patient. No well-controlled study is available.

082 Lifestyle Changes Secondary to Communication Disorders Among Individuals with Multiple Sclerosis

Principal Investigator: David Beukelman, Ph.D.

Status: New

Dates: January 1979-December 1981

Cost: Annual $19,055 — Projected Total $45,000
RT Annual $17,675 — RT % of Annual Total 92%

Annual Report Reference: #18, Page 578, R-174

OBJECTIVES: The objectives of these investigations are (1) to survey a segment of the multiple sclerosis population and to determine the frequency with which non-vocal individuals with multiple sclerosis terminate or change vocational and educational activities primarily due to communication problems, experience difficulties in personal and medical care primarily due to communication problems, use communication augmentation systems and devices, and are essentially non-vocal; (2) to develop communication augmentation systems to assist five individuals with multiple sclerosis who have varying levels of communication limitations.

METHODOLOGY: A checklist will be prepared in which the communication limitation of the multiple sclerosis individual can be recorded. This questionnaire will be sent to individuals with multiple sclerosis in the Pacific Northwest contacted as part of the MS Project described elsewhere.

After initial pilot work, modification, and eventually acceptance of these questionnaire items, they will be included in the larger questionnaire. Two hundred individuals with multiple sclerosis will be surveyed, the results will be analyzed to determine the frequency with which these individuals experience communication difficulties.

The questionnaire survey will be reviewed to reveal potential participants in Phase II of the study. Five individuals with multiple sclerosis will be selected to participate in the communication augmentation activities. The communication problems of these persons will range from those who are having education or vocationally significant communication problems to persons who are nearly totally non-vocal. Each of these individuals will be evaluated to determine the communication augmentation system which would best meet their needs. After the system has been selected, each person will be given a performance evaluation in their natural setting. Generally, their performance with the system will be evaluated to determine the frequency of communication events, the variety of communication partners and environments, the time demands placed on their communication partners, and the message type which they communicate. The communication performance of these five individuals will be analyzed prior to their use of the augmentation communication system and during the use of the augmentation system, so that a comparison of their communication performance can be made.

FINDINGS TO DATE: The survey of the multiple sclerosis population described in Phase 1 has been completed. All of the questionnaires have been returned and the computer programs designed to analyze these questionnaires are currently being completed.

Communication augmentation systems have been developed for two individuals with multiple sclerosis who are no longer independent verbal communicators. (Phase II) These individuals have demonstrated their ability to control the Morse code-based communication augmentation systems. One of them controls the system by squeezing pneumatic bulbs while the other controls the system with a joy stick. The Morse code is converted into orthogonal English with an automatic Morse code translator. The results of the translation are displayed on a 16-character marquee display and also on a small portable printer. To date, both of these individuals have been given trials on a system developed at RT-3 and requests for financial support of the individual systems have been prepared and submitted to third party agencies.

APPLICABILITY: At this time, the research shows that nearly half of those persons with multiple sclerosis experience significant communication problems. However, the degree to which these problems interfere with or modify the individual's life style hasn't been clearly documented. If the frequency of the interference or modification can be documented and if individuals from this population can be selected for the development of communication augmentation systems which will improve their ability to participate in educational or vocational activities, improve their physical and medical care, or allow them to maintain a communication panel, these individuals will have received an important rehabilitation outcome.

083 Telemetric Method of Monitoring Pathophysiological Voiding

Principal Investigator: **Rosemarian Berni, R.N.**

Status: **New**

Dates: **September 1979-September 1981**

Cost: **Annual $13,225** **Projected Total $27,000**
RT Annual $13,225 **RT % of Annual Total 100%**

Annual Report Reference: **#18, Page 216, R-175**

OBJECTIVES:

1. To create a monitoring system which allows continuous recording to identify times, flow, and volume of voiding and patient's awareness of the need to void.
2. The system should allow the patient to signal his awareness of the need to void, which may be relayed to a nurse or other staff person while also being recorded via a strip chart recorder. Also needed is the response of the staff to the patient's signal. There must also be a method of recording the act of voiding, if it is done in other than the desired receptacle.
3. The recording must be time related and retrievable over a 12-hour period and should allow for telemetry.
4. The sensors should not be adverse to patient acceptance or interfere with therapy.

METHODOLOGY: To monitor pathophysiologic voiding effectively involves accomplishing several separate tasks: sensing the call for assistance by the patient and the response of the clinic staff, sensing the urination event, encoding this information and transmitting this information to a recorder. These tasks should be met by a system of minimum complexity which can be easily set up and operated by clinical staff.

The most difficult part of the proposed system is sensing and measuring the urination event. Measurement of urodynamics has taken several forms, most of which use electro-mechanical systems to incrementally measure urine volume. As early as 1963, urine flow was measured by using an electromagnetic conduction flow meter. In this system, the electrolytes in the stream moving through a magnetic field produce an electical current which is a function of flow. This system, which is rather expensive and complex, fostered the development of several urine flow meters using electro-mechanical systems, including one commerically-produced system which uses 40 partition chambers mounted on a wheel. The wheel is driven by constant-speed electric motor so that it revolves once every 40 seconds. This partitions the flow of urine into the receiving chambers, providing an incremental measure of flow and volume. The second commercially-produced system, the IDSA Micticmeter, has been widely used. This system directs the urine flow onto a rotating disk driven by an electric motor with a very sensitive electronic control circuit. The circuit senses the energy required to keep the rate of rotation of the disk constant, which is

proportional to the urine flow rate, after correcting for specific gravity. This system was first presented in 1971. Recently, ultrasonic volumetry has been used, and electro-mechanical urine flow meters are continuing to be developed at RT-9 in Alabama.

None of the systems described in the literature so far provide a portable monitoring system to meet current clinical needs. Therefore first the possibility of developing a flow-through sensor which will provide sufficient accuracy to determine the time of events and the approximate volume of urine flowing through a drainage hose will be examined. Since the goal of this project is to meet the needs of patients who are incontinent or who have neurogenic bladders, precise volume measurement is not necessary. Rather, the system should provide accurate temporal data on the urination event, along with an indication of relative volume.

Consequently, the first objective will be to evaluate existing inline flow meters. They will be made urine-resistant if possible, and will then be evaluated through calibration techniques. Along with this evaluation, efforts will be made to develop a simple detector to provide precise timing of the urination event.

Once the sensing problem is resolved, a system will be designed to telemeter this data to a hospital ward call system and to a recorder. This will utilize currently-available equipment wherever possible and will be designed to interface with standard hospital call systems.

Call-signaling will be made possible from both the hospital bed and the wheelchair, using the ward call system. This is possible by using a wheelchair-based transmitter and fixed receiver connected to the call system. The call and urination signals will both be transmitted to a recorder or will be wired directly where the sensor and recorder are in the same location. These signals would then be coded and recorded on a strip chart recorder.

In order to measure volume of urine voided, a flow meter would be modified to be urine-resistant to provide an indication of urine flow rate. This information would then be recorded in a similar manner using a transmitter-receiver pair and direct wiring to measure urine flow for a patient when he is mobile and/or when he is in a hospital bed.

FINDINGS TO DATE: New project, none to date.

APPLICABILITY: Currently there are many patients who void inappropriately. In order to determine whether the inappropriate voiding is caused by physiological, psychological or environmental reasons, there is now a manpower-intensive observation period which requires multiple observers over a period of weeks to obtain the necessary data. If a method were obtained that would provide this information within 24 to 48 hours, it would be an improvement in patient care and also reduce the prorated cost of staffing and observation.

084 Prevention of Chronicity in Back Pain

Principal Investigator: Wilbert E. Fordyce, Ph.D.

Status: New

Dates: August 1979-August 1982

Cost: Annual $237,200 — Projected Total Not Specified
RT Annual Not Specified — RT % of Annual Total Not Specified

Annual Report Reference: #18, Page 253, R-177

OBJECTIVES: The overall objective of this proposal is to compare the effectiveness of conventional and behavioral regimens in the management of acute or recent onset back pain problems in reducing the incidence of chronicity. Specifically, the aims of the proposed investigation are to compare the effectiveness of conventional vs. behavioral methods for:

1. Reducing pain-related medication consumption;
2. Increasing or restoring activity level and reducing functional impairment.
3. Reducing the proportion of recent onset patients who undergo surgery for back pain;
4. Reducing pain-related health care utilization rates and costs:

5. An additional aim is to measure outcome under each regimen against a set of predictor variables to search for predictors of chronicity.

METHODOLOGY: Patients will be assigned randomly into the Conventional (Pathway A) or the Behavioral (Pathway B). The A and B treatment regimens will differ in:

a. programming or scheduling of pain related medications;
b. programming or scheduling of rest and exercise or activity designed to restore function;
c. instruction and preparation of spouse participation in restoration of function;
d. scheduling of physician contact;
e. methods of seeking to influence patient compliance with prescribed regimens.

Following medical workup and prescription (according to whether patient is in A or B) of medications and exercise/rest, baseline measures of current functioning will be taken and then the patient will undergo the A or B regimen for approximately six weeks. Outcome assessments by which relative effectiveness of the A and B regimens will be made at three points 6 to 8 weeks, six months and twelve months.

FINDINGS TO DATE: Base Rate Characteristics: Acute vs Chronic

1. Sex ratio: Characteristically, studies of chronic pain programs reveal an approximate 2:1 ratio of female over male patients. Our data pool shows 119 males (36%) and 208 females (64%). Thus far in the Prevention study the base rate is 23 males (59%) and 16 females (41%). Comparison of these ratios yields a Chi Square value of 6.6, $p \leq .01$. If this trend continues, the implications would seem most important.

2. Age: Acute mean age is 32.2, with a standard deviation of 11.1. Chronic mean age is 44.9, with a standard deviation of 12.5. Comparison by t test ($t = 6.68$, $p \leq .001$) confirms a striking difference. This finding is expected and probably has little importance.

3. Education: Acute mean years of schooling is 14.9, with a standard deviation of 3.5. Chronic mean education is 12.5 with a standard deviation of 2.6. The ensuing t value is $p \leq .001$. This finding, if the trend continues, could be important.

Acute Back Pain Patients Compared with Age, Sex and Education Matched Chronic Pain Patients

1. MMPI: The following scales show statistically significantly higher scores from the chronic than the acute S's: F, Hs, D, Hy, Pt, LBP. Those patterns indicate differentiation between the two groups on both somatic and emotional distress measures. Additional data should help to develop empirical criteria to assist in screening chronic pain patients and in helping to identify acute pain patients at risk to become chronic.

2. Activity Pattern Indicator Form: This behavioral frequency count form helps to characterize impact of pain problems on activities of daily living: social, leisure, vocational, familial, homemaking, etc. Because of the inherent diversity of activity patterns among people, variability is high and large samples are needed to identify criterion group differences. In spite of that, in these thus far small samples (39 in each of the acute and chronic pain groups) the following items show statistically significant differences. The findings may be summarized as:

Acute back pain patients, when compared with chronic pain patients,

a. rest or nap much less frequently during the daytime;
b. work far more hours per week;
c. leave the home to go to work far more often;
d. visit physicians much less often;
e. visit social agencies much less often.

APPLICABILITY: This project should yield data bearing on two aspects of the very expensive and prevasive health problem: back pain. The first is that assessing the effects of Regimens A and B may provide a basis for modifying current practices in management of acute back and thereby to reduce the number who linger on into chronicity. The second result of this study will be to develop data on a wide spectrum of aspects of the acute or recent onset back pain patient. Those data will be useful in their own right but will also permit direct comparisons with chronic back pain patients; something heretofore not accomplished in regard to the demographic, behavioral and psychological parameters included in this study.

Baylor College of Medicine (RT-4)
Medical Rehabilitation Research and Training Center

CORE AREAS

The Comprehensive Rehabilitation of Persons with Severe Spinal Cord Injury

Describing and analyzing the mechanisms of the functional limitations and disability that are involved, devising new and more effective treatment procedures, evaluating systematically the outcomes of specific rehabilitation services, developing improved services that will enable persons with severe functional limitations to live productively in the community.

Rehabilitation of Patients with Ischemic Heart Disease

Evaluating the effects of reconditioning exercise for these persons and the physical and biochemical bases of these effects.

Behavioral Ecological Studies of the Comprehensive Rehabilitation Process

Assessing the patient's progress both inside and outside the hospital and the effectiveness of specific rehabilitation programs.

Rehabilitation-Related Applications of Biostereometric Methodology

Rehabilitation-related applications of biostereometric methodology to providing precise quantitation of the three-dimensional geometry of body deformities and limitations of motor functioning.

BAYLOR COLLEGE OF MEDICINE

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COMPLETED

CONTINUING

NEW

PROPOSED

085 Transitional Living: A Program Fostering Community Integration of Severely Physically Handicapped Persons

Principal Investigators: J.A. Cole, Ph.D.
Lex Frieden

Status: Completed

Dates: June 1976-August 1980

Cost: Annual $63,698 — Projected Total $719,000
RT Annual $33,808 — RT % of Annual Total 53%

Annual Report Reference: #13, Page A-85, R-172

OBJECTIVES:

1. To trace internal processes of development in the transitional living program, focusing on changes in goals, methods of planning, program content, and in other areas.
2. To analyze the project as a social system, examining roles, interpersonal relationships, and patterns of interaction among staff members and participants.
3. To examine external relationships between the transitional living project and other organizations with particular emphasis on relationships with the host rehabilitation hospital and the state vocational rehabilitation agency.

Sub-study II: A Study of Program Effects and Outcomes

OBJECTIVES:

1. To determine the behavioral effects of the transitional program.
2. To determine the informational effects of the transitional program.
3. To determine the attitudinal effects of the transitional program.
4. To determine what specific effects the program will have on certain types of individuals and to develop a means of predicting relative outcomes.

METHODOLOGY: The anthropological study of program development utilizes observation, weekly calendars, logs and other routinely maintained records, participant diaries, and interviews with participants, staff, and personnel from outside organizations to document the evolution of the project and its operation as a service delivery system.

The longitudinal study of program effect and outcomes employs a series of measures which are made before, during, and after persons participate in the program to determine the effects of the independent variable (program) on individuals' behavior, attitudes, and information base. Data collection methods include intake and referral documents, wheelchair odometers and rest time monitors, functional activity and performance scales (Tufts Long Range Evaluation Summary), behavioral logs, informational quizzes, and questionnaires.

FINDINGS TO DATE: During New Option's third year of operation, the program continued to operate as a service delivery system and to refine and evaluate methods for teaching independent living skills. These efforts have been reviewed at length in previous PT reports on this part. In addition to continuing these activities, the project also evolved in several new directions during its third year.

1. Development of audio-visual materials;
2. increased emphasis on interaction within the residential system as an experiential learning tool for participants and attendants; and
3. emphasis on follow-up research.

During the project's third year an intensive effort was made to interview each former New Options participant in depth. This part of the overall effort to collect and analyze comprehensive data on the project to produce a thorough final grant report evaluating the effectiveness of New Options. Research developments are discussed at length in the section below.

Longitudinal Research on Individual Outcomes: During the past three years, twenty-two New

Options cycles have been completed. One hundred twenty-six persons have started as participants in the program, and one hundred one persons have finished the course. Of those who were admitted, ninety-nine were male and twenty-seven were female. Eighty-three percent of the program participants were spinal cord injured. The rest were severely disabled as a result of cerebral palsy, muscular dystrophy, polio, brain damage, spina bifida, rheumatoid arthritis, cerebellar dysfunction, and ataxia. Most of the individuals in the program were from twenty to thirty years old. The exact age range was from 17 to 53 years. Thirty-one percent of the participants were non-white.

One variable which may prove to be critical in determining who could benefit most from the New Options program is time since onset of disability. Thirty-one percent of the participants in the program had been disabled less than two years when they entered New Options. The most recent time since onset of disability was five months. Another thirty-one percent of the program participants had been disabled two to five years before they came to New Options. Finally, thirty-eight percent had been disabled more than five years before they participated in the program. The longest period from onset of disability to admission in New Options was twenty-nine years.

Another critical variable which may be tied to potential to benefit from this program is the individual's pre-admission living arrangement. Approximately half of the participants came from rural communities and the other half were from metropolitan areas. Perhaps more importantly, eighty-two percent of the New Options participants were living with their family before they came to the program and the remainder from institutionalized settings such as junior college, hospitals, and nursing homes. With respect to transportation, all but two of the participants were dependent on someone else to drive them. Seventy-five percent of these individuals depended directly on family members or close friends.

APPLICABILITY: Many of the functional skills and the psychological and social coping abilities that serve well within a rehabilitation hospital are inadequate resources as severely physically handicapped individuals leave this specialized protected environment and return to the larger society. Some persons manage to bridge the gap successfully between the institutional environment and the community, but these are usually persons with exceptional capabilities and resources. Current rehabilitation programs are largely lacking in methods to assist physically impaired persons in making this transition. For many handicapped persons, the demands of independent living and of educational or vocational productivity are more than can be managed simultaneously. Consequently, many potentially productive persons never have a chance to become independent, and they either retreat or are pushed into isolated environments. The New Options project is intended to develop and evaluate transitional programming designed to bridge this serious gap in rehabilitation services. Community integration and an active lifestyle can become feasible goals for many handicapped persons if they are taught and can practice new adaptive skills and if they are allowed to deal with stresses and assume responsibility in a segmented sequence.

086 Clinical Implications of the Disturbance in Calcium and Collagen Metabolism in Quadriplegia

Principal Investigator: J. Claus-Walker, Ph.D.

Status: Completed

Dates: December 1976-December 1980

Cost: Annual $134,054 — Projected Total $361,000
RT Annual $104,422 — RT % of Annual Total 78%

Annual Report Reference: #18, Page A-1, R-173

OBJECTIVES: The **first objective** of this project is to find (1) the bone and collagen related metabolic effects of extensive muscular disuse in man; (2) the additive effects of complete recumbency; and (3) how both effects are influenced by muscular exercises and by sitting.

The **second objective** of this project is to find out if urinary tract calculi and/or ectopic bone are initiated while the patients have large increases in circulatory and urinary collagen metabolites and urinary calcium.

METHODOLOGY: **Description of subjects:** The 20 male patients included in this project will be Houston residents who have sustained functionally complete cervical cord injuries: 10 of these will have been injured less than a month and be entering The Institute for Rehabilitation and Research for the first time, and 10 others will be returning to this hospital at least 2 years after onset of paralysis. **Record of progress and activity:** A procedure has been developed to document the patient's status every week during his hospitalization. The data will be used to establish scores for sitting and for muscular activity. **Urine collection and analysis:** Urine, collected on ice daily from the admission day to the discharge day, will be analyzed in pools of 7 days for the early patients and 2 to 3 days for the chronic ones. Calcium, hydroxproline, and non-dialyzable hydroxyproline will be evaluated. Hydroxylysine glycosides will be evaluated. **Urine extracts:** Urine extracts of 7 or 3 days urine pools will be prepared and stored "in vacuo." **Tetracycline marking:** During a period of high hydroxyproline excretion we will give the patient, after obtaining his written consent, 2 doses of 500 mg tetracycline for 2 consecutive days. In case the patient develops urinary calculi and/or ectopic bone, the specimens will be examined under ultra violet light to detect a fluorescent line corresponding to calcification processes progressing at the time when tetracycline was administered. **"In vitro" experimental effects of urine extracts:** A synthetic urine-like solution has been prepared with variable calcium uric acid and hydroxyproline concentrations. The solutions will be examined to detect the possible formation of crystals during 4 hours incubation at 37°C. The experiments will be repeated with the urine extracts. Traces of heparin were used in the "In vitro" crystallization experiment to assess whether or not this acid product modifies the precipitation kinetics. If crystallization is observed, the necessary conditions will be reproduced in the presence of 10 mg tetracycline. The crystals will be examined under fluorescent light and x-ray diffraction. **"In vivo" experimental effect of urine extract in rats:** Extracts will be made into the form of pellets containing 60 mg of extract. urine extracts with low hydroxyprolinuria will be used for controls. Test pellets will be placed with a pellet injector near the right foreleg and hindleg, and the control pellets will be placed near the left legs of 20 rats. The animal will be palpated weekly to detect ectopic bone growth.

FINDINGS TO DATE: From June 1, 1978 to July 31, 1979, ten new patients participated in the R-173 project. All urines were processed for total hydroxyproline, hydroxyproline polypeptides, calcium, phosphates, and extracts. Aliquots were stored for hydroxylysine glycosides evaluation. Some chromatographic fractions of the extracts were sent to Dr. Charles Pak, at Southwestern Medical School, Dallas, to study their effect on crystal formation.

The findings to date confirm that the initial trauma leads to increased bone turnover and to a general increase in collagen turnover. In patients injured over 3 years, the osteoporotic bone is very slow to lose more calcium during prolonged recumbency, whereas the increase in collagen turnover occurs rapidly. A recurrent hypercalcemia occurred in one quadriplegic patient. This complication interferred with the research protocol, but the patient was kept on the study, because it was felt that many subjects have transient hypercalcemia. In addition, this hypercalcemic quadriplegic patient, who was given calcium-free intravenous feeding for 5 weeks, had a large increase in calciuria (over 100 mg per day) and hydroxyprolinuria.

The free amino acid profile shows that free hydroxyproline was not increased in quadriplegic patients when compared to healthy subjects. In contrast, the excretion of total free amino acid and of 3 methylhistidine is reduced in the patients.

The administration of flavonoids has no effect upon the excretion of calcium, phosphorus or hydroxyproline in the 3 quadriplegic patients who were given the food supplement 10, 12, and 13 weeks after the injury, for 7, 9, and 16 weeks.

The "in vitro" studies are now completed, including the tetracycline incorporation. Each sediment weight has been compared at various pH. The results show that alkalinity is the predominant factor to produce heavy sediments with calcium crystals. The addition of heparin, in the presence of increased uric acid, produced more sediment in acid urine but did not affect statistically the weight of the sediments in more alkaline urine. At similar pH, Proteus was more efficient than alkali to initiate a heavy precipitation. More descriptive results will be available after examination of the microphotographs and x-ray diffraction identification. The same "in vitro" experimental procedure was carried out with and without tetracycline. Sediments with tetracycline showed a typical fluorescence which increases together with the alkalinity of the fractures and with the increase in the weight of the sediments. Therefore, it is very likely that the tetracycline fluorescence

can be used to date the appearance of these pathological calcifications. The method "in vitro" can be used to test drugs which may interfere with calcium-containing crystal aggregations.

APPLICABILITY: This project was designed to yield a better understanding on the role of muscular activity and sitting and their biochemical effects on the formation of urinary stones, ectopic bones, and skin ulcers in quadriplegic patients. The original loss of bone and skin cannot be avoided, but the improvement of bone and skin anabolism and shortening of the duration of the bone loss and their relapse, all may be prevented by physical, and perhaps also pharmacological, management. This will allow the patient to accede to professional rehabilitation at an early stage of paralysis, and to be able to maintain optimum functional capability, giving more independence and a better chance for continuous employment. This achievement will reduce hospital and rehabilitational costs and lower the occurrence of re-hospitalization and its additional cost.

087 Stereometric Analysis of Static Equilibrium in Patients with CNS Disorders

Principal Investigators: R.E. Herron, Ph.D.
Daniel B. Shaffer, Ph.D.
Don Lehmkuhl, Ph.D.

Status: Completed

Dates: September 1977-September 1980

Cost: Annual $56,768 — Projected Total $150,000
RT Annual $42,894 — RT % of Annual Total 75%

Annual Report Reference: #18, Page A-303, R-177

OBJECTIVES: The main purpose of this preliminary study is to explore the use of a newly developed biostereometric sensor as a means of recording "static" body balance of patients undergoing therapy for disorders of the central nervous system.

The original biostereometric sensor was selected for an IR-100 Award as one of the one hundred most significant technical developments of 1974. With support from the Rehabilitation Engineering Center program at TIRR several refinements in the design have been made to make it more suitable for use in studies of the disabled. The proposed study represents a continuation of our efforts to further develop and demonstrate the clinical potential of this novel instrumentation system.

METHODOLOGY: The study will be conducted in three phases. Phase I will involve the development of a test procedure for evaluating the static body balance of a seated individual and when the individual is standing upright with the aid of parallel bars. Different methods will be explored with a view towards establishing the best means of sensor orientation and attachment for obtaining a faithful record of the individual's body excursions (at the point of sensor attachment).

When Phase I has been satisfactorily accomplished, the procedure will be applied to a small sample of patients (5-10) undergoing treatment for CNS disorders in the TIRR physical therapy program (Phase II). In the standing test position, the patient's lower extremities will be braced or splinted if necessary. During this phase, we will focus primarily on two elements: (a) eliminating any remaining practical difficulties in the use of the sensor by clinical personnel, and (b) identifying output parameters that will be most meaningful to the therapist and clinician.

Phase III will involve increasing the size of the subject sample in an effort to systematically establish standards against which to measure the patient's performance. Additionally in Phase III refinements in data output, both numeric and graphic, will be made to increase ease of interpretation by the therapist.

The biostereometric sensor has been used successfully to record the ranges of motion of major joints of normal children and adults. The concept of direct stereometric motion recording has proved to be basically sound and recent modifications to the original sensor design should make the aforementioned application to the disabled subjects quite feasible. The present project is an exploratory one, and it is impossible to prescribe a highly rigorous experimental program since the successive steps are dependent on not-readily-definable preceding ones. This limitation seems to be inherent to the development of a test procedure which departs substantially from the state-of-the-art.

FINDINGS TO DATE: Research conducted during the current reporting period had produced results allowing for the completion of Phase II, as stated in the Methodology section of this report. Additionally, tasks necessary to meet the planned goals for Phase III were implemented. The first of the primary objectives to be accomplished in Phase II was the elimination of the remaining practical difficulties in the use of the sensor. To achieve this goal a new data acquisition system consisting of a three axis quantizer and cassette tape recorder was designed and fabricated. An instruction manual specific to data collection for this project was also produced. The advantage of this new system over the one previously used in Phase I lies in the fact that it is a dedicated system with fewer options and therefore simpler for clinical personnel to operate. Additionally, this system is significantly more compact and provides the portability necessary to collect data at a variety of clinical sites.

The second primary objective of Phase II (also a continuing investigation for the coming research period) has been the identification of the output parameters most descriptive of postural stability and more meaningful to the therapist and clinician. The Postural Stability Index (PSI) described in the Annual Report for the grant period 10-1-77 to 9-30-78, reflected a combination of features such as (1) the total excursion distance recorded during a test trial; (2) the maximum area of horizontal displacement of the trunk while the patient attempted to maintain balance; (3) a favor relating to the duration of the trial. The resultant PSI was therefore a single index reflecting the ability of a subject to maintain trunk equilibrium. Recently, however, a decision was made to study not only the changes in the PSI but also investigate individually the original components of the index. Three additional parameters available from existing data are also being examined. These are: (1) rate of change in the excursion per unit time (cm/sec); (2) rate of change in the area of horizontal displacement per unit time (cm^2/sec); (3) the linear distance from the sensor location (C-7) when the subject is in an "ideal" sitting or standing posture to the location of the sensor when all coordinates are averaged following the test trial. Ideally, as the subject improves in his efforts to maintain postural equilibrium, the values for all of these additional parameters will approach zero. By examining all parameters individually and not just in combination, a more definitive analysis of postural stability should be achieved.

Concurrent to the testing of patients, a sample (N=11) of normal subjects was tested using both the sitting and standing protocols. Subsequent analysis of the data indicated the presence of an error that was attributed to an electronic component failure in the quantizer during the time period when normal subjects were tested. Appropriate corrections were made and further testing of normal subjects will take place in Phase III to determine more accurate values for the objective evaluation of subjects with Central Nervous System (CNS) injuries.

To date ten subjects with serious disorders of the CNS have been tested periodically in an attempt to record changes in postural equilibrium that can be correlated to their progress in physical therapy.

APPLICABILITY: A sensor capable of providing a continuous readout of the position of a selected point on the surface of a body part, thus providing a three-dimensional spatio-temporal analysis of an individual's equilibrium control functions, affords great potential for evaluating the motor status of patients with upper motor neuron lesions and for documenting their progress in a therapeutic program. Such records provide new data concerning the effects of CNS disorders on critical motor functions and the remedial effects of different treatment regimens.

The production of a "hard copy" record of a patient's progress in gaining improved motor control of body balance may also prove valuable in motivating the patient to maintain a cooperative attitude towards the treatment procedures.

More complete records of equilibrium control functions at various stages of CNS disorders would contribute to a better understanding of the natural history of problems affecting the central nervous system. Information of this type could have important implications for both clinical and research purposes in rehabilitation medicine.

088 Appropriate Entry Level Jobs and Sheltered Workshop Tasks for the Less Educated, Severely Physically Handicapped with Upper Extremity Impairments

Principal Investigator: W. Alfred, M.A.

Status: Continuing

Dates: July 1975-June 1981

Cost: Annual $32,662 — Projected Total $137,000
RT Annual $21,435 — RT % of Annual Total 66%

Annual Report Reference: #18, Page A-270, R-168

OBJECTIVES:

1. To document the details of successful entry level job experiences and sheltered workshop tasks that can be performed productively by severely physically disabled individuals who have upper extremity impairments and who have less than a four year college education.
2. To develop and evaluate two inventory formats containing the details described above for utilization by VR counselors and sheltered workshop personnel interested in providing improved services to the severely physically disabled.
3. To publish and disseminate the two inventory guides to VR counselors, sheltered workshop personnel, and rehabilitation practitioners involved in providing services to the severely physically disabled.

METHODOLOGY: In terms of the severely physically handicapped, the project includes the disability groups with which the RT-4 Center is identified, viz., spinal cord injury, neurological disease, brain injury, CVA; skeletal systems deformities, amputation, multiple sclerosis, muscular dystrophy, birth defects, chronic and severe arthritis.

From these disability groups, the project is limited to those (1) who manifest functional impairments in one or both upper extremities such as paralysis, spasticity, weakness, amputation, incoordination, deformity, and limited range of motion (2) who have less than a college education.

It is estimated that approximately 15-30 with the aforementioned disabilities and functional impairments will be entered into the program each year. The referral sources will include TIRR and the Texas Rehabilitation Commission.

To date, information on 37 clients has been registered.

1. Entry level jobs for this project are defined as jobs which require no specific vocational preparation beyond on-the-job training and/or less than six months of skills training. The criteria by which a severely handicapped person is judged as successfully and gainfully employed are (a) receipt of minimum wages or above; (b) demonstrated ability to perform job assignments; (c) maintenance of employment for a minimum of 30 days.
2. For sheltered employment to be considered remunerative, the handicapped individual must demonstrate that he is capable of producing work at a rate of not less than the minimum floor wage that has been established by the U.S. Department of Labor for sheltered workshops; that is not less than 50% of the minimum labor wage. At TIRR's WAP, the floor wage is $1.33 per hour. If a worker's productivity falls below this level, then he is considered as a slow and unproductive worker who cannot generate enough income to contribute to the financial solvency of the workshop operations and programs.
3. Before finalizing decisions as to what specific data to include in both reporting formats, other RT Center personnel, RT-4 Regional Advisory Council members, state VR administrative personnel and counselors, as well as sheltered workshop personnel will be consulted as to their views of the kinds of information that would be most useful.

FINDINGS TO DATE: The final format resulted in a composite job inventory which contains:

1. a client profile which contains vocational relevant information and history about the disabled individual:

2. a job profile which presents basic factors about the job including identification information, employment requirements, job duties, and working conditions;
3. a client job profile which reveals an assessment of disability/job factors, work modifications, and client benefits.

The following sequential steps are being pursued:

1. Development of a preliminary model in consultation with local State VR counselors and administrative personnel, TIRR vocational and workshop staff, local workshop personnel and with the RT-4 Regional Advisory Council.
2. Evaluation of the proposed inventory with examples by a larger number of rehabilitation practitioners located in other RT centers, state VR agencies, sheltered workshops, and rehabilitation facilities. Their input will be obtained by means of an evaluation form.
3. Revision of inventory based on responses received from practitioners.
4. Publication and dissemination of inventory on a national basis.
5. Establishment of a clearing house to receive new data from contributors and dissemination of enlarged inventory at intervals.

The entry level job inventory has progressed to Step 2. The proposed model, which underwent nine significant revisions, was developed in consultation with the rehabilitation professionals outlined in Step 1. Recently the inventory format with examples was printed and distributed to 100 rehabilitation professionals for their evaluation by means of an evaluation form. These professionals represent individuals from 22 states who have expressed interest in the project. Currently responses to the evaluation form are being awaited prior to final revision of the format and publication of the inventory for dissemination on a national basis.

At TIRR Vocational Industrial Center, data on entry level jobs have been completed on 37 severely disabled clients.

The sheltered workshop task inventory will reach Step 2 by September, 1978. Current attempts are being made to simplify the data recording form. At the TIRR Vocational Industrial Center, data on six subcontracts comprising 22 workshop tasks have been acquired.

APPLICABILITY: The potential benefits of the project can lead to improved vocational services for the less educated and severely physically handicapped population with upper extremity impairments in a number of ways:

1. development of more appropriate vocational assessment techniques;
2. development of more adequate sheltered workshop programs to meet their needs;
3. improvement in vocational rehabilitation guidance and counseling services;
4. increase in number of job opportunities and placement possibilities for them;
5. reduction in their financial dependency on government sources; and
6. greater increase in their social and economic independence.

089 Application of a Neurophysiologic Profile to Predict Responses to Treatment of Abnormal Movements Associated with Severe Spasticity

Principal Investigators:	**Milam Dimitrijevic, M.D., D.Sc.** **D. Lehmkuhl, Ph.D.** **A. Sherwood, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1977-October 1981**	
Cost:	**Annual $127,746** **RT Annual $79,539**	**Projected Total $380,000** **RT % of Annual Total 62%**
Annual Report Reference:	**#18, Page A-21, R-174**	

OBJECTIVES: The specific objectives of this investigation are to:

1. Perform comprehensive neurological and electrophysiological testing to develop objective criteria for classifying muscle groups of spinal cord injured patients in terms of being (a) under volitional control, (b) under volitional control when facilitated by such maneuvers as neck reflexes or vestibular reflexes, (c) activated only involuntarily by segmental reflexes or by indirect factors such as tonic vibratory reflexes, or (d) unresponsive.
2. For patients with selected muscle groups falling into one of the first three categories in item 1 above, develop operational procedures for selectively modifying the segmental reflex mechanism to achieve functional goals.
3. Assess possible correlation between types of control and other factors such as level of the lesion, kind of trauma, and clinical signs at different stages after the injury.

METHODOLOGY:

1. Population Sample - The study group will consist of approximately 50 patients from the Spinal Cord Injury Service of the Texas Institute for Rehabilitation and Research who experienced a traumatic injury of the cervical or thoracic region of the spinal cord at least eighteen months previously. This lengthy recovery period is believed desirable to provide a stable baseline of physical, physiological, psychological, and medical findings against which any changes in behavior resulting from specific interventions might be measured.
2. Instrumentation - The Neurophysiology Laboratory is arranged and equipped to support a large variety of measurement techniques and experimental procedures. The capability for essentially any electrophysiological technique required exists through the ability to measure electrical and mechanical events, record or store these signals, process them and display them, and to generate the necessary patterns of electrical and mechanical stimuli to elicit the desired response. These capabilities include wide band amplifiers and paper and magnetic tape recorders, general and special purpose digital computers and externally controllable isolated electrical stimulators as well as continuous and intermittent mechanical stimuli.
3. Neurophysiological Analysis of Residual Motor Control - Each patient in the study group will undergo a series of tests using electrophysiological techniques designed to determine the presence or absence of residual control of motor functions by the brain. The tone of selected muscles supplied by nerves arising above and below the lesion will be monitored by recording the response to controlled tendon taps. Similarly, the volitional and reflex control of these muscles will be detected by recording the electromyographic activity associated with volitional and reflex events. This neurophysiological investigation will provide evidence for an analytical differentiation of muscle activity which is produced by:

   (a) volitional control
   (b) volitional control requiring facilitation by such maneuvers as neck reflexes or vestibular reflexes
   (c) involuntary or indirect factors such as tonic vibratory reflexes.

   Neurophysiological analysis of residual motor control will describe motor unit activity of selected muscle groups, the motor unit activation pattern, and evidence of concurrent and reciprocal muscle activity between antagonistic and synergistic muscle groups during attempts at volitional and postural reflex activation. Additionally, we shall examine the effects of volitional reinforcement on tendon jerk amplitudes by comparing averaged numerical values as well as determining the average amplitude variations during rest and during volitional reinforcement. Measurement of vibratory-induced tonic reflex in selected muscles such as the quadriceps femoris represents an independent parameter for the determination of segmental and supra-segmental functional and anatomical integration of the spinal cord.

   Each of the patients will be the subject of a program planning conference, involving representatives of the medical staff, the Clinical Neurophysiology Laboratory, and the physical therapy staff, to plan a specific program designed to gain maximum functional use of any residual motor control potential reflected in the neurophysiological profile. Following the initial conference to identify potential short-term and long-term goals for the patient, these potential goals and the possible means for achieving them will be discussed in detail with the patient and a significant member of the family. In some instances surgical or chemical procedures may be indicated to deafferent selected cutaneous zones and thereby reduce the intensity of spasticity as well as the sensitivity to gross muscle spasms.

The physical therapy program will focus on teaching the patient specific techniques to trigger, augment or suppress motor activities below the level of the lesion which are of practical importance in improving the quality of life for the individual, such as triggering flexion and extension reflexes at appropriate times to assist in transferring from one position to another. Specific techniques may include the use of biofeedback and electrical stimulation of trigger points.

FINDINGS TO DATE: During the past thirteen months a neurophysiologic profile has been obtained for each of 40 patients with spinal cord injury who have been referred to the Department of Clinical Neurophysiology because of severe spasticity which interferred with their ability to perform certain functional activities. Of these, 29 had injuries of the cervical segments of the spinal cord, 9 had injuries of the thoracic segments and 2 had injuries of the lumbar segments.

The information gained from the poly EMG test is proving helpful in establishing the relative degree of preservation of voluntary activation or inhibition of target muscles as well as the relative degree of preservation of long loop reflexes.

Data collection is proceeding on schedule. We are now beginning to analyze some of the results and to organize them in a form which will facilitate making comparisons.

APPLICABILITY: The work undertaken in this project is directed toward minimizing the consequences of paralysis of limbs resulting from traumatic injuries to the spinal cord of man. Decisions about allocation of concentrated rehabilitation services should be based on neurophysiological documentation of the existence of preserved pathways. Only those who can potentially benefit should undergo the training program. In these selected candidates, special techniques will be devised to bring bothersome segmental reflexes under increased control so they can be used for transfer activities or maintaining equilibrium of the body. Preservation of nervous control rather than denervating spastic muscles will have the additional benefit of retaining the trophic function of nerves on the innervated muscles thereby helping to avoid the development of atrophy, edema, and phlebitis. Rehabilitation practitioners have long recognized the significant role of the control of posture in the prevention of trunk deformities and the importance of posture in patient adaptation to support vehicles. From our preliminary work, we anticipate that patient use of residual suprasegmental control of segmental organization in initiating or halting gross movements is possible and that it will significantly improve the quality of life for these patients.

090 Clinical Application of Longitudinal Functional Assessment

Principal Investigators:	**E.P. Williams, Ph.D.** **James A. Alexander, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1977-December 1981**	
Cost:	**Annual $160,621** **RT Annual $112,176**	**Projected Total $480,000** **RT % of Annual Total 70%**
Annual Report Reference:	**#18, Page A-155, R-176**	

OBJECTIVES: We are developing an approach to measuring functional performance in rehabilitation called Longitudinal Functional Assessment (LFA). The LFA is both a perspective on rehabilitation and a set of techniques based on continuous, direct monitoring of patient activities during hospitalization and postdischarge. Goals for the project period are to (a) finish the design of a refined LFA that can be used with many patients simultaneously; (b) begin extensive collaboration between clinical teams and the research team; (c) phase out involvement of the research team in the collecting and interpreting of performance data; (d) transplant the LFA to clinical teams in a number of other institutions involved in comprehensive rehabilitation; (e) package the manuals and training procedures; and (f) offer training workshops and internships for dissemination.

METHODOLOGY: **What to Measure:** One of the themes guiding the project work has been to develop key indicators of patient performance status. We now have such a set of measures referred to as behavioral vital signs. These vital signs were determined from our data archive, which includes over 28,000 instances of patient behavior described in detail during more than 2500 hours of

direct patient monitoring. An analysis procedure was developed to map out the data archive based on a dimensional approach to the data. First, the variables were intercorrelated in order to locate obvious redundancy and to establish a common metric among the variables. The second step was a principal components factor analysis. The output of the principal components analysis was analyzed with a hierarchical cluster analysis routine.

How to Get the Measures: The LFA consists of four component sets of tools: (a) direct patient monitoring, (b) instrumented patient monitoring, (c) the environmental negotiability survey (ENS) and (d) the telephone structured interview (TSI). The ENS and TSI are finished and ready for use by clinical personnel. Three instrumented measures of patient activity being developed are the wheelchair odometer and two closely related electronic monitors which measure time out of bed (the RTM, rest-time monitor) and the amount of time spent sitting in a wheelchair (the STM, sit-time monitor).

The direct patient monitoring component of the LFA consists of four procedures. First, for detailed, descriptive monitoring of patient activity, we have the narrative observation procedure with which we began our work. Second, our noteform observation procedure is a more practical and less time consuming approach to gathering the same detailed data produced by the narrative. Third, the Performance Assessment System (PAS) is based on the behavioral vital signs established for SCI patients and represents the most efficient, most stream-lined direct observation procedure available. Fourth, having patients observe and report their own behavior provides an even more efficient means for obtaining performance information.

To test the self-report method, ten SCI patients were asked to monitor various characteristics of their own behavior and to report these events chronologically to a researcher at the end of a 4.5 hour period. Other behavioral data were collected by two different methods which were used for evaluating the accuracy of the self-reports. The first method relied on 90-minute observations which overlapped various parts of the client's reporting periods. The second independent measure of behavior was obtained from the rest time monitor. Each client was monitored five days a week for a consecutive two week period.

Why Get the Measures?: The concept and application in clinical practice of behavioral vital signs is crucial for comprehensive rehabilitation to become more effective, cost-effective, individualized, and based on rational principles. Three parts of our work will illustrate this point.

First, development of the concept of behavioral vital signs involves an important analogy with physiological vital signs such as temperature. One reason that traditional medical vital signs are so diagnostically informative is that for each, there are well-established normative values or ranges. We are developing standard curves for behavioral vital signs.

Second, an important research question centers on the issue: why not have staff members rate the patients along requisite dimensions? We have tested this issue. members of treatment teams rated whether patients were doing better (+), the same (0), or worse (-) than last week on three important behavior dimensions: (a) mobility, (b) diversity of activities, and (c) independence. Assessments were collected weekly throughout the hospital stays of five patients who were being observed concurrently by our research group.

Third, one of the most promising applications of the LFA approach is the ability to use the behavioral trajectory measured during hospitalization to predict individual functioning in the home and community environment. In preliminary analyses, nine performance measures were factor analyzed at two periods during hospitalization, the first three weeks out of bed and the last three weeks prior to discharge. The resulting factor scores were used as independent variables in a multiple regression procedure to predict three key aspects of patient functioning during follow-up.

Training: Training is an important methodological component of our overall LFA. Not only must we be able to use the tools of the LFA, but more importantly, we must be able to teach others to use them. For our narrative observation procedure and our standard note from observation, we have complete training materials available. These training packages also serve for the PAS. For the self-report procedure we have the supporting manuals in press, a series of training videotapes, and the supporting forms for data management and logistics. We are developing a videotape training procedure for the TSI.

Implementation of LFA Components: The primary task ahead for our project is to bring our methods and perspective into practice by clinical personnel at TIRR. As we develop and refine

various component parts of our LFA, we will fit them into ongoing clinical activities and procedures. The STM has achieved application by the OT department on a reimbursement basis. We are working with the model SCI Center and TIRR's outpatient clinic to integrate the ENS and TSI into routine posthospital clinical practice.

We are beginning a research project in collaboration with the Physical Therapy department. One main thrust of this effort is to find ways to adapt our methods to suit the goals and objectives of the PT department.

FINDINGS TO DATE: **What to Measure:** The mapping analyses began with 215 variables measuring patient performance. An extensive correlation analysis reduced these to 42 measures. Applying the factor-cluster procedure to the set of 42 measures provides the first overall picture of the topology of the measurement domain. Based on the structure revealed in the mapping analysis, six measures were selected as behavioral vital signs. **Independence** represents the first major facet, behavioral dynamics. The second major facet is represented by the two instrumented measures, RTM **(time out of bed)** and the wheelchair odometer **(mobility)**. The minor facet of **family involvement** is included. A measure of **activities in the ward** was selected as a vital sign. The **activity level** indicator serves as an aid in interpreting the other vital signs based on rate or percentage measures. Since it is the denominator in the equations for calculating the rates of independence, family involvement, and ward activity, the measure must be in the data system anyway.

How to Get the Measures: Before relying on the self-report procedure for gathering data on behavioral vital signs during hospitalization, we tested it against our proven procedures. In general, we find that the self-reports provide slightly less detailed accounts of the stream of behavior. One primary source of disagreement was the patient's failure in reporting brief idle periods. The self-report is practical for use by clinical staff; it provides a potentially cost-effective and time-efficient method for obtaining behavioral vital signs.

Why Get the Measures?: We have compared staff estimates of patient functional health status with our direct measures of patient functioning. Patterns of consensus between the ratings of treatment team members were identified and agreement levels between staff ratings and the observational records were examined. Treatment team members did not agree very well with each other nor with external measures of the same functional performance criteria they were rating. Team ratings were more inclined to rate positively and much less inclined to rate negatively than was warranted by direct measurement of behavioral variables.

Developing standard curves for the behavioral vital signs is an important step in our project work. In previous years we reported on a preliminary standard curve for the RTM. This standard curve is being used in treatment team chart round meetings. Preliminary normative curves have been developed for the behavioral vital signs and will continue to be developed.

In the area of outcome and prediction, we have preliminary prediction analyses based on 9 patients for which we have data on functional performance during both hospitalization and post-discharge periods. Using inhospital performance data as the predictors (independent variables) we looked at three outcome measures (criterion or dependent variables). First, the rate of unscheduled readmissions to TIRR over an 18 month period following discharge represents an important outcome measure to service providers. The inhospital performance indicators predicted 54% of the variance in this criterion variable. This is a predictive correlation of .74. Second, the inhospital performance indicators accounted for just over 50% of the variance in overall independent functioning at three months postdischarge. The predictive correlation was .71. Finally, an inhospital index of mobility predicted nearly 50% of the variance in the rate of conducting activities outside the home setting at three months postdischarge. This is a predictive correlation of .70.

An old adage in rehabilitation asserts that it is ability that counts, not disability. Another popular cliche states that past performance is the best predictor of future performance. The LFA approach to assessment and evaluation of functional health status combines the kernels of truth embodied in these two condensations of traditional wisdom.

APPLICABILITY: We anticipate two major sets of products from this project. The first will include a tested and demonstrated method for the longitudinal measurement of functional performance by persons with severe physical disabilities, as well as the supporting manuals, descriptions, and

procedures for training users. The second set will include a general approach to research and problem definition in the area of human behavior, specific methods of data gathering, a clear set of strategies for progressing from general description to refinement and testing of hypotheses, a large, integrated set of findings regarding the behavioral aftermath of spinal cord injury, and some new conclusions regarding the structure of human performance.

Our perspective and our procedures have been somewhat new. However, they have been accepted by clinical staff and patients, probably because the principles of the LFA are seen to relate so directly to the central philosophical and pragmatic problems of rehabilitation: progress in functional performance and adjusting to the environment. We offer a conception of rehabilitation and a set of measurements around which patient programs can be unified and individualized. Our major purpose in this project is to test the extent to which this conception and the measurement procedures (the LFA) can be used by those responsible for delivering rehabilitative care to severely disabled persons.

091 Stereometric Measurement of Thoracolumbar Mobility in Scoliosis With and Without Fusion

Principal Investigators: **R.E. Herron, Ph.D.**
Daniel B. Sheffer, Ph.D.
Jesse Dickson, M.D.

Status: **Continuing**

Dates: **September 1977-March 1981**

Cost: **Annual $29,336** **Projected Total $175,000**
RT Annual $20,208 **RT % of Annual Total 69%**

Annual Report Reference: **#18, Page A-321, R-178**

OBJECTIVES: The purpose of the project is to explore the use of a stereometric range of motion sensor (ROMS) for evaluating the natural history of scoliosis with and without modification by spinal fusion. The mobility measurement is confined to the thoracolumbar region because the segment is most affected by the fusion process.

METHODOLOGY: The population sample for this exploratory study will be comprised of five normals, five scoliotic cases with spinal fusion and five scoliotic cases without spinal fusion. All subjects will be within the age range 12-18 years and be matched as closely as possible with regard to sex and age. If the initial examinations present no special problems, the sample size will be increased as far as time and other practical constraints permit.

A stereometric Range of Motion Sensor (ROMS) consisting of a lightweight rod and a set of electro-optical transducers interfaced to a storage device, will be used to record point locations in three-dimensional coordinate form.

The spinal orientation of each subject will be recorded in five positions: (1) neutral; (2) maximum lateral bending to the left; (3) maximum lateral bending to the right; (4) maximum flexion; and (5) maximum extension in the sagittal plane. The five tests will be performed according to the procedures outlined by the American Academy of Orthopedic Surgeons (1965). With the subject in position, the tip of the ROM sensor will be placed in contact with the spine at intervals along the entire spinal column. Control points will be recorded at the palpable limits of the spinal length at strategic landmarks, e.g., C1, T12 and S1. Additional points will be recorded between the control points, as close to identifiable vertebrae as possible. It is not essential that the intermediate points fall exactly on the vertebrae, because the ultimate aim is to characterize the orientation of the spine and its major segments as a whole. However, the feasibility of achieving close approximations of vertebral landmarks will be explored as part of this preliminary study.

Both graphical and numerical displays of the spinal orientation will be investigated in order to identify a simple and meaningful format suitable for clinical application.

The first phase of the project will be carried out during Year I. If the results are promising, the second phase will be devoted to a more tightly controlled experimental analysis, using larger subject

samples, with a view toward obtaining a more representative, statistically sound data base. The ultimate aim is to generate functional standards which can be used routinely to evaluate the natural history of scoliosis and, perhaps, other spinal abnormalities.

FINDINGS TO DATE: Research conducted during the current year was primarily centered about the quantification of the three-dimensional geometry of the spine in a manner that would allow comparison of thoracolumbar mobility in normal subjects and those with abnormal spinal curvatures. In the previous year's report (10-1-77 to 9-1-78), it was reported that software was developed to express the spinal geometry by a single best fit polynomial (2nd order). However, further testing of both normal subjects and objects with fixed curvature demonstrates that a single polynomial equation would not adequately fit the shape of the spine. As a result of the finding, work was begun and is continuing into the next year of study that will enable the curve to be described by a series of piece-wise polynomial equations. Basically this technique requires the fitting of a curve by a second order (cubic) polynomial for every five data points collected.

The means of determining these series of equations and combining them to develop the description of a normal curvature would involve collection of data from a large number (N=100) of subjects. Plans have been formulated to test children between 8 to 16 years of age. Presently we have identified and begun the training of several graduate research assistants for Department of Physical Therapy at the Texas Women's University in Houston. These research assistants form the core for the data collection of both the three-dimensional coordinates describing the spine and a scoliosis screening examination (criterion). The testing phase will begin in September 1979.

Concurrent with the research assistant training program, data has been collected by four testers to determine both inter- and intra-tester reliability. The results of this phase will serve as a standard level of measurement accuracy for all the research assistants to achieve in operation of the data acquisition system.

Finally, a new data acquisition system consisting of a compact three axis quantizer and a data cassette recorder have been designed and fabricated in the past year. This activity allows for portability necessary to collect data at a variety of sites and therefore reduces the problem previously encountered in locating large numbers of normal subjects within the Texas Medical Center area.

APPLICABILITY: The improvement of methods for evaluating the natural history of severe disabilities is given a high rating (second order) in the recent documentation of RSA goals. It is our contention that the proposed method may offer a convenient, innocuous and comprehensive means of evaluating the effects of surgical intervention (fusion) on spinal mobility. It has the potential for making the evaluation of spinal mobility more objective, reliable and practicable than currently available methods. The apparatus is conceptually simple and a cost effective system based on modern electronic technology seems well within reach.

092 Cardiac Rehabilitation Program for Patients with Myocardial Ischemia and Arterial Hypertension

Principal Investigator:	**D. Cardus, M.D.**	
Status:	**Continuing**	
Dates:	**September 1977-September 1981**	
Cost:	**Annual $182,694** **RT Annual $117,631**	**Projected Total $594,000** **RT % of Annual Total 64%**
Annual Report Reference:	**#18, Page A-245, R-179**	

OBJECTIVES:

1. To evaluate the effects of reconditioning exercise in patients who have both ischemic heart disease and hypertension.
2. To identify criteria which could be used to select coronary and hypertensive patients for exercise training therapy as a major component of a cardiac rehabilitation program.

METHODOLOGY:

1. Subjects - the subjects will be males 30-60 years old subdivided into patients having (a) hypertension (diastolic pressure above 90mm Hg but below 130 mm Hg) without ischemic heart disease, (b) hypertension with ischemic heart disease (IHD) without previous myocardial infarction (MI) and (c) hypertension and having had a previous MI. Subjects in each group will be randomized into exercising and non-exercising sub-groups.

2. Plan - the study is to be developed in three phases: (1) patient recruitment, selection and preparation (12 months); (2) collection of data before, during and after the period of exercise training (24 months); (3) analysis of data and preparation of final report (6 months). Allowing for overlapping between the first and second phases, the project is planned to be carried out in three years.

3. Procedures - During the first phase, patients are screened for hypertension and ischemic heart disease. Hypertension is determined by measurements of blood pressure at rest in three occasions. In case of doubt, an additional cold pressure test is administered. The presence of ischemic heart disease is assessed by either documented myocardial infarction, a positive exercise test or evidence of coronary stenosis by coronary arteriography.

    a. Pretraining evaluation. Once a patient is found to have hypertension and coronary heart disease, a pre-exercise training evaluation is conducted consisting of clinical and socio-economic interviews, a physical exam, an exercise stress test and determination of some blood components. These determinations will eliminate those patients who have clinical conditions for which exercise is clearly contraindicated or which might impair physical performance or interfere with the effects of an exercise training program. The hypertension will be treated in an attempt to reduce it to normal limits prior to initiating an exercise program.

    b. Exercise training. This phase will consist of supervised exercise with a bicycle ergometer conducted in our laboratory. Exercise will be prescribed according to individual performance and conducted five days per week for 20 to 30 minutes at each session. Each subject will be in the program for three months.

    c. Follow-up evaluation. Physical performance evaluation will be carried out at the end of the exercise training period and at three month intervals thereafter. Evaluation criteria will be based on changes in parameters derived from observations and measurements obtained of these studies.

FINDINGS TO DATE: Recruiting - A total of 82 tests were performed in the 13 months on which this report is based. All subjects studied were screened for participation in this project. First time studies were conducted on 50 persons of which 28 persons having historical evidence of hypertension were selectively recruited for this project. The remaining 32 studies were follow-up studies on subjects who had participated in previous projects. Half of these had presented clinical evidence of hypertension and repeat studies were performed to meet the requirements of this study. Direct recruiting for this project has been obtained by recalling patients seen in our laboratory who presented historical or clinical evidence of hypertension. Seventy-five letters were sent to reach new prospective subjects; 16 responses were obtained from which five persons were recruited for the exercise phase of this program. Two entered the program and three are being further studied for hypertension in accordance with the protocol. Presentation of the program has been made to community and civic groups totaling more than 100 attendees. There has been no appreciable recruiting response to these presentations. Following effective control of their hypertension, nine patients have entered the reconditioning exercise phase of the program. Four have completed the exercise training, were retested, and are now on a prescribed home exercise program. Three patients temporarily dropped from the program and two more were unable to continue the program at this time for clinical reasons. The other patients having hypertension but not entering the exercise program are being followed as controls.

APPLICABILITY: The potential benefits of this project may take place in terms of (a) an increase in the individual capacity for physical work which is generally severely affected in ischemic heart disease and hypertension; (b) reduction in the number of work days missed by shortening the time of recovery and the number of recurring episodes due to patient anxiety; (c) increasing the probability of the patient being able to return to his normal occupation; (d) reducing the cost

of medical care by using a rehabilitative procedure (exercise) not as costly as others (medical treatment, coronary by-pass, etc); (e) the possibility of extending the use of the physical reconditioning methods developed in this project to patients with other kinds of disabilities; and (f) a gain in the understanding of the multiple facets of ischemic heart disease and the possible rehabilitation approaches to the problems presented by the disease.

093 Longitudinal Study of the Course of Vocational Development Following Severe Spinal Cord Injury

Principal Investigator:	**W. Alfred, M.A.**	
Status:	**Continuing**	
Dates:	**January 1978-January 1983**	
Cost:	**Annual $43,226** **RT Annual $35,583**	**Projected Total $175,000** **RT % of Annual Total 82%**
Annual Report Reference:	**#18, Page A-293, R-180**	

OBJECTIVES: The basic purpose of this project is to document the course of vocational development among SCI persons from the time shortly after onset of injury to two years post injury. Specific objectives are:

1. To determine what are the statistically documentable trends in vocational development among SCI persons during the prescribed period.
2. To assess how the vocational development of SCI individuals changes in its stability over time during the two years post injury.
3. To determine if trends in vocational development differ among groups of SCI persons according to differences in pre-injury level of vocational development, disability, kinds and degree of functional limitations, educational level, and age.
4. To determine if vocational outcomes among SCI individuals can be predicted in terms of vocational development observed during the two year course following injury.

METHODOLOGY:

1. Subjects - The subjects will be patients of the TIRR Regional Spinal Cord Center who have been admitted for comprehensive rehabilitation services no more than 90 days following injury. Each will have the provisional diagnosis of having sustained a spinal cord lesion (complete or incomplete) at a level ranging between C2, 3 to L5. The subject's minimum age will be 18; their sex, race, and education will not be used as criteria for admission into the study.

   It is estimated that 35 to 45 subjects will be available for study over the entire two year period. Since some subjects will become unavailable for follow-up study, as many as possible (75-85) will be admitted initially into the project.

2. Interviews and Scales - Vocational Development will be measured using the Goldberg Scale of Vocational Development (GSVD). The pre and post injury sections of the GSVD will be administered to subjects during the interval between the time the patient is able to sustain vertical tolerance and prior to the medical prognosis conference. The post injury section of the GSVD will be repeated on a periodic basis at the following times:

   a. after the medical prognosis conference but before hospital discharge;

   b. during the first hospital readmission or first outpatient clinic visit occurring within a 2 to 6 month period after hospital discharge;

   c. during the subsequent hospital readmission or outpatient clinic visit occurring within an interval of 10 to 14 months;

   d. during a hospital readmission or outpatient clinic visit occurring at the end of 2 years post-injury.

   The Barthel Index, Manual Muscle Test, and Evaluation of Personal Independence Scale will be

utilized to assess subject's functional abilities and to correlate with progress in vocational development. These scales will be administered during (a) and (b) as stated above.

3. Analysis of Data - The analysis of data will require:

   a. establishing reliability of trained raters in scoring the GSVD;

   b. correlational analysis to assess stability of the components of vocational development over time; and

   c. correlational analysis of the relationship of post-impairment vocational development with pre-impairment development, type and level of injury, age, degree of personal independence and other demographic variables.

FINDINGS TO DATE: Satisfactory rater reliability in scoring the GSVD has been achieved. Ten SCI patients were admitted into the preparatory phase of the project which involved achieving rate reliability in scoring the GSVD. Since May 1, 1978, three SCI subjects have been admitted into the project for actual study. With two of the subjects the GSVD interviews have been administered prior to and after the medical prognosis conference. The third subject has had medical complications and has not yet achieved limited vertical tolerance.

As a result of an analysis of recent statistics on the SCI population at TIRR, a decision has been made to expand the study's admission criteria to (1) include patients admitted to TIRR within 90 days after onset of injury and (2) include patients with incomplete spinal cord lesions. This will allow for a broader based and more comprehensive study, particularly in analyzing the vocational development of persons with varying degrees of functional limitations as a result of spinal cord trauma and in comparing the vocational development process between those with complete and incomplete spinal cord lesion.

Since this modification of the study will require more accurate assessment of functional residuals among SCI patients, the Barthel Index scores will be supplemented by scores on the Manual Muscle Test (MMT) administered by the physical therapy staff, and by scores on the Evaluation of Personal Independence (EPI) administered by the occupational therapy staff. The MMT and EIP scores will be obtained twice: prior to first admission discharge and during the last hospitalization before the end of the 2 year post injury date.

APPLICABILITY: A key tenet of vocational rehabilitation practice is that the kinds of vocational services that are offered to clients must be finely tuned to the individual's readiness to participate actively in the rehabilitation process. In this study a serious attempt will be made to determine when vocational intervention should take place following SCI and to determine the content of vocational services which would be most meaningful to SCI clients at different junctures in their post-injury vocational development.

094 Evaluation of the Effects of Spinal Stimulation on Motor Performance in Patients with Upper Motor Neurone Lesions

Principal Investigators:	**Milam Dimitrijevic, M.D., D.Sc.** **P. Sharkey, M.D.** **R. Campos, M.D.** **A. Sherwood, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1978-December 1981**	
Cost:	**Annual $242,987** **RT Annual $52,910**	**Projected Total $598,000** **RT % of Annual Total 22%**
Annual Report Reference:	**#18, Page A-44, R-181**	

OBJECTIVES: The objectives of this work are (a) to determine the degree to which clinically non-recognized but neurophysiologically detectable, residual functioning can be augmented with spinal stimulation in patients with upper motor neurone lesions, thereby resulting in improved motor performance. (b) to determine which categories of patients with upper motor neurone lesions can be expected to benefit from this technique, not only M.S. patients but also those with paralysis

or paresis due to spinal cord injury and Friedreich's ataxia, and (c) to determine what neurophysiological mechanisms are responsible for modification of residual spinal cord functioning during spinal stimulation to produce these beneficial clinical effects.

METHODOLOGY:

1. **Population Sample:** The subjects for this study will be those patients referred to the program of Restorative Neurology, Department of Clinical neurophysiology, TIRR for management of problems of spasticity and weakness or paralysis associated with upper motor neurone disorders due to multiple sclerosis, spinal cord injury, head injuries and Friedreich's ataxia. From this group approximately 20 will be selected for evaluation of the effects of spinal stimulation. The selection will be made on the basis of the clinical criteria that (1) the patient is suffering from a chronic, stabilized or slowly progressing neurological disorder with a predominant upper motoneuron defect. (2) there are no better alternative treatments available for the patient, (3) that the patient will be able to benefit from minimization of the motor defect in his/her activities of daily living.

2. **Experimental Plan:** This study will be divided into three phases. After the patient has been clinically evaluated and a clinical determination made that the patient is a suitable candidate for stimulation as described above, the first phase consisting of measurement of the neurophysiological profile of the patient's dysfunction will begin. This will include a kinesiological evaluation of gait and of the function of the upper limbs, of any defects in speech, and a neurophysiological evaluation of descending motor control functions by testing segmental reflexes and reflexes dependent on brain influence—postural reflexes, long loop reflexes and volitional control—using a polyelectromyographic recording technique. In addition, measurement of the status of the sensory system will be made, including somato-sensory evoked potentials. Each of these tests is conducted using non-invasive techniques.

   Following the thorough clinical examination and neurophysiological measurements, and assuming that the patient fulfills the criteria above, the second phase, consisting of placing the epidural electrodes and monitoring the short term effects of spinal stimulation, will begin. Following receipt of patient's informed consent, the electrodes are placed using Touhy needles inserted into the spinal canal in the epidural space above the dura, by passing the electrodes through the needles. The postelectrode placement period testing will be of the same nature and similar extent to that done pre-stimulation. As is done in routine clinical use, the continuous stimulation strength, frequency and pulse duration will be adjusted at a comfortable level for the patient. The shortest possible time consistent with adequate clinical and neurophysiological evaluation of the effects of stimulation, typically three days, will be used to determine whether or not the system should be permanently implanted in phase three. The neurophysiological measurements in this phase will be a subset of measurements used in phase one, selected according to the anticipated and observed effects of the percutaneous spinal stimulation.

   If it is determined that the patient has received obvious clinical benefits from the stimulation and wishes to continue, a second consent will be obtained from the patient and the stimulation system will be implanted according to accepted surgical practice for such implants. Currently, the permanently implanted systems consist of an implanted receiver placed in a pocket under the skin on the patient's side, connected to the previously implanted electrodes via a subcutaneous tunnel. The electrodes are energized by placing a transmitting coil on the skin surface above the receiver, connected to a battery powered externally worn transmitter/generator. Future systems may employ a "permanent" totally implanted system with an average life of three to five years.

   The surgical procedure for implanting the system is a routine procedure, employing the standard hardware, done under local anesthesia which is particularly important for the M.S. patients. The patients will again be monitored for long term effects using the same general procedures as outlined in phase one, and will be evaluated typically after three months, six months, and every six months thereafter unless some unusual results are obtained which necessitate more frequent monitoring.

   Independent variables will include (1) placement of the stimulating electrodes; (2) stimulating pulse frequency and duration; (3) fixed protocols for performing the individual tests.

   The dependent variables will be (1) intensity of spinal cord stimulation; (2) latency of onset of major effects; (3) persistence of effects; (4) carry-over effects following cessation of spinal cord

stimulation; (5) changes in pattern of response to polyelectromyographic evaluation, to TT-TVR test, and to elicitation of spinal and cortical evoked potentials; (6) changes in functional performance of motor tasks representative of activities of daily living; (7) changes in temperature of the extremities; and (8) changes in the number and severity of handicaps as perceived by the patient.

FINDINGS TO DATE: During this initial project year, significant progress has been made toward meeting all three objectives. With completion of remodeling of the laboratory and installation of a new computer system, the quality and quantity of measurements have increased, through the resultant improvement in facilities, equipment and techniques.

As a consequence, more extensive neurophysiological evaluations can be carried out on a routine basis. During this year 19 patients have been selected for evaluation of the effects of spinal cord stimulation. From this group, 10 received significant benefits and subsequently elected, in consultation with the clinical staff, to have a system permanently implanted. Three were found to have insufficient improvement to warrant implantation, and the remainder are either still in evaluation of the effectiveness of stimulation or waiting for system implantation.

Through these preliminary studies, we have found that spinal cord stimulation will be effective if the patient's long loop reflexes are preserved. Two of the three patients who did not respond to spinal cord stimulation likewise did not show any neurophysiological evidence of preserved long loop pathways. (All 3 not responding were spinal cord injury patients, the third however, was a lumbar injury, the first such studied in our laboratory.) The stimulation studies were carried out in these two patients in spite of the lack of evidence of long loop pathways, since the reflex testing we use is not exhaustive, and it has not yet been shown that pathways which are so evaluated are identical to those involved in producing the beneficial effects of spinal cord stimulation.

In the work to date, we have divided the evaluation of the effects of spinal cord stimulation into a consideration of the immediate effects and the long-term changes with chronic stimulation. Immediate effects include: Sensory inputs consistently distinguishable in frequency and in amplitude, and the facilitory effect on segmental stretch reflexes when applied in the correct time relationship. Evaluation of chronic stimulation effects revealed no profound changes in the character of evoked potentials or of segmental reflexes, but did show a marked decrease in the electromyographic features of spasticity and some evidence of increased suprasegmental control.

The clinical findings to date suggest that spinal cord stimulation is effective in controlling spasticity of brain stem origin, and that it can beneficially modify action tremor and ataxia. The effects of the stimulation can in some cases extend rostrally as well as caudally, resulting in improved speech production, and improved eye coordination and control as well.

Work on a model of the effects of spinal cord stimulation is continuing. At the present time, the working hypothesis is that the stimulation effects are indirect, primarily mediated via the dorsal columns and subsequent augmentation of suprasegmental function, resulting in at least partial restoration of brain influence on segmental reflexes.

APPLICABILITY: It is anticipated that there will be two primary types of beneficial effects of spinal stimulation on the patients. The first effect, which is now well documented for the M.S. patients, and has been observed in other patients as well, is the generalized improvement in volitional control of movement due to the facilitation provided by the constant stimulation. This effect has some carryover, in that the patient's motor performance does not return to the prestimulation state for several hours to several days when the stimulation has been turned off after several weeks of stimulation. The second effect, which has been observed in several patients, including spinal cord and head injury, is the reduction of abnormal movements or spasms which in turn, permits fuller usage of residual motor performance of the patients. The use of this stimulation has been demonstrated to improve the quality of life of some patienrs with disease or injury of the central nervous system. The improvements in motor function lessen their dependence on others for care and thus reduce the cost of caring for them. Some can be expected to become independent and able to return to work.

095 Demonstration and Evaluation of a Model Surveillance System for Neurologically Active Drugs Used in Spinal Cord Injured Patients

Principal Investigators: L.S. Halstead, M.D.
Jacqueline Claus-Walker, Ph.D.

Status: Continuing

Dates: October 1978-October 1981

Cost: Annual $38,502 — Projected Total $97,000
RT Annual $28,697 — RT % of Annual Total 75%

Annual Report Reference: #18, Page A-60, R-182

OBJECTIVES:

1. Develop the component parts of a model surveillance system for neurologically active drugs commonly used in spinal cord injured patients.
2. Implement the model surveillance system at TIRR's Regional Spinal Injury Center.
3. Evaluate the impact of the model surveillance system on health care providers and consumers.
4. Facilitate implementation and evaluation of the model surveillance system at other spinal cord injury centers.

METHODOLOGY: **Components of the Model Surveillance System.** Four major components to the model surveillance system for neurologically active drugs must be developed. The first component is a special drug code which can be applied to neurologically active drugs. A prototype of the code that has already been proposed by the principal investigator is called the TIRR Drug Code. Drugs are coded based on two considerations: (1) a drug's primary (intended) and secondary (unintended) effects, and (2) the final neuro-structure(s) by that drug.

A second component of the model surveillance system will be a handbook tentatively entitled, "Neuroactive Drugs and Spinal Cord Injury: A Guide for using Neurologically Active Medications in Spinal Cord Patients." This will contain a description of how the code was developed and how it can be applied to individual drugs. There will be a number of composite tables and lists that summarize the following information: (1) the active ingredients, their physiological effects and the TIRR Drug Code for 54 commonly prescribed agents; (2) a list of the most common clinical problems for which these 54 drugs are prescribed, with special precautions, cost information, and specification of drugs of first and second choice for each clinical problem; and (3) an index that provides a comprehensive "interaction reference" for each of the 54 drugs with respect to all of the other neurologically active drugs using the interaction classification adopted by Hansten (1975).

A third component of the model surveillance system will be the reduction and reproduction of the TIRR Drug Code on pocket-size laminated cards with appropriate color coding to indicate inhibition or stimulation of various receptor sites. The back of the card will contain a listing of the 54 most commonly used neurologically active drugs at the Institute and their TIRR Drug Codes (Halstead, Claus-Walker, and Hma, 1978).

The fourth component will be a drug profile sheet which will be placed at the front of each patient's medical chart. This form will list all medications that the patient is currently taking and a column will be provided where the drug code can be entered for neurologically active drugs. This sheet will be kept current every 10 days by the pharmacy staff and is intended to serve as a reminder of all those medications which have been prescribed and might produce adverse effects.

Dissemination: After the TIRR Drug Code is finalized, a preliminary draft of the handbook on "Neuroactive Drugs in Spinal Cord Injury" will be written by the co-investigators and reviewed by pharmacologists and paraplegists at the TIRR Regional Spinal Cord Center, Baylor College of Medicine and other regional spinal cord centers. When a version suitable for clinical use is completed, the handbook will be printed and made available for evaluation to nurses, physicians, and pharmacists at TIRR. Later, a revised version will also be made available for evaluation by patients and their families.

FINDINGS TO DATE: Considerable progress has been made over the past year in achieving this project's first objective, namely the development of four component parts of a model surveillance system for neurologically active drugs used in spinal cord injured patients. The first component in the proposed system is a drug code specifically designed for clinical use with neurologically active medications. In response to a number of suggestions and comments from medical students, residents and attending physicians at TIRR and other centers, the TIRR Drug Code described in last year's report was revised to make it easier to read and use. The new revised code retains the same coding rules as before.

The second component of the model surveillance system is a pocket sized, laminated card which shows the TIRR Drug Code on one side and, on the other side, a list of 54 most commonly used neurologically active drugs prescribed at the Institute with their codes. Several dozen of these cards were produced and distributed to health care professionals at TIRR and those attending presentations describing the Drug Code at several professional meetings.

Finally, the fourth component of the proposed system was intended to be a mechanism for the clinical application of the drug code in hospitalized patients. Ideally, such a mechanism would help the clinical staff identify drugs with neuro-active components, provide a list of their codes, and alert them to possible adverse interactions. A drug profile sheet was suggested in the project proposal last year as one mechanism for accomplishing these objectives. Such a sheet was developed and tested on a pilot basis on one of the nursing stations at TIRR for three months during the past year.

APPLICABILITY: The model surveillance system is intended to provide a systematic approach to help organize and rationalize a large amount of information concerning neurologically active drugs used in the management of spinal cord injured patients. In the course of the rehabilitation program, spinal cord injured patients are frequently treated with multiple medications at the same time. Even for a knowledgeable and conscientious physician, nurse, pharmacist or patient, storing, organizing and analyzing the various combinations and ways these drugs might interact adversely is a mammoth task, and in many instances for practical purposes, an impossible one. The problem of adverse drug interactions is a major one in the treatment of many conditions. It is compounded in spinal cord injured persons for several reasons: there is severe impairment of normal nervous system mechanisms; a large number of drugs, many of which have a neuro-active component, are frequently taken at one time to manage a multiplicity of organ system dysfunctions; and medications are prescribed simultaneously and sometimes unknowingly by more than one physician. Finally, it is clear for many medications, and especially newer ones, that there is a large knowledge gap regarding their effects in spinal cord injured persons.

096 1979 Survey of Disability in Houston, Texas

Principal Investigators: J. Alexander, Ph.D.
M.J. Fuhrer, Ph.D.
C.D. Rossi, M.S.

Status: New

Dates: September 1979-September 1981

Cost: Annual $62,384 Projected Total $97,000
RT Annual $51,354 RT % of Annual Total 82%

Annual Report Reference: #18, Page A-143, R-183

OBJECTIVES: This study focuses principally upon three aspects of disability associated with severe physical impairments. These aspects are:

1. vocational performance,
2. community participation, and
3. self-care.

The specific objectives of the study are:

1. To determine the prevalence and demographic characteristics of these aspects of disability in a major U.S. population center, Houston, Texas;

2. to compare critically the resulting prevalence estimates with those from comparable studies performed at a community, state, or national level;
3. to establish the coincidence of these aspects of disability;
4. to describe the correlates of each aspect of disability in terms such as the associated physical impairments, types and degrees of functional limitations, expressed needs for services, use of assistive devices, transportation problems, amount and sources of income, living conditions, etc.;
5. to prepare recommendations for improving the methodology of survey studies of disability.

METHODOLOGY: The principal survey technique was that of random digit dialing in which the sampling units were individual private residences. Approximately 16,000 households were contacted by phone of which 13,000 provided data. Based upon an average of 3.09 residents per dwelling in the Houston area, it was expected that approximately 40,000 respondents would be included in the sample.

Part I of the interview, the screen, was targeted upon each and every individual in the residence. With one exception, Part II of the interview was administered only to individuals who were identified in Part I as having a relatively long-term severe functional limitation or a medical condition associated with such limitations. The exception is that Part II was also administered to 200 individuals who did **not** meet criteria for interviewing. Essentially, these individuals represent an able-bodied comparison group.

The proposed analyses were designed to blend a substantive, question-probing approach with one that is exploratory and open-ended. The major analytic thrusts are in three areas. First, four indices of disability have been created from specific items in the questionnaires. These serve as key references in organizing the data. Second, using both the disability indices and traditional categorical approaches, a variety of prevalence questions are posed. Third, a variety of questions dealing with relationship issues both among the disability indices and between the indices and other data are being examined.

FINDINGS TO DATE: Data preparation began with receipt of a raw data tape from Telesurveys of Texas, the firm that conducted the survey. The tape contained coded responses to the survey questionnaire for a random sample of 30,000 non-institutionalized Houston residents. From this sample, a target group of 900 (2.95%) severely handicapped persons was identified, as was a comparison group of 200 non-handicapped persons. A total of 639 data items was available per case, providing a total data base of 702,900 items. Plans were made for conducting statistical analyses on a CDC 170 Cyber computer system with version 8.0 of **The Statistical Package for the Social Sciences** (SPSS).

In the second phase that required approximately a three-month period, synthetic variables (indices) were constructed from original data items. These indices represent composite scores that were normalized and scaled for analysis. They fall into 5 major groups dealing with:

1. functional limitations,
2. activities of daily living,
3. psychological functioning,
4. vocational status, and
5. community participation.

The third phase of the analytic effort centered upon the Community Participation Index representing activities such as shopping, visiting friends, voting, etc. In process are a series of multiple regression analyses within the handicapped target group which have the Community Participation Index as the key dependent variable. Subsequent regression analyses will focus upon the other indices as principal dependent variables.

APPLICABILITY: Consistent with the recent amendments of the Rehabilitation Act of 1973 and with congressional mandates to the NIHR, this study's focus extends beyond traditional concerns with the vocational aspects of disability to include other significant role performances expected of physically impaired individuals in a social environment. As such, this study will contribute to the aggregate of data needed to provide credible estimates of the national prevalence of these aspects of disability. Those estimates must inevitably be of interest to advocates of newly proposed rehabilitation programs as well as to administrators seeking to justify current programs.

In the benefit-cost approach to program evaluation, for example, the individual recipient of benefits is frequently the unit of analysis. Thus, the estimated total number of recipients becomes a key datum. Similar prevalence estimates are no less important in evaluating competing rehabilitation research proposals since the "size of the problem" (the number of individuals manifesting the problem to be researched) is typically a matter of concern.

Survey studies typically are one of two types: 1) large scale studies like those of the U.S. Census Bureau in which a limited amount of information is obtained from a sizable, statistically representative sample of the national population, and 2) small-scale studies in which relatively accessible samples are probed in detail to yield comparatively in-depth information. The small-scale studies often deal with a single categorical group defined in terms of specific impairment, e.g., spinal-cord injury, partially sighted, heart disease, etc. Typically, the data are acquired from service recipients associated with a specific program rather than from a statistically valid sample drawn from a designated population. Collating the results of such studies in order to make comparative analyses across categorical groups is an Augean task because of the use of idiosyncratic terminology, noncomparable measures and statistical analyses, etc. The present study is characterized on the one hand by statistically valid sampling techniques and on the other hand by acquisition of relatively fine-grained comparative data on a variety of impairment groups.

097 Validation of the Criteria for a Form of Better Functioning Architecture for All People, Including Those with Severe Functional Limitations

Principal Investigator: R.M. Warmington, D.E.D.

Status: New

Dates: October 1979-October 1982

Cost: Annual $52,538 — Projected Total $150,000
RT Annual $39,921 — RT % of Annual Total 76%

Annual Report Reference: #18, Page A-128, R-184

OBJECTIVES:

1. Attempt to validate the design criteria for a form of better functioning architecture (Warmington, 1977) by comparing the performance of several different groups of impaired persons with that of encumbered able-bodied persons in two different architectural environments: (a) one constructed according to the traditional design criteria, and (b) one conforming to the criteria of better functioning architecture.
2. Utilize the performance data obtained in both environments as a basis for refining and modifying as necessary the criteria for better functioning architecture.
3. Based on the set of refined architectural design criteria, undertake an educational program to influence (a) future programming, designing and documentation of architectural projects as well as (b) future design and production of components, e.g., door hardware.

METHODOLOGY: A minimum of 15 able-bodied subjects in each of six age groups: 5-7, 12-17, 18-35, 36-55, 56-65, and 66+ are being studied. A seventh age group, 8-11 years old, will have a minimum of 30 subjects because of the importance of this age range in the formulation of the study. A minimum of 15 quadriplegics and 15 paraplegics are also being studied. To control variability attributable to age per se, these subjects all will be in the range of 13-55 years of age.

Two architectural units will be constructed in the Texas A&M University Research Annex. The traditional module, approximately 15 x 9 feet (4.5 x 2.7 m) in size will be constructed using traditional design techniques. A second module designed according to the proposed criteria will be 5 x 3 m and will contain features considered necessary to improve accessibility and usability for impaired or for physically encumbered able-bodied people.

The participants will be asked to perform simple tasks daily enacted in most households in each of the two modules. The type, order, and number of tasks to be tested are the same in each module.

The tasks are open and shut door(s), turn on a faucet, fill a glass and turn off a faucet, select a box from an array of shelving(s), turn on and later turn off a light switch, and remove an electric plug from a socket.

After a familiarization pass through each module, the subject will be required to make two additional passes through each module. The order will be counterbalanced within each group. For able-bodied participants, the additional passes will be (1) unencumbered while performing the tasks and (2) encumbered while performing the tasks. During the later pass, both hands will be encumbered in ways that are representative of everyday occurrences.

A principal measure and dependent variable will be the time (in seconds) to pass through the module (i.e., enter, perform each task and exit). In addition, the performance of each task will yield a variety of both primary and supportive data.

FINDINGS TO DATE: A minimum of 28 persons were tested in each of the specified groups. The data collected was organized into the following groups (1) observers' ratings of the participants performing in the modules; (2) the overall time for a pass and the times for critical tasks; (3) the opinion of the participant of each of the modules; and (4) background information of each participant.

An outline is being developed with Mr. Don Rossi, RT-4's statistician, to organize the data prior to analysis.

APPLICABILITY: The "afterthought" character of today's architecture intended to meet the needs of functionally limited persons is likely to continue. This is owing to the implicit notion that these persons are categorically distinct from the population at large. Significant re-orientation will occur after it is recognized that able-bodied people also encounter conditions dictating that they function sub-optimally. Such conditions occur with pregnancy, walking while holding a child's hand, carrying packages or a briefcase, etc. The overriding need is for design and construction performance standards that will encompass these wide variations of human capabilities as well as variations associated with (severe) physical impairments.

The conviction underlying this research program is that a uniform approach to building design is required that facilitates the performance of functionally limited people—including able-bodied but encumbered, physically impaired, as well as relatively young and old. Drawing upon criteria synthesized from research in the fields of architecture, human factors, psychology, sociology, and rehabilitation medicine, appropriate design propositions have been developed and readied for evaluation. If validated, they can be used to guide development of a building system that will permit people with a wide range of physical abilities to have access to and use of buildings and their environs. Further, it will be possible to perform these activities with convenience, independence, safety, and confidence.

098 The Role of Respiratory Muscle Fatigue in Neuromuscular Disease

Principal Investigator:	**D.K. Sellheimer, M.D.**	
Status:	**New**	
Dates:	**October 1979-September 1982**	
Cost:	**Annual $143,987** **RT Annual $106,410**	**Projected Total $300,000** **RT % of Annual Total 74%**
Annual Report Reference:	**#18, Page A-69, R-185**	

OBJECTIVES:

1. To compare methods of power spectrum analysis of the diaphragmatic electromyograph as indicators of respiratory muscle fatigue (RMF).
2. To develop a practical (non-invasive, on-line) technique for the clinical and experimental detection of RMF.
3. To assess the role of RMF in respiratory failure in patients with neuromuscular disease.
4. To use the technique to study:
   A. weaning patients with neuromuscular disease from IPPV.
   B. factors which increase the endurance of the respiratory muscles in patients with neuromuscular disease.

METHODOLOGY: In the initial project of this program, a comparative assessment will be made of the High/Low ration of Gross et al. (1979) as modified by Muller et al. (1979), the centroid frequency of Schweitzer et al. (1979) and an automated method of EMG analysis ("ANOPS" method) currently being used in our Institute.

The second project of this program is the design, fabrication, testing, and refinement of an instrument which can provide non-invasive bedside monitoring for RMF. Detailed specifications for it will include (1) band widths of interest, (2) methods of analysis, (3) method of gating ECG, (4) use of a single or multiple breath analysis, (5) the need not to interfere with access to the patient (the instrument must be reasonably remote from the patient), (6) portability and a size small enough to fit into space available around the patient in the ICU, (7) applicable hospital safety requirements for electronic devices, (8) provision for simultaneous recording of the Edi spectral analysis, and (9) cost.

The third project of this program will use the instrument developed for on-line bedside monitoring of Edi for spectral changes indicative of RMF. Studies will be performed on patients hospitalized at The Institute for Rehabilitation and Research (TIRR) for care of neuromuscular diseases.

This study will (1) assess the role of RMF in patients on IPPV, (2) determine any differences in the fatigability of the respiratory muscles of patients being weaned with IMB as opposed to ISV, and (3) assess the RMF instrument as an indicator for the speed of weaning.

FINDINGS TO DATE: The methods of Edi collection and spectral display for analysis are operational in the neurophysiology lab. RMF can be induced in normal subjects and SCI patients by inspiratory resistive loads which were designed by Dr. Seilheimer and fabricated by the Rehabilitation Engineering Center. RMF has been induced in subjects by inspiratory resistive loading while Edi was recorded.

Edi from quiet breathing was subsequently analyzed and the spectrum obtained resembled that reported by Schweitzer, et al. Qualitative analysis of the power density spectrum obtained from breaths near the point of exhaustion as compared to breaths during the initial quiet, non-loaded ventilation revealed both a generalized increase in power and an increase in the low frequency components during fatigue.

APPLICABILITY: Pulmonary complications are a leading cause of morbidity and mortality in neuromuscular disease. They prolong hospitalization, prevent or interrupt rehabilitation, decrease vocational opportunities increase dependency, and increase the cost of hospital and home care. Respiratory muscle fatigue (RMF) is thought to be a major cause of pulmonary complications in these diseases. By obtaining objective evidence of RMF and its role in producing pulmonary complications (especially the need for intermittent positive pressure ventilation), strategies may be developed for preventing fatigue and thus minimizing complications.

More effective control of pulmonary complications makes it possible to remove the patient from the intensive care unit into a rehabilitation setting. Even in centers like ours where an aggressive rehabilitation program is pursued while the patient is on IPPV in the intensive care unit, the rehabilitation process is facilitated by the discontinuation of mechanical ventilation. Weaning the patient from IPPV usually allows removal of the tracheostomy tube which is necessary for ventilation. Removal promotes speech, decreases the amount of costly nursing care that is required, and forestalls complications such as pneumonia which delay rehabilitation.

Emory University (RT-6)
Medical Rehabilitation Research and Training Center

CORE AREAS

Medical

The etiology, natural history and the effects of various approaches to management of neuromuscular skeletal disorders.

Psychosocial

The effects of societal influences on neuromuscular skeletal disorders and the modification of these influences to reduce disability.

Vocational Rehabilitation

Those factors which influence vocational achievement and modify those factors to increase productivity.

EMORY UNIVERSITY

J. Robin deAndrade, M.D., Director
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CONTINUING

NEW

PROPOSED

099 Training Improved Control of Spastic and Paretic Muscles with Computer-Controlled Feedback

Principal Investigator:	**Gary DeBacher, Ph.D.**	
Status:	**Continuing**	
Dates:	**August 1974-July 1980**	
Cost:	**Annual $21,441** **RT Annual $21,441**	**Projected Total $210,781** **RT % of Annual Total 100%**
Annual Report Reference:	**#15, Page 20, R-52**	

OBJECTIVES:

1. To document in detail the EMG changes which occur during EMG feedback training to correct spasticity and paresis.
2. From such detail, to learn more about the nature of the learning process, especially the extent of generalization from trained to untrained muscles, the strategies patients use to inhibit spasticity, and generalization of control from one limb position to another.
3. To use this information to make decisions about how to improve application of EMG feedback in clinical settings.

METHODOLOGY: The project is based technologically on an on-line computer which controls training and data acquisition, and conceptually on a training task hierarchy. Subjects are first trained to relax spastic muscles in the resting state, if necessary. The more challenging tasks are introduced, including passive stretching of the muscle being trained, or voluntary contraction of its antagonist. EMG from up to four muscles is integrated every 1/10 second, digitized, and stored on disc memory for analysis. The computer generates auditory and visual EMG feedback displays and updates performance criteria based on the subject's progress in relaxation and control.

FINDINGS TO DATE: Ten subjects with spasticity and paresis have been trained on a variety of tasks. Eight received training to inhibit spasticity in elbow or wrist flexors during passive stretch at gradually increasing rates. Results for five were equivocal and not clearly indicative of learning. Three subjects learned to inhibit spasticity in the spastic elbow flexor from which feedback was derived, but showed incomplete generalization to the untrained spastic elbow flexors. This may imply that spastic synergists should be trained in groups rather than individually during clinical application of EMG feedback.

Four subjects were trained to better activate and control a paretic extensor muscle while inhibiting co-contraction of spastic antagonists. Two succeeded and showed obvious improvements in extensor strength. A third subject's performance was improved on presentation of EMG feedback, but improvement in control of wrist flexors and extensors was minor, probably because of flaws in the training paradigm. Slow progress for the fourth subject, and lack of sensitivity to presence or absence of feedback, suggest that observed improvements were primarily due to systematic practice.

APPLICABILITY: EMG feedback training is a new modality which is particularly useful with paretic and spastic muscles which are unresponsive to conventional neuromuscular re-education procedures. By itself, it is only a muscle training procedure, but training better control of individual muscles is sometimes an important pre-requisite to successful application of movement training procedures which produce functional gains.

100 Vasomotor Response Training in the Arthritic Patient

Principal Investigator: Gary DeBacher, Ph.D.
Status: Continuing
Dates: February 1976-February 1981
Cost: Annual $28,424 — Projected Total $67,504
RT Annual $28,424 — RT % of Annual Total 100%
Annual Report Reference: #15, Page 36, R-58

OBJECTIVES:

1. To measure the degree to which arthritic patients can learn general relaxation and peripheral vasodilatation.
2. To measure the degree to which patients experience reduced arthritis symptoms.

METHODOLOGY:

1. The training technique was applied to 9 non-arthritic subjects to test the equipment and prototype.
2. Five pilot arthritic patients were trained and arthritis activity measurements taken over a six month period.
3. A study is planned in which arthritics are trained without feedback in progressive general relaxation and peripheral vasodilatation. A waiting list control is employed. A variety of arthritis symptoms will be measured during and after training to see if improvements seen in pilot studies can be obtained with a training method which might constitute an efficient, cost-effective therapeutic delivery approach.

FINDINGS TO DATE:

1. Five of the non-arthritic subjects received true feedback training and did learn to consciously produce changes in peripheral blood flow. Four received false training (as we plan to present to the control arthritic patients), and they did not exhibit the ability to control blood flow.
2. The five pilot arthritic patients all received true training.
    a. Three exhibited good ability to control blood flow and were cooperative. Their arthritis symptoms generally improved over the six month observation period.
    b. One patient probably had control over peripheral blood flow but was uncooperative and did not return for the six month re-check of blood flow control. There was mixed improvement of this patient's symptoms until the last measurement session during which it was observed that she had developed a reaction to her medication.
    c. One patient did not exhibit the ability to control blood flow. She developed a reaction to her medication rather early in the study, and as a result, the medication was altered substantially. Her arthritis symptoms generally worsened over the period of observation.

We are encouraged by the results from the three patients who were cooperative and whose medication was constant or varied only slightly over the observation period. Results of these and related studies suggest that application of proper strategies and consistent practice may bring about learned relaxation and vasodilatation without use of expensive biofeedback technology.

APPLICABILITY: The daily activity of millions of arthritic patients is limited by the use of cumbersome treatment equipment and techniques (e.g., paraffin baths, heating pads, Hubbard tanks, and the use of massage). These techniques are difficult to apply outside of home or hospital. We are evaluating the effect on arthritis symptoms of a less restrictive therapeutic technique, the use of which would increase the patient's mobility, independence and employability.

101 Use of Feedback Goniometers for Hand Rehabilitation

Principal Investigator:	**Gary DeBacher, Ph.D.**	
Status:	**Continuing**	
Dates:	**June 1978-March 1981**	
Cost:	**Annual $14,094** **RT Annual $14,094**	**Projected Total $27,780** **RT % of Annual Total 100%**
Annual Report Reference:	**#15, Page 60, R-61**	

OBJECTIVES:

1. To conduct studies to:
   a. demonstrate the effectiveness of feedback goniometers for overcoming limitations in finger flexion/extension; and
   b. learn more about how they may be optimally employed.
2. To make effective feedback finger and wrist goniometers generally available at a modest price.
3. To disseminate information about these devices and their use to the therapeutic community so as to induce a marked increase in their utilization.

METHODOLOGY:

1. Plans have been written with which therapists can construct simple but effective feedback goniometers from readily available tools and parts. Designs have been developed for the fingers, the wrist, the elbow, and for forearm pronation/supination.
2. Experiments are underway to determine the effect of joint angle feedback on exercise behavior in normal volunteers and in selected patients undergoing hand rehabilitation. Additional comparison studies will be conducted to determine the extent to which therapy outcome is improved when feedback goniometers are integrated into a hand rehabilitation program.

FINDINGS TO DATE:

1. Clinical data obtained in the Emory Hand Management Center indicate that use of feedback finger goniometers produces somewhat more rapid and larger gains in active range-of-motion in patients recovering from tendon repair or from arthroplasty.
2. Experience to date with the "do-it-yourself" simplified feedback goniometers indicates that the average therapist can construct them successfully. They stand up well in clinic and home use, and they seem as effective for therapy as more complex electronic feedback goniometers.
3. As one would expect, the studies on normal volunteers indicate that they can do range-of-motion exercises more accurately and consistently with goniometer feedback than without it.
4. Do-it-yourself finger goniometer plans have been disseminated to over 350 therapists. A follow-up survey is being conducted to determine how many have built and used goniometers.

APPLICABILITY: Systematic, progressive, active range-of motion exercise is part of the hand rehabilitation program for many patients after hand trauma or surgery. Joint angle feedback makes it possible for the therapist to closely control stress on healing tissues and gives patients concrete goals which foster motivation and compliance with exercise studies.

102 Biofeedback Relaxation Therapy in the Treatment of Spasticity and Anxiety in CVA Patients

Principal Investigator: Paul L. Fair
Status: New
Dates: April 1978-April 1981
Cost: Annual $59,062 — Projected Total $88,417
RT Annual $59,062 — RT % of Annual Total 100%
Annual Report Reference: #15, Page 82, R-62

OBJECTIVES: The purpose of Project R-62 is to assess concomitant effects of general relaxation training using EMG feedback and non-biofeedback techniques as a procedure for facilitating the learned control of spasticity and as an anti-stress technique for the alleviation of debilitating emotional and motivational states in severely disabled patients with neurological disorders. We believe that deep relaxation training will result in improved motor and psychological functioning which will greatly facilitate patients' return to active, independent lives.

This project is integrated with the clinical study entitled "Developing Specific Treatment Strategies for Muscle Biofeedback in Stroke Patients" (R-63 - S.L. Wolf, Ph.D., Principal Investigator).

These two projects have a common objective: to develop and define ancillary facilitatory techniques which may assist the patient in gaining maximal voluntary control over spastic musculature.

In addition, the specific objectives of Project R-62 are:

1. To determine whether relaxation training, assisted by multimodality biofeedback, will facilitate voluntary control over spasticity indicated by reduced EMG activity and/or reduced latency of self-induced relaxation in response to quick passive stretch.
2. To determine whether relaxation training will result in reduced levels of anxious and depressed mood states and psychological dysfunction as measured by psychological rating scales.
3. To obtain preliminary information on the potential effects of relaxation training on the use of non-prescription and prescription medications. Specifically, we will monitor the use of medications of all types (e.g., pain killers, tranquilizers and sleeping pills) that are taken as needed (prn), as well as any alterations in fixed dosage medications (e.g., anti-hypertensives) that are adjusted by the patient's personal physician. Observed changes in medication usage may justify a controlled study in the future.
4. To assess the effects of relaxation training on subsequent targeted muscle retraining.
5. To develop psychophysiological profiles on stroke patients that can be integrated with the biofeedback evaluation forms being developed in R-64 in order to provide a more comprehensive evaluation of stroke patients, thus potentially optimizing treatment strategies.
6. To develop specific biofeedback techniques and a series of tape-recorded relaxation programs for home practice that can be utilized by physical therapy, psychiatric and vocational counseling personnel.
7. In consultation with a vocational specialist we are assessing the potential role that relaxation therapy may play in vocational rehabilitation settings. Vocational counselors are faced with clients who are typically both physically and emotionally disabled.

Although it is no panacea, relaxation training efficiently integrates aspects of physical therapy and psychotherapy which could be of considerable value in helping many individuals to cope with stress responses that may impede successful vocational rehabilitation. Vocational counselors should be made aware of the existence of relaxation techniques and their potential in the total rehabilitation process.

METHODOLOGY: In order to meet the objectives, two interrelated studies are being conducted.

Study 1:
Study 1 assesses the effects of 20 relaxation training sessions on spasticity, anxiety, depression and maladaptive psychological functioning in 20 subjects using a within-subject design. Identical psychological, psychophysiological and spasticity measurements are obtained on the subjects in two evaluation sessions preceding 20 relaxation training sessions and one evaluation session following the twenty sessions.

Study 2:
Study 2 expands upon Study 1 and assesses the effects of relaxation training on subsequent targeted muscle retraining. Three groups (Sequential Group, Concurrent Group and Targeted Muscle Retraining Group) of 20 subjects comprise an Independent Groups Design. The **Sequential Group** receives a sequence of 20 relaxation sessions followed by 20 targeted muscle training sessions. The **Concurrent Group** receives 20 sessions of relaxation training concurrently with 20 sessions of targeted muscle retraining; that is, a relaxation session will precede each target muscle training session on the same day. The third group, the **Targeted Muscle Retraining Group,** receives 40 targeted muscle training sessions only. No systematic training in generalized relaxation is undertaken with individuals in this group, unless a specific individual fails to make progress after at least 15 sessions of targeted training and is considered a failure by the criteria established in Project R-64.

All subjects receive two identical evaluation sessions preceding the first block of 20 treatment sessions (i.e., relaxation training, targeted muscle retraining, or a combination of 10 relaxation with 10 targeted muscle training sessions).

A third evaluation is obtained at the completion of the first 20 sessions. Additional evaluations are made upon completion of each additional block of 20 at the midpoint and end-point of each extremity trained in R-64.

Subjects receive an initial screening to determine eligibility followed by an assessment of limb function and spasticity levels using procedures developed for R-64. Each experimental group for Study 1 and Study 2 will have 20-30 subjects (50% men, 50% women) between the ages of 16 and 64 years.

Evaluation measures consist of (1) a battery of psychological scales to assess anxiety, depression, mood, family environment and personality; (2) electromyographic recordings from 8 muscle regions and peripheral skin temperature under conditions of relaxation and stress; and (3) electromyographic assessment of spasticity levels following quick passive stretch.

Relaxation training consists of 20 biofeedback training sessions over the course of ten weeks and daily home relaxation practice utilizing audio cassette tapes.

FINDINGS TO DATE: **Preliminary Psychological Results (Baseline 1):** Results for the Self-rating Depression Scale (SDS) (N=19) and the Self-rating Anxiety Scale (SAS) (N=20) were obtained on 20 patients. W.W.K. Zung has described cutoff-criteria for normal, symptomatic, and clinically depressed individuals. The mean depression score for the total group was 59.7 which falls in the range indicating a potentially significant clinical depression (Depressed Score ≥ 57) in this patient sample. Eleven patients (58%) had scores of 57 or greater; 6 patients (32%) were in the 50 to 56 range indicating symptomatic depression; and only 2 patients (10%) were in the normal range (Score ≥ 49). In light of the results of the Depression Inventory, the results of the Anxiety Inventory were somewhat surprising. For the purpose of the present study, an SAS score ≥ 44 falls within the normal range of anxiety symptoms; an SAS score ≥ 56 indicates severe anxiety symptomology. The mean anxiety score for this group was 44.4 (N=20) which is the borderline between normal and symptomatic anxiety. Eleven patients (55%) were within the normal range, 7 patients (35%) were in the symptomatic range, and only 2 patients (10%) fell within the clinically significant range of anxiety symptomology.

A further breakdown of this anxiety and depression result, based on a media split as a function of body side affected (right vs. left), did not indicate a significant influence for this variable.

In summary, these preliminary results suggest that a significant degree of depression may be present in the stroke population. Ninety percent of the present group of stroke patients showed moderate to severe levels of depression as measured by the Zung Self-rating Depression Scale. Forty-five percent of these patients had moderate to severe levels of anxiety as measured by the Zung Self-rating Anxiety Scale. However, the majority of these individuals possess physical symptomology due to the effects of the CVA which are tapped by these scales and might tend to elevate their anxiety and depression scores: the distribution may not differ dramatically from a group of physically normal individuals of similar age.

Preliminary Psychophysiological Results (Evaluation 1): The psychophysiological profile provides information about 8 muscle regions and peripheral skin temperature in response to self-induced relaxation, mental stress, post-stress relaxation, and relaxation facilitated by tape-recorded instructions. The forehead, neck and peripheral skin temperature sites are the most widely used indicators of generalized body tension in biofeedback training for generalized relaxation. Tonic level, degree of reactivity to stress, and subsequent recovery should be evaluated in order to determine the appropriateness of biofeedback training. Further, if a particular physiological system responds appropriately to relaxation instructions, then this system may be the desired initial target of training before training a more difficult system.

The absolute levels of frontal EMG for relaxation conditions ranged between 3.2 and 4.9 uV in stroke patients as a group. A comparable range in untrained normals would be approximately 1.0 to 2.5 uV of activity for these relaxation conditions and as recorded on our equipment. A further distinction between stroke patients and normals is the continued rise in activity in Rest 2 following the termination of mental stress. This could indicate a potentially greater reactivity to stress in stroke patients. This interpretation, however, must be considered in light of the reactivity of other physiological systems.

When the total group is split between right body side affected vs left body side affected (right affected vs left affected), these preliminary results indicate that right affected individuals may have both higher levels during relaxation and relatively greater reactivity to mental stress (Serial 7's task) than left affected individuals.

The EMG results for the upper trapezius region (neck) for the total group and separately for right and left affected sides indicated that with the exception of the first period of tape recorded instructions (Relax Tape 1) both groups show similar profiles in this region. The total group, however, still shows overall higher levels than comparably sampled normals.

Preliminary observations of the peripheral skin temperature profiles for the Total group and separately for right side vs left side affected individuals indicated that the temperatures for the total group, as well as right side and left side affected groups are within normal limits. There appears to be a difference in the peripheral skin temperature response as a function of right vs left side affected with right side affected individuals showing consistently higher skin temperature levels. Since dominant handedness affects temperature assymetry in the body, however, these data are potentially confounded and any conclusions would be premature.

Summary and Preliminary Conclusions: Based on this brief presentation of psychological and psychophysiological data, some tentative inferences can be drawn. The SDS results indicate a significant degree of depression in this sample of stroke patients and are consistent with our expectations. The SAS results reveal high normal to moderate levels of anxiety symptomology which are lower than anticipated. The psychophysiological data on the two most used indicators of general muscle tension (i.e., Frontalis and Upper trapezius) indicate higher than normal muscle tension and are consistent with the depression data. Further, they are not excessively elevated (e.g., as compared to a psychiatric sample of anxious patients or our current finding with a sample of speech disordered individuals) and are consistent with the findings of nominal anxiety in the SAS results. Third, the profiles obtained thus far indicate that stroke patients could benefit from biofeedback assisted relaxation training for mood and body tension control.

APPLICABILITY: A significant number of individuals are disabled each year by cerebral vascular accident, resulting in neuromuscular impairment. While many of these individuals may return to active, independent lives through current rehabilitation procedures, others are impeded in their progress by the interaction of their disability with psychosocial stresses. Biofeedback relaxation training can significantly facilitate medical and vocational rehabilitation goals at two levels of the person's functioning. First, self-regulated control of generalized muscle tension should facilitate the functional retraining of spastic and paretic limbs. Second, relaxation training produces a cultivated state of low arousal which functions as an anti-stress response.

In the past, stroke patients have not been considered viable candidates for biofeedback relaxation training by many clinicians. Through our development of specific training strategies and home practice programs for use with this difficult population, we have been able through our dissemination activities to begin to alter this bias. Should subsequent findings from this project indicate that generalized relaxation training has significantly beneficial effects for psychological and physiological functioning and/or control of spasticity in the course of neuromuscular retraining, the rehabilitation potential for these patients could be considerably improved.

This project is most immediately relevant to the physical rehabilitation of stroke patients in a medical facility. In addition, relaxation training is appropriate for other neuromuscular hyperarousal syndromes including cerebral palsy and spinal cord injury. These groups constitute a severely disabled population. Although this proposal does not attempt to assess the long-range effects of training on employment potential, the acquisition of this skill should facilitate coping with interpersonal and vocational stresses as well as facilitate motor function. New coping skills may make possible, for example, the placement of severely disabled stroke patients in sheltered workshop settings, thus meeting national, regional and state vocational rehabilitation objectives.

103 Biofeedback Rehabilitation of the Incomplete Spinal Cord Patient

Principal Investigator: Steven L. Wolf, Ph.D.

Status: New

Dates: April 1978-March 1981

Cost: Annual $47,887 — Projected Total $130,256
RT Annual $47,887 — RT % of Annual Total 100%

Annual Report Reference: #15, Page 104, R-63

OBJECTIVES: **General:** To examine the effect of EMG biofeedback training with strengthening exercises upon the ability of incomplete SCI patients to increase functional activity so as to optimize their prospects for increased independence in activities of daily living and gainful employment.

Specific: To evaluate the change in several quantifiable variables between initial and final testing, including:

1. muscle strength for specific muscle groups;
2. action necessary to control spasticity in specific muscle group(s);
3. amount of time necessary to control spasticity in specific muscle group(s);
4. activity level achieved with respect to the involved limb(s).

Specific: To develop a rating scale (in finalized form) for the above so that a digital profile can be achieved for involved limbs as well as the entire person.

Specific: To determine if relationships exist among the duration of disease, duration of previous rehabilitation, location of the lesion, number of EMG biofeedback treatments, pharmacological therapy, and final outcome from training sessions.

Specific: To identify those psychosocial factors which may impede the progress of clients during EMG biofeedback training.

General: To provide vocational rehabilitation personnel with assessments of motor performance in order to maximize the employment opportunities for this client population.

Specific: To develop an informational packet designed to inform VR counselors about biofeedback and its implications for serving VR clients.

Specific: To demonstrate that information on patient outcomes (e.g., psychological disposition, endurance, muscle strength, control of spasticity) can be written and disseminated for practical use by VR personnel.

METHODOLOGY: SCI clients are screened for admittance into this project. Acceptance is based upon: EMG or voluntary motor unit activity in muscle groups caudal to the site of lesion; evidence of some voluntary activity in musculature caudal to site of lesion; uncontrolled induced or spontaneous spasm; cognitive awareness of unusual or unique sensation arising in musculature caudal to the lesion (e.g., pain, anticipated tremor or spasm, etc.); and accessibility to our facility at least twice per week for 9 months. Patients are evaluated for active range of motion; duration of induced clonus or spasm; voluntary electromyographic activity; function; and changes in activity of daily living. All these data are quantified and stored on line to a PDP8/E computer for subsequent analyses. Evaluations are performed at monthly intervals up to 9 months. The intent of this project is to develop training strategies, using EMG biofeedback, that will effect improvements in function among chronic SCI patients and to relate these changes to the duration and levels of the injury. Medical improvement will be assessed via changes in a comprehensive neurological examination.

FINDINGS TO DATE: Progress toward meeting our stated objectives has been limited because of programmatic difficulties in completing our evaluation-computer, on-line interface. These problems have now been remedied and data acquisition is underway. Insufficient information is available at present to address the issue of functional or neuromuscular improvement resulting from EMG biofeedback training with SCI patients. During the past year considerable information was obtained from numerous spinal cord injury treatment centers throughout the country. This information was synthesized to develop our functional and neuromuscular evaluation forms. These data sheets also helped to determine those elements which would be of most value in our computer acquisition program.

While in-house progress has been limited, considerable effort was expended in training and data acquisition at the Shepherd Spinal Center in Atlanta. Several of the rehabilitation team at that facility have been instructed in the use of EMG biofeedback for acute spinal cord injury patients with particular emphasis placed upon biofeedback applications during acute stage immobilization and as an assessment for changes in muscle activity over time. Analysis of this approach in use of the EMG biofeedback modality is encouraging among selected patients and, at the least, provides immobilized patients with the opportunity to perform static muscle activities during the initial post-injury phase of hospitalization.

APPLICABILITY:

1. **Impact on Vocational Rehabilitation:** The materials, scales and other findings developed from this study should benefit VR personnel. They assist the rehabilitation counselor and evaluator in gaining knowledge of an additional modality which can be of assistance to selected SCI clients and can provide information on the level of functional activity the SCI person has attained when he/she completes biofeedback treatment.

   To provide this information to VR personnel, the material and scales developed will be adapted to the specific needs of the VR professionals.

   This adaptation will be done in the following manner:

   a. A VR specialist at RT-6 (Mr. Decker) is spending time in observing and discussing the techniques of biofeedback and their implications and limitations, and in gaining a working knowledge of the modality. He therefore will be able to facilitate communication between medical rehabilitation health personnel and VR.

   b. An advisory group of VR professionals will be used to provide feedback on the materials developed to improve their relevance to VR work.

   With input from these two sources, the project staff will develop a common level of communication to bridge the sharing process between the two rehabilitation professions and to expand the services available to the SCI patient.

2. **Impact upon the SCI Population:** Approximately one-half million young Americans have sustained traumatic spinal cord injuries. The personal and financial costs, when coupled with the potential loss of earning power for these citizens, approaches staggering monetary figures. We are developing methods of employing EMG biofeedback to facilitate neuromuscular recovery in SCI clients and thus aid them in assuming more independent and productive lives, which as a goal for the SCI patient has been virtually neglected. This project provides an opportunity of evaluating the effectiveness of EMG biofeedback training on a population of SCI clients who have already been exposed to previous rehabilitation treatment regimes. As a consequence of this training procedure, we may be able to restore further function to these clients, thus increasing the possibilities for substantial gains in independence and employment; to determine (on the basis of past rehabilitation history, duration of the disease, extent of injury and specificity of improvement in muscle groups) which clients may best benefit from EMG biofeedback training; and to increase communication and delivery of services between medical rehabilitation experts and VR personnel.

104 Developing Specific Treatment Strategies for Muscle Biofeedback in Stroke Patients

Principal Investigator: Steven L. Wolf, Ph.D.

Status: New

Dates: April 1978-March 1982

Cost: Annual $37,674 — Projected Total $207,641
RT Annual $37,674 — RT % of Annual Total 100%

Annual Report Reference: #15, Page 134, R-64

OBJECTIVES:

1. To develop biofeedback evaluation forms designed to: (1) rate functional mobility about involved joints (active and passive range of motion) and functional use of an extremity (activities of daily living rating scale and reporting system); (2) document and determine changes over time in range of motion and electromyographic activity for specific joints and muscles respectively; (3) provide maximal information to vocational rehabilitation personnel to assist such individuals in adequately appraising the client's neuromuscular status in preparation for employment evaluation.
2. To determine if a relationship exists between the patient's ability to relax spastic muscles (as measured by integrated EMG values) and his maximal functional rating score (numerical value).
3. To develop and define ancillary facilitatory techniques which may assist the patient in gaining maximal voluntary control over spastic musculature in the presence of EMG biofeedback training.

METHODOLOGY: Stroke patients meeting specific criteria (no previous feedback training, at least one year post-stroke) are evaluated through a battery of neuromuscular, electromyographic, sensory-motor, and functional tests, all of which are quantified. Biofeedback training then proceeds at 20 session intervals up to a maximum of 60 sessions for one hemiplegic limb. Evaluations are repeated and compared after each sequence of 20 training sessions. Initiation of treatment to the hemiparetic upper or lower extremity is randomized. Training follows a strict protocol which includes: selection of specific target muscles for relaxation and facilitation; progression in a proximal to distal manner; relaxation of spastic muscles preceding recruitment of weak, antagonist muscles; progression of training from a supine to standing (or ambulating) posture. Specific aspects of the training strategies are subsequently related to functional gains in an effort to conclusively determine those aspects of training most essential to beneficial outcomes using this modality among a chronic stroke population.

FINDINGS TO DATE:

1. It is much easier to achieve significant gains in the hemiplegic lower extremity than upper extremity.
2. The greatest limitation to upper extremity improvement using EMG biofeedback training resides in continued restricted use of the involved thumb, and, to a lesser extent, the finger flexors.
3. From a preliminary perspective, the single most important training component related to functional improvement appears to be the patient's ability to learn to inhibit hypermotor responses from spastic musculature, particularly during induced (passive) stretch of these muscles.
4. EMG biofeedback appears to facilitate improvement in chronic stroke patients.
5. A need exists to further delineate specific organic and pathophysiological aspects of stroke in order to more clearly ascertain which stroke patients can improve through clinical application of this modality.

APPLICABILITY: This research helps to clarify relevant clinical training strategies among practitioners using EMG biofeedback for chronic stroke patients. The functional assessments embodied in this study should help, both clinicians and vocational rehabilitation personnel, to more clearly and quantitatively note improvements in their stroke patients' upper and lower extremity activities.

105 Evaluation and Restoration of Function in the Hemiparetic Upper Extremity of the Hemiplegic through EMG Feedback within the Patterns of Movement.

Principal Investigator: C. Gonnella, Ph.D.

Status: New

Dates: January 1978-October 1982

Cost: Annual $77,135 — Projected Total $242,635
RT Annual $77,135 — RT % of Annual Total 100%

Annual Report Reference: #15, Page 173, R-65

OBJECTIVES: The overall goal is determining the efficacy of electromyographic feedback (EMGFB) within diagonal patterns of movement in re-establishing the temporal spatial organization of movement essential to functional control of the upper extremity in stroke patients. Functional control is defined as the usual normal pattern of movement.

The project has two phases. In phase I, descriptive data bases are being developed for two groups: normal and patient subjects, identifying the temporal-spatial relationships of muscle groups in a selected functional pattern of movements of the upper extremity.

In phase II, the experimental treatment protocols will be tested for their effectiveness in shaping control of movement. Neuromuscular retrievability, i.e., degree and rate of recovery and maintenance of function will be determined.

METHODOLOGY:

Phase I:
Normal subjects will perform two basic functional patterns of movement of the upper extremity: D1 flexion and D1 extension (as described by Knott and Voss) which are exaggerated components of the basic eating pattern. EMG activity of six muscles in the upper extremity will be analyzed. A modified Cybex II Dynamometer System will be used to control the movement pattern.

A similar analysis will be done with CVA subjects. In addition, a modified format of the Brunnstrom battery, ADL activities, and reaction and movement time will be assessed. The data will provide descriptive report of the EMG and functional status of the CVAs as well as a data base for comparisons where appropriate.

Phase II:
In this phase, two proprioceptive neuromuscular facilitation (PNF) patterns. D1 extension and D1 flexion will be applied by the research therapist, with and without EMG feedback to predetermined muscles which are integral to D1 flexion. A multiple baseline across behaviors single subjects design is the research strategy. Subjects will be followed for two years following the block of experimental treatments.

FINDINGS TO DATE: Most of the past year has been spent in perfecting our technique of EMG analysis. The problem has been controlling the desired pattern of motion so that the movement could be duplicated consistently and exactly. A modified Cybex II Dynamometer system is now providing us with the desired consistency.

The first half of Phase 1, EMG analysis of a group of normals is currently being concluded. Data analysis of the results has not yet been completed, but some trends are appearing:

1. Each normal subject (woman) has her own pattern of muscle activation within the specific pattern of motion used. These patterns are not consistent across subjects. There appears, however, to be a high degree of consistency within each subject, particularly in groupings of particular muscles that seem to fire as a unit.
2. Certain parameters of the EMG may be comparable between right and left upper extremities. The duration of the burst of EMG activity of the non-dominant upper extremity shows a difference of 15% or less from the duration of EMG activity of the dominant upper extremity in 90% of the trials thus far conducted.

The latency of the muscle activation may also be comparable between the two upper extremities within a certain narrow range. Analysis of this parameter is continuing. Amplitude of the EMG activity does not appear, at this point, to be a valid comparison between the two extremities.

APPLICABILITY: A significant number of persons (450,000 per year) are stricken with cerebral vascular accidents that interfere with their return to employability or to independent living. The return to employment or further education in a still vocationally active group has been very low. The statistics on rehabilitation of the stroke patient are grim, particularly when we consider the greater difficulties we have in assisting the patient to reacquire functional control of the paretic arm and hand; therefore, further understanding of the potential for recovery of functional control of the upper extremities and identification of mechanisms to tap into this potential will benefit the patient and the health service delivery systems.

106 Development of a Systematic Approach to the Selection and Vocational Rehabilitation of the Severely Disabled

Principal Investigator:	**Roger Decker, M.A.**	
Status:	**New**	
Dates:	**November 1977-October 1982**	
Cost:	**Annual $33,043** **RT Annual $33,043**	**Projected Total $248,502** **RT % of Annual Total 100%**
Annual Report Reference:	**#15, Page 221, R-66**	

OBJECTIVES:

1. The **purpose** of the project is multifaceted:
   a. To ascertain the current state-of-the-art in serving the severely disabled as represented by the models used by VR agencies on a national basis;
   b. To synthesize the various models into a composite model;
   c. To apply the composite model with three groups of severely disabled clients;
   d. To experiment with innovations in various components of the model; and
   e. To disseminate the results via training conferences, monographs, and/or other publications.

2. The specific **research questions** addressed by this project are:

   a. How much variation/similarity exists among the state models used to provide vocational rehabilitation services to the severely disabled?

   b. What evidence, e.g., benefit-cost ratios, consumer satisfaction, percent severely disabled rehabilitated, exists to support the models in use?

   c. Can the most effective components of the various models be synthesized into a comprehensive, coordinated, ideal model using a systems analysis approach?

   d. Can the ideal model be implemented on a pilot-basis at reasonable costs?

   e. Is the ideal model superior to other models in rehabilitating the severely disabled?

METHODOLOGY:

Phase I:
National Survey of State Vocational Rehabilitation Agencies. The 56 state vocational rehabilitation agencies serving general clientele were included in this survey. Agencies serving only the blind and visually handicapped were excluded.

Phase II:
Survey of Atlanta Area Employers. A stratified random sample of 300 employers has been selected from the greater Atlanta area. An equal number of small (5-49 employees), medium (50-199 employees), and large (200 or more employees) employers will be sampled. A return of 60% is anticipated. The initial survey includes descriptions of the work activities; e.g., number and type of handicapped employees, if any; employer knowledge and attitudes regarding the disabled. A follow-up observational survey will be conducted for a sample of the respondents in order to assess architectural barriers; the possibility of improving accessibility of the work site; and the feasibility of job restructuring.

Phase III:
Originally, we planned to set up an ideal model rehabilitation program for groups of patients who represented disabled population, and implement it on a pilot basis. Lack of adequate resources prevented this. We plan to synthesize material we receive, into components of workable programs and to disseminate results.

FINDINGS TO DATE: The survey activities of Phase I of the project have been completed. Fifty-one State/Federal Vocational rehabilitation programs were surveyed with a questionnaire which was developed in the first year of the project. Eighty-one of those programs surveyed returned completed questionnaires and copies of the ongoing Innovation and Expansion (I&E) projects.

Over 230 projects were received. They were then reviewed and divided into disability groups dictated by the quantity of returns. The major groups which evolved were services to the deaf, services to the visually impaired, services to the mentally retarded, services to the spinal cord injured, services to the mentally ill, and a final potpourri classification of other disabling conditions.

The data received from this initial survey are presently being analyzed. Some of the early findings, however, can be indicated now. In response to the section on innovations for the severely disabled, there is general agreement among regions on most items. A primary change made by agencies is in the utilization of similar benefits; e.g., resources such as insurance, medicare, medicaid, are also used to support sources for this population. Other changes which have been made include the initiation of training for staff to increase their capacity to serve the severely disabled and the addition of staff positions.

The I&E projects which have been divided into selected groups by disability types and functions are currently being shared with experts within the field of rehabilitation who are familiar with the specific field. Each expert has been asked to review the I&E projects and to develop a written report.

Thus far we have received the reports concerning the following disabilities: hearing impaired, mentally ill, mentally retarded, and visually impaired.

The second phase of the project is to provide a survey of employer attitudes toward the employment of the severely disabled. This activity has been initiated and all survey information has been collected to date. One hundred and seven Metro Atlanta employers were surveyed on their attitudes toward employment of the severely disabled. The two instruments used were developed as a modification of previous instruments developed by Rickard et al., combined with materials developed by A.C. Williamson, Jr.. Data will be analyzed and compared within respondents and among three groups of small, medium and large employers. An on-site survey for architectural barriers within business and industry was also completed. Fifteen (15) employers from each of the small, medium and large classifications were selected and accessibility was reviewed within the employment setting.The initial review of the information suggests that a very limited number of employers have barrier-free facilities for the severely disabled. Suprisingly, a significant number have employed disabled persons within their work force. A comparison of the accessibility to employment by the size of employer suggests problems continue to exist in the provision of employment for the severely disabled.

The initial data suggest also that most employers expressed an interest in accepting the disabled for employment. All large employers stated that they could accept the handicapped employee, while only 69% of the medium employers felt they could accommodate the disabled. The small employers reported with an 88% positive response to this question. Employers presently have disabled workers on their work force at a varying rate. Large employers lead the other groups, with 83% reporting that they have disabled employees. Small employers were second with 56% and the medium-size employer hired disabled workers at the lowest rate of 44%.

There were inconsistencies with responses related to types of handicaps accepted and types employed. Large companies reponded with 87% demonstrating that they would accept blind applicants for entry level positions, yet they show only one current blind employee. For accepting paraplegics in entry level positions, 80% of large companies and 86% of medium size companies responded positively. However, neither company responded that any such employees were presently working there. These discrepancies may indicate that although employers are willing to match the type jobs available with types of handicapped people appropriate, they are not following through.

In order that employers can be in touch with a pool of qualified disabled job applicants, they need to have contact with a Vocational Rehabilitation agency. When questioned about their contacts with Vocational Rehabilitation agencies, the employers reported very limited contact, 25%, while the larger employers had a higher rate of contact, 73%.

A final area which was assessed in this part of the study was the availability of job descriptions. It is important for a potential job applicant to be able to review the tasks involved in performing a job in order to determine his capacity for performing the job. Our data suggest that only 27% of the large companies surveyed had job descriptions. Only thirteen percent (13%) reported having job descriptions.

In addition to surveying employers about accessibility to employment, additional data were gathered on architectural barriers at the work site. Initial analyses of the data suggest that most employers have done little to remove architectural barriers to employment.

On the positive side, all employers sampled had accessible water fountains and telephones. Beyond these items, however, a rather dismal picture emerges on the other items studied. Of major concern were rest rooms. There were no (0%) rest rooms available for the disabled in the small and medium companies and only 20% of the large companies have accessible rest room facilities.

A second major area where barriers exist is the work space. The on-site survey found that only 44% of the medium companies have work space which is accessible to the disabled worker. The small companies were observed to have 56%; and the large companies were highest, with 60% barrier-free.

The initial interpretation and recommendations from these data suggest that employers appear to be lagging in their response to laws which encourage the employment of the disabled workers, not only in employment practices, but also in the removal of architectural barriers which impede the entrance into and full participation within the work site.

APPLICABILITY: We anticipate that the findings would result in a significant contribution to the successful implementation of the Rehabilitation Act of 1973 as amended. Specifically, the **anticipated benefits** include:

1. A detailed description of the current state-of-the-art in providing services to the severely disabled.
2. A mechanism for sharing information among the VR agencies, pointing out gaps in the current models being used, and indicating needed facility, personnel, and fiscal resources.
3. An opportunity to test the feasibility of applying a systems approach to model integration among a variety of organizational structures all attempting to provide efficient and effective services to the severely disabled through the state-federal program.
4. Documentation of the resources and procedures needed to implement an integrated, ideal model derived through a systems analysis of existing models.
5. Research evidence for the efficiency/inefficiency and effectiveness of an integrated, ideal model derived through a systems analysis of existing models.
6. The reviews of the I&E projects will be suitable for inclusion in a monograph built upon an outline developed by us. This document, along with the data which have been gathered, will be one of the primary dissemination modes from the materials provided by the experts. Specific recommendations for services for the severely disabled will be developed.
7. The role of the VR agency in providing information to business and industry on the removal of architectural barriers, and finally in providing information on the potential pool of qualified disabled job applicants for employers in need of workers will be clearly identified.

107 Clinical Effectiveness of Patient-Self-Instruction in Physical Rehabilitation Skills and Implications for Delivery Systems

Principal Investigator: C. Gonnella, Ph.D.
Status: New
Dates: April 1980-December 1981
Cost: Annual $59,371 — Projected Total $59,371
RT Annual $59,371 — RT % of Annual Total 100%
Annual Report Reference: #15, Page 239, R-67

OBJECTIVES:

1. To demonstrate the effectiveness of a self instructional strategy in crutch walking with English and non-English speaking patients in various settings.
2. To add sign language to the video tapes developed and test these with a deaf sample.
3. To assess the feasibility of the self-instruction units within different delivery systems.
4. To identify other physical rehabilitation tasks that will lend themselves effectively to patient self-instruction and develop two representative prototypes: One in occupational therapy, and one in physical therapy.
5. To test the prototypes developed.
6. To identify the implications of this strategy with practitioners.
7. To derive guidelines with practitioners which would assist them to develop patient self-help video tape.

METHODOLOGY: A 26-month project is planned in which work toward the accomplishment of the objectives overlap. The major emphasis in the first year is on collecting data in several different delivery systems on the effectiveness and the conditions of effectiveness in the use of the self-instruction unit in the three-point crutch gait. At the end of the first project year we shall have met the first three objectives: (1) and (2) identifying the effectiveness of self-instruction in different systems with a variety of patients (without brain damage); and (3) assessing the feasibility of this strategy within these varied settings. Examples of delivery systems are the general hospital, rehabilitation centers, outpatient clinics and possibly home health services. Some work will have been done also on the fourth and fifth objectives: (4) developing representative prototypes for other activities lending themselves to the self-instructional approach; and (5) identifying the implications of this self-instructional approach with practitioners.

In the second year, the focus of the work is objectives 3 and 4, and guidelines will be derived with practitioners for furthering the development of similar self-help units and their use. The remaining two months will be used to prepare final materials for dissemination.

Specific Activities, Year I:

1. Modify the evaluation forms already developed which were used in the laboratory testing of the self-instructional units on crutch walking.

2. Recruit and orient the two samples of participants. We will meet with those within Region IV. Our working association with participants outside of Region IV will be conducted by correspondence and phone.

3. Explore with the local participants other rehabilitation skills that are amenable to the self-instructional strategy.

4. Select two of these skills, one in P.T. and one in O.T. to be programmed and developed into a self-instructional videotape format.

5. Design evaluation forms to test the effectiveness of the two new units and to assess the administrative problems of using this strategy.

Specific Activities, Year II:

1. Analyze data from first year.

2. Test two new units, collect and analyze data.

FINDINGS TO DATE: None. This project has not yet been activated because of lack of funds.

APPLICABILITY: Self-care and self-instruction in the prevention and maintenance of health are principles receiving much attention these days, for a variety of reasons: e.g., cost effectiveness, optimal use of personnel time and skills, and client involvement as a desirable process. We believe these reasons and others apply to the advocacy of wider use of self-instructional materials, particularly in acquiring or relearning the motor skills of physical rehabilitation. This wider use requires the kind of concerted effort and attention to strategies of patient administered self-instruction that is proposed in this project. The general strategy is one that should apply to many age groups and to many disability groups.

108 Methods Time Measurement in Establishing Standards of Performance in Physical Rehabilitation

Principal Investigator:	C. Gonnella, Ph.D.	
Status:	New	
Dates:	October 1978-September 1981	
Cost:	Annual $66,774 RT Annual $66,774	Projected Total $66,774 RT % of Annual Total 100%
Annual Report Reference	#15, Page 250, R-68	

OBJECTIVES: The development of standards of performance to determine therapeutic effectiveness, cost effectiveness, and related questions in the provision of health services requires reliable valid tools which are also easy and inexpensive to apply. In response to this issue of developing criteria, we proposed to adapt an assessment tool derived from the system of Predetermined Time Standards (PDTS) to the needs of health professionals in physcial rehabilitation. Methods Time Measurement (MTM) derived from Predetermined Time Standards (PDTS) is a procedure which reduces any operation (activity) into its basic motions and then assigns to each motion a predetermined time standard. The pre-determined time standard stems from the nature of the motion and the conditions under which it is made.

To confirm the potential use of MTM identified, and to encourage the use of MTM, we propose the following objectives:

1. To identify the applications and limitations of MTM in physical rehabilitation;
2. To develop and test representative applications of MTM;
3. Identify differential control of movement elements by the client through MTM analysis, thus permitting individualized therapeutic intervention.

   Because MTM divides a functional movement into its component parts, performance efficiency can also be determined for the elements within the total movement.
4. Design performance measures that by the very process of using MTM produces a standardized test.

   Since MTM has predetermined normal values, construction of a performance test designed through MTM synthesis would have normal values automatically.

METHODOLOGY: This project has been divided into four stages: I) Preparatory; II) Development/Testing; III) Dissemination; and IV) Evaluation.

The Preparatory Phase will consist of the training of associated physical therapy and occupational therapy personnel in the use of MTM and the selection by these personnel of activities in therapy that would lend themselves to the application of MTM. The Development/Testing Phase will include the development and testing of the chosen application of MTM and preliminary work on a monograph and videotapes which will be used as self-instructional units for other health personnel. During the dissemination phase, the monograph and videotapes will be completed and a workshop prepared for various health personnel interested in learning and applying the MTM method. The evaluation phase will consist of the assessment of the impact of disseminated materials through the use of mailed questionnaires.

FINDINGS TO DATE: Phase I (Preparatory) is now close to completion and Phase II begun. A two-day workshop was held at RT-6 during which the occupational and physical therapists associated with the project learned the application of MTM. The Jebson test of hand function was selected as an example of an activity that could be analyzed with MTM. The results of the MTM analysis could then be compared with the standardized values determined previously by the authors of the test.

As part of Phase II (Development/Testing), this MTM analysis was completed and compared with the values supplied by the test's authors. Out of seven tasks analyzed in the test, the time standards from MTM analysis and those predetermined by the authors were comparable in only two of the tasks. Further testing of other possible applications of MTM analysis is planned to assess the extent of the disparate results, to identify the reasons for the discrepancies and their implications for the use of MTM as originally proposed.

APPLICABILITY: The term "cost effectiveness" has invaded the concerns of all health professionals with insistent demands for outcome assessment. Effectiveness, however, cannot be achieved separately or independently of standards for quality of care, which inevitably involve questioning the efficacy of current practice. The development or adaptation of assessment tools, such as proposed here for patient outcome assessment and for monitoring patient progress help to guide and direct the kinds of changes that may need to be made in the patterns of current practice. Objective norms thus become essential elements as a precursor to improving cost-effectiveness. MTM holds promise for providing a reliable and valid tool, easy and inexpensive to apply from which normative guidelines for treatment programming and outcome assessment can be developed.

109 Muscle Re-Education for Chronic Low Back Pain Patients—An Electromyographic Biofeedback Study

Principal Investigator: **Steven L. Wolf, Ph.D.**

Status: **New**

Dates: **April 1979-March 1981**

Cost: **Annual $30,310** **Projected Total $59,365**
RT Annual $30,310 **RT % of Annual Total 100%**

Annual Report Reference: **#15, Page 202, R-69**

OBJECTIVES:

General: To determine whether neuromuscular re-education, using EMG feedback from paraspinal musculature, can alter pain levels in a chronic low back pain population.

Specific: To determine if quantifiable EMG levels change significantly as a function of neuromuscular re-education.

To analyze, when such changes do occur, whether they begin to approximate values already measured for sex-and-age matched normals.

To determine whether a significant correlation exists between changes in trunk mobility (straight leg raising, rotation, lateral bending) and present pain rating indices.

To decide whether a specific EMG feedback training pattern or sequence can be established during dynamic back movements among a chronic low back pain population.

METHODOLOGY: Twenty chronic back pain patients, without previous back surgeries are admitted to this study if they meet the following criteria: no drug abuse, older than 20 years of age; no previous experience with EMG feedback; easy access to RT-6 facilities; presently employed; and willing to participate in this 20 week session. Electromyographic analysis of paraspinal musculature and mobility measurements are made routinely and compared to normative data previously obtained from age and sex matched individuals. Patients are seen in 4 blocks each lasting 5 weeks. Evaluation (control) and training sessions are alternated and quantitative changes in EMG, mobility and pain are compared over time. Electromyographic biofeedback training sessions consist of feedback during dynamic movement and are designed to teach patients to change posture, particularly related to activities that exacerbate pain.

FINDINGS TO DATE: This project has been active for six months and presently 5 patients are being treated. Preliminary data analyses would suggest:

1. Appropriate responsiveness in terms of pain reduction and electromyographic changes are most obvious during treatment rather than control sessions.
2. Improved mobility appears greater than subjective reports of alleviation of pain.
3. A clear need for psychological intervention (behavioral modification techniques) as a component of low back neuromuscular re-education is appropriate.
4. Patients with seemingly similar diagnoses respond differently to treatment and each treatment plan incorporating EMG biofeedback training must take work-related postural problems into account when developing specific training strategies.

APPLICABILITY: Since surgical and physical rehabilitative treatment of the low back pain patient involves mounting costs to the patient, prolonged treatment time for the rehabilitation expert, difficulties in job placement for the vocational rehabilitation counselor and loss of productivity to society, the implications of this study, when acted upon by clinicians, could dramatically alter contemporary treatment. The outcomes of this study could provide clinicians with new methods for postural positions, revisions in the working or home environment, and new approaches to the use of body mechanics in performing functional activities. While patients may not be able to assume their previous vocations, particularly where hard manual labor is concerned, they will be employable rather than dependent on society for their subsistence. Consequently, we anticipate referrals of these patient types to VR agencies for placement in new job opportunities.

The addition of EMG biofeedback training during dynamic movements in low back pain patients will add another dimension to the overall rehabilitation process. Should this procedure prove feasible, allied health professionals will be able to apply standardized guidelines using a new technique in the rehabilitation process with low back patients. As a result, the physician will not need to devote as much time and effort to the evaluation and placement of his patients.

Tufts University (RT-7)
Medical Rehabilitation Research and Training Center

CORE AREAS

Independent Living

Research into programs and policies that restrict the ability of disabled persons to live independently and evaluation methodology for independent living programs.

Rehabilitation Engineering

Studies in engineering design to develop solutions for communication and environmental problems for persons with severe physical disabilities.

Applied Physiology

Various studies in areas of regional concern such as medical rehabilitation/exercise physiology, biofeedback for spinal cord injury, and cardiac rehabilitation.

TUFTS UNIVERSITY

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COMPLETED

CONTINUING

NEW

DEFERRED

PROPOSED

110 Comparison of Outcomes of Obese Diabetics to Obese Non-Diabetics After a Multidisciplinary Program of Alteration of Preventive Health Behaviors

Principal Investigator:	Theresa A. Hoskins, R.P.T., M.S.	
Status:	Completed	
Dates:	July 1976-September 1980	
Cost:	Annual $15,318 RT Annual $6,290	Projected Total $76,525 RT % of Annual Total 41%
Annual Report Reference:	#14, Page 335, R-65	

OBJECTIVES:

1. To determine outcome differences between two groups of obese subjects: diabetics and non-diabetics, after a multidisciplinary program for the alteration of their preventive health behaviors.
2. To measure outcomes of all obese subjects involved in the multidisciplinary program, in terms of physiologic change (aerobic capacity), physical change (weight loss and body composition measures), metabolic change, (fat or carbohydrate substrate utilization), vocational or avocational change, and behavioral change (eating and activity behaviors).
3. To compare motivational factors in the two groups of obese subjects toward altering their preventive health behaviors.
4. To clarify the barriers, emotional or physical, which prohibit appropriate alteration of preventive health behaviors.

METHODOLOGY:

1. Screening of all obese subjects referred by physicians for a program of weight control was done on the basis of dietary history, body weight (20% over ideal), exercise tolerance, emotional suitability, and compliance with an individual diet over a preliminary four week period.
2. A written contract was written and signed by each person and each staff member.
3. Group behavior modification sessions were held once per week and group exercise sessions three times per week.
4. Behavior modification for weight control consisted of daily eating and activity records, the identification of eating cues, habits which encourage over-eating and factors in the social environment which lead to over-eating or under exercising. Elimination or substitution of maladaptive behaviors and environmental modifications were suggested. Relaxation techniques were taught. Videotaped simulation techniques were used to introduce issues confronting dieters.
5. Measures at the end of the contract period include changes in eating behavior, compliance with diet, weight loss, body composition changes, aerobic capacity, activity questionnaire.

FINDINGS TO DATE: Twenty-six percent of the population enrolled in this program completed it successfully. Fifty percent of these were diabetic.

Diabetic mean improvement in aerobic capacity is - .78 L/min O_2, while non-diabetic mean improvement is - 95 L/min O_2. Diabetic mean weight loss is -8.85 Kg, while non-diabetic mean weight loss is -7.41 Kg. Diabetic mean axillary girth measures were reduced by 2.04 inches, while non-diabetic mean girth reduction was 5.40 inches. Diabetic mean systolic blood pressure was changed by -6.2 mm Hg, non-diabetic mean systolic was changed by -3.1 mm Hg. Diabetic mean diastolic blood pressure was changed by -4.0 mm Hg, non-diabetic mean diastolic blood pressure was -2.4 mm Hg.

Follow-up on the people who completed the program successfully show:

	Diabetic Current Status	Non-Diabetic Current Status
No further contact	3	5
exercising self	7	6
sought more help for weight	1	0
co-morbidity developed later	2	1
number employed	9	8

APPLICABILITY: The results of this study should provide information useful to other rehabilitation facilities and clinics where exercise can be made an integral part of an approach to treatment of obesity. Information about the problems diabetics have relative to those non-diabetics have in their efforts to lose weight have been relatively unavailable. These findings can be applied to a variety of settings.

111 Design of an Inexpensive Audio Message System

Principal Investigator: Andrew Thomas, B.S.

Status: Completed

Dates: November 1979-October 1980

Cost: Annual $14,307 — Projected Total $23,500
RT Annual $13,444 — RT % of Annual Total 94%

Annual Report Reference: #14, Page 124, R-68

OBJECTIVES: The objective of this project is to develop a low-cost audio tape storage unit that can be used in conjunction with existing communication devices. The system will be capable of storing up to 256 recorded messages of human speech which will be selectable by the user.

The unit will have the following features:

1. Less than 10 seconds average access time to the stored 4-second messages.
2. Acceptability of inputs from scanning, direct selection and encoding devices.
3. Ability to be reprogrammed by the clinician using standard nontechnical methods.

METHODOLOGY: There exists on the commercial market an inexpensive tape transport which can be operated at high speeds of rewind and fast forward. The unit is equipped with a photo optical counter which provices a fairly accurate position indication of the tape location.

The Massachusetts Department of Education has provided funding for the placement of 8 of these units in special education classrooms in the Commonwealth. Additionally, one unit has been placed with a commercial manufacturer to test its marketability. These units will be attached to the Symbol Tufts Interactive Communicator which will provide an input mechanism. The SymTIC is by no means the only device which can serve as an input to the tape recorder.

The initial devices constructed during the Spring of 1980 store 56 messages which conform to the SymTIC format. The tape drives are provided with microprocessor circuitry which will accept an input from the scanning unit. This input will select a position on the tape that is in the drive and the track on which it is stored. The messages will be stored in 28 consecutive locations on each of two tracks of a standard Philips tape cassette. The tape will begin to "fast forward" from the beginning of the tape (BOT). The circuitry will monitor the photo optical position indicator for the desired location. When the specified count is recorded, the unit switches into the play mode. Once the message is played, the tape will be returned to the BOT.

Upon completion of the design described above, the 8 units will be fabricated and placed in appropriate settings. The BMFC staff will observe the use of the devices and identify the parameters of a final design. Meetings with the classroom teachers and clinicians as well as the users will provice valuable input.

The final stage of the project will be the development of a unit which will store up to 500 messages. The chosen tape transport has the capability of recording on 4 tracks. A method will be devised to calibrate the tape to the center of the tape after each message is "spoken." An inexpensive microprocessor (RCA 1802) will provide the processing. Engineering evaluation such as reliability, durability, and accuracy will be undertaken. At the time of successful completion, a manufacturer will be sought.

System cost including tape transport, circuitry and additional memory should be in the $1,000 range. This is approximately the cost of a printing or display unit used in other communicators.

FINDINGS TO DATE: The following systems have been evaluated for speed of access, portability, intelligibility, cost and reliability potential. T-NEMC Tape Transport, Stanford Tape Transport, Votrax Handivoice, TSI Talking Calculator, McDonnell-Douglas Stored Speech Device and Scitronics Form-A-Phrase.

The principle differences between the T-NEMC and Stanford systems are the tape transport and the speed. The T-NEMC unit will use a standard sized cassette in comparison to the Stanford device which employs a miniature data logging system (Microvox), made in Waltham Massachusetts. The Microvox is a continuous loop which must be run at real time. Each message must, therefore, play the entire tape (only the message desired is heard). Thus, if 500 messages are words on a tape, each selection must play the tape for the entire time for 500 words. The use of the more conventional tape transport allows for dual track locations, thus reducing by one-half the distance traveled by the search. The fast search is on the order of 10 times the playing speed.

The quality of the recording is also superior in the cassette unit. The Microvox uses a miniature tape which was originally intended for digital data logging only.

The final stage of the project will be followup on the placed units to determine reliability, durability, and general usefulness. If the units are considered a worthwhile teaching aid, manufacturers will be pursued. Currently, Zygo, Inc. has expressed the most interest.

System cost including tape transport, circuitry and additional memory should be in the $1,000 range. This is approximately the cost of a printing or display unit used in other communicators.

APPLICABILITY: The result of this project will provide private enterprise with communication devices using low-cost video game technology. With this high volume off-the-shelf components and considerably less labor involved in construction, manufacturers will now be able to increase the availability of these units as well as reduce their production expense. The flexibility in design will also allow future adaptations without major increases in cost.

112 Evaluation of Commercial Speech Recognition Device as an Aid to the Motorically Disabled

Principal Investigator: William Crochetiere, Ph.D.

Status: Completed

Dates: November 1978-October 1979

Cost: Annual $8,127 — Projected Total $8,127
RT Annual $5,166 — RT % of Annual Total 64%

Annual Report Reference: #14, Page 213, R-79

OBJECTIVE: The objective of this project is to explore the usefulness of a small and inexpensive speech recognition device that is currently marketed for $250.00. This device was developed for the hobbyist computer market, and is compatible with commercially available microprocessor hardware. This device is small in size, and low in cost, and the manufacturer claims a high level of speech recognition accuracy. This study will address itself to:

1. Determining the actual reliability of the device to distinguish among the "words" in two low redundancy vocabularies: the spoken digits "zero through nine," and the spoken alphabet "able, baker, charlie . . ."
2. Improving this base level of reliability by fine-tuning the device to recognize the limited vocabularies.

Consideration will be given throughout the study to the eventual use of the device as a voice controlled typewriter, environmental control, and wheelchair guidance control.

METHODOLOGY: The Biomedical Engineering Center has obtained a SPEECHLAB manufactured by Heuristics, Inc. of Los Altos, California which will be used in conjunction with a controlling microprocessor to reach the project's objectives. Individual steps will include ordering and assembling hardware, research and determine command vocabularies; test and improve reliability of SPEECHLAB software, test the system by human subjects; reduce obtained data into final report.

FINDINGS TO DATE: A Z-80 microprocessor system was assembled, tested and interfaced to the SPEECHLAB. Next, the speech recognition programs supplied by Heuristics were implemented and run on the system. The system operates as follows.

In the **Training Mode**, the outputs of the three band-pass filters and the zero-crossing detector are sampled at the rate of 100 samples per second for 1.5 seconds. Within this 1.5 second time

window, the beginning and end of the spoken utterance are identified as the points where the speech signal crosses a preset threshold value. Then, for each of the 4 channels, 16 equally spaced samples between these two points are stored in a memory reference table.

Note that by obtaining 16 samples per channel regardless of the duration of the word, all waveforms are effectively normalized with respect to time. Amplitude normalization is also performed by peak normalization, area averaging, or vertical translation.

In the **Recognition Mode**, the spoken utterance is sampled and normalized as above and compared to each of the words in the reference table. The word which most closely matches it is then identified as the spoken utterance. The criteria used to determine a "close match" are the Chebyshev Norm, Euclidian Distance, Polynomial Measurement, or Hamming Distance.

After extensive preliminary experimentation, a final experiment was conducted to determine the characteristics of the optimal system. To reduce the possibility of storing a "bad" reference word, the system was further modified to store the average of three samples, rather than a single sample, in the reference table during the **Training Mode**. Comparisons were made among the three amplitude normalization schemes (peak, area, translation), two vocabularies (numbers, and months), and two recognition methods (Chebyshev, and Hamming). The conclusion was that the combination of area averaging and Hamming Distance resulted in an average maximum recognition rate of 88% for the 5 subjects in the experiment.

To improve the system performance further, the individual errors in recognition were investigated to determine their probable cause. It was noted that when an error occured, the unknown utterance was closely matched to more than one word in the reference table. In fact, in each case where an error occured, the ratio of the difference between the unknown utterance and the two nearest matches was less than 1.6. An effective strategy therefore might be to incorporate into the recognition algorithm a scheme to reject any utterance for which this ratio is less than 1.6. The problem with this approach is that this would increase the recognition time of the system as trials are repeated.

The relative effects of errors in such a system will depend upon the particular application. For instance, a recognition error for an environmental controller may not be as critical as it would be for a wheelchair guidance control. The values of a correct recognition and the costs of an incorrect recognition would be different for both applications. Recognizing this trade-off between speed and accuracy, a Receiver Operating Characteristic Curve is developed which allows the communication system designer to select the correct operating point for a particular communication system.

APPLICABILITY: The availability of a low-cost sound or voice recognition system will provide the intended users with an interface that allows them to use a controllable mechanism (speech). If this is successful, the use of vocal commands will provide more flexible and less physically demanding control of devices for communication, and environmental control.

113 Development of Functional Eye Movement Communication System

Principal Investigator:	**Richard Foulds, M.S.**	
Status:	**Continuing**	
Dates:	**November 1978-May 1981**	
Cost:	**Annual $10,219**	**Projected Total $98,024**
	RT Annual $8,929	**RT % of Annual Total 87%**
Annual Report Reference:	**#14, Page 97, R-66**	

OBJECTIVES: The principal objective of this project is to develop an understanding of the potential benefits of a line of sight communication system for the severely physically disabled. The initial aspects of the project have concentrated on the development of electronic monitoring systems which can provide ocular orientation and head position and orientation data from which the line of gaze can be computed. Later portions of the project are intending to deal with the human factors aspects of communicating (expressing) messages with one's eyes. Such considerations as language board layout, language medium, and rate of output will be considered.

Data from this study will lead to the specification of an ocular communication system which can be clinically useful.

METHODOLOGY: The project is divided into three major phases. The first phase involves the development of both the hardware and software required to establish a laboratory line of sight communication system. This phase consists of three subparts, the design of an interface between the user and the corneal reflection monitor, software control of the system timing and output devices such as auditory and visual feedback and the development of a calibration routine requiring a minimum of user involvement.

The second phase is an evaluation of the usefulness of such a device with disabled individuals. The final phase will be to define the parameters for the design of a clinically usable device.

Basic Technique: The underlying approach to computing line of sight will be that of monitoring angular rotation of the eye, as well as monitoring the orientation and position of the head.

A review of eye orientation systems by the investigators has resulted in the selection of corneal reflection as the method of choice. The targets for the system will be placed within the environment in known locations. An indication of the selection of one of the targets will be available when the line of sight (defined by the straight line equation) intersects the location of the target.

Corneal Reflection Apparatus: The investigators have chosen an optical system which has high resolution. The optical element is a 100 x 100 charged coupled device manufactured by Fairchild. The unit is incorporated into a sensing system with appropriate electronics by Solid State Sales of Cambridge, Massachusetts. This system will be constructed and modified so as to be wearable on an eyeglass frame and with custom molded bridge structure to minimize shifting of the frames. The corneal reflection will be created by a small infrared light source also fixed to the glasses frame.

The corneal reflection signal monitored by the CCD array is subjected to a number of possible sources of error. Erroneous inputs can be reduced by properly orienting the monitor and IR emitter with the eye.

All control and timing for scanning the 100 x 100 array is performed by a micro-computer. The recognition of the corneal image is processed and filtered in the computer to filter out noise inherent in the circuitry.

Head Position and Orientation System: The laboratory apparatus monitors head position and orientation by means of an ultrasonic ranging system. The particular apparatus to be employed in this project will be a three dimensional Graf Pen manufactured by Scientific Accessories Corporation.

Three transducers are to be attached to the head, two are mounted on the eyeglass frames, which contain the corneal reflection receiver, one is mounted on a band passing over the top of the head. Transmitters are sequentially triggered under control of computer and distance of each transmitter to all four microphones is stored in the computer.

Information is processed by the computer to define the position of the head. The head's orientation is represented in terms of a vector equation which defines the origin and direction of the head.

Target Detection: The two subsystems, Eye Position and Head Position are designed such that vector equations define both the eye's and head's orientation in space. Addition of the two vectors renders a summation vector which defines the subject's line of sight. This vector is then solved simultaneously with the equation defining the object plane. The resulting point in the surface of the object plane is the coordinate at which the subject is fixating.

This calculation is repeated approximately 40 times a second and resulting intersection point is analyzed statistically to ascertain the points validity as a line of sight intersection.

To compensate for the fluctuations in the corneal reflection due to the movement of the sensing instruments, system calibration is then performed many times a second. This approach will serve to maintain the systems calibration for a more prolonged period.

A Communication System: The targets from above will be replaced with communication messages. Initially the messages will be individual letters of the alphabet. This will result in an optical typewriter. The actual selection of the target will be made by fixating on the target for a set period of time. Parameters relating to that fixation time will be determined.

Ocular Controlled Vocal Output: The laboratory system will be programmed to identify 500 tar-

gets. Each of the targets will be defined as a phonetic element (phoneme, syllable, or other combination of phonemes) as defined by Trepagnier. The output will consist of the spoken utterance via a model VS-6 4 voice synthesizer (Votrax) that is attached to the BMEC computer. Additional output will be provided through a video graphic terminal.

Experimentation with this system will consist of measurements of the rate of communication made possible by the line of sight system. The viability of the syllabary will be tested in another project in this report.

FINDINGS TO DATE: Activities have focused on developing the eye position monitor hardware and interfacing this into the main system. Substantial research and experimentation has been performed to develop a user oriented line of sight communication system.

Software programs have been written to perform the initial calibration of the system for the user. These will, however, be revised and improved to decrease and simplify the degree of user involvement in the calibration routine.

APPLICABILITY: The severely impaired nonvocal person who successfully uses a typical scanning communication device is limited by the operating procedure to less than 10 words per minute. If such a user can maintain ocular fixation (as he must for use of the scanning device) the use of a line of gaze system could dramatically increase that output rate. The incorporation into this project of the syllable based language system (RT-7 Project No. 69) offers a hypothetical communication rate of 60 words per minute.

114 Application of Low-Cost Micro-Computer Systems for Communication Aids

Principal Investigator: Andrew Thomas, B.S.

Status: Continuing

Dates: November 1979-October 1980

Cost: Annual $31,921 — Projected Total $58,000
RT Annual $30,657 — RT % of Annual Total 96%

Annual Report Reference: #14, Page 113, R-67

OBJECTIVES:

1. The major objective of the project will be to construct a general purpose communication system using low-cost technology. The new device will offer three interface options to the user.
   a. Tufts Interactive Communicator
   b. Dictionary Mode
   c. Anticipatory Mode
2. The goal of this phase of the project is to replace the expensive communication devices on the market with a low-cost system. The result will be increased availability of communication aids for non-vocal individuals, enhancing their vocational, educational and social potential.
3. The last phase of the proposed project will be to develop a low-cost, direct selection communication device that utilizes the electronics of the scanning communicator to lower the cost of both machines. Shortly after ten prototypes have been placed and evaluated for effectiveness, we will be negotiating with commerical manufacturers to produce both.

METHODOLOGY: The problem will consist of two phases (1) construction of low-cost, programmable scanning-type communicator (2) construction of a low-cost, programmable direct-selection communicator.

Phase 1 includes becoming acquainted with private enterprise regarding production techniques, implementation of the proposed system using the low-cost RCA 1802 microprocessor, development of a software package, development of a production model.

Phase 2 consists of adapting the Phase I design to a direct-selection device.

FINDINGS TO DATE: Progress on this project was hampered somewhat by the resignation of the principal investigator in September 1978. A new principal investigator was recruited in May 1979. Activities during the transition period were primarily concerned with the functional configuration of the nonvocal communication device. Information accumulated in Projects 25 and 44 have been

quite helpful. Feedback from users of communication device has also been of extreme importance.

Several manufacturers have renewed their interest in producing and marketing this microcomputer communicator. The Regional Advisory Council has supported the establishment of a committee to negotiate with the potential firms. The project staff is continuing to develop the final design, but will be able to discuss compromises with the ultimate manufacturer.

Phase two of the project is progressing with the purchase of a 32 x 32 photodiode array. This will be interfaced to a low cost Cosmal VIP Micro-computer game system. Pilot work will be done during the Fall of 1979 to determine correct character (symbol) size, and user operation.

Developments in both phases of this project will be greatly enhanced by the addition to the engineering staff of a nonvocal individual with experience in the area and interest in transferring that knowledge into this effort.

APPLICABILITY: The result of this project will provide private enterprise with communication devices using low-cost microprocessor technology. With this high volume off-the-shelf components and considerably less labor involved in construction, manufacturers will now be able to increase the availability of these units as well as reduce their production expense. The flexibility in design will also allow future adaptations without major increases in cost.

115 Development, Testing and Application of a Phonologically-Based Communication System for the Non-Vocal

Principal Investigator: C. Goodenough-Trepagnier, Ph.D.

Status: Continuing

Dates: December 1977-December 1983

Cost: Annual $31,350 — Projected Total $202,432
RT Annual $28,935 — RT % of Annual Total 92%

Annual Report Reference: #14, Page 132, R-69

OBJECTIVES: The purpose of this research is to develop and test a language component for non-vocal communication which can be implemented with any type of hardware, which will have the following two features:

1. access to all of language: that is, the capability of producing any and all words of English.
2. maximum efficiency; that is, messages are produced by means of the smallest possible number of acts (pointing gestures, switch closures, etc.) per word.

METHODOLOGY:

1. Studies of the distribution in spoken English of sequences of phonemes. Phoneme sequences will be chosen for their frequency and combinability. Different algorithms to produce the ideal set of phoneme sequences will be compared for the "efficiency" of their result. Efficiency is defined as the number of unit (phoneme sequence) selections required per word to produce a test corpus.
2. Refinement of system, development of a simplified orthography. The system will be realized in pointing board and Etran formats. It will be tested with speaking subjects.
3. Selection and screening of non-vocal subjects. Subjects will be paired, based on similarity of scores in screening tests, age, and academic level. Development of training materials.
4. Training in system. Experimental Subjects will receive intensive training in this system, while control members of pairs will spend same amount of time in communication practice using their current communication mode.
5. After a 6 month period, language of all subjects will be reevaluated. Controls will then begin training in this system. After a second 6 month period language evaluation will again be carried out.

   Comparisons will be made between experimental and control subjects, and between pre and post-trained control subjects, in order to assess the effect of learning this system on language performance.
6. Messages produced by subjects in the course of training and practice with the system will be noted and analyzed. Error analysis will provide useful information both for adjusting the system

and for improving the training techniques. Linguistic analysis of subjects' production will provide insight into productive language abilities of the non-vocal.

7. Comparisons will be made between non-vocal language development of speaking children.
8. The language data obtained from non-vocal subjects will provide the basis for development of materials designed to enhance language development and encourage language use.
9. Materials for communication enhancement in very young children will be devised, making use of the data obtained on non-vocal language acquisition.

FINDINGS TO DATE Testable sets of SPEEC units have been developed for 256-item and 400-item direct selection boards and a 256-item Etran.

Derivation of SPEEC

The process of verifying the four-step procedure for deriving optimally efficient units from a word-frequency list is still underway.

Tests of SPEEC

Calculations of SPEEC efficiency on selected corpuses of children's speech and a nonvocal person's typewritten letters have been carried out.

Actual testing of SPEEC commenced in October, 1979, with 5 nonvocal adolescents in the Massachusetts Hospital School in Canton and one in the Boston College Campus School, who received approximately 1 to 2 half-hour training sessions per week during the school year. Training was done by the childrens' usual language specialist during the periods set aside for language instruction. Teachers used the SPEEC Manual and their own adaptations of the materials.

Videotapes were made of the Canton users at 10 weeks and again at 5 months, and a videotape of the student at Campus School was made after 4 months. These videotapes have been transcribed and the output rate calculated for each individual at each period.

There is some indication that pointing response time is unaffected by provision of an auditory image, and may even be quicker in the non-auditory-image case, i.e., when the user must draw solely on his own auditory representation. If further data bears this out, the implications for the integrity of the nonvocal person's phonological capacity are of interest. Comparison of rate using an alphabet system, with a SPEEC-400, by one user revealed a twofold advantage in words-per-minute for SPEEC, in spite of much faster letters-per-minute pointing with the alphabet.

Language Ability in the Nonvocal

The field testing of SPEEC raises questions as to the phonological capabilities of nonvocal children and adults. Numerous clinicians have expressed doubts as to the nonvocal person's ability to develop linguistically. Some interesting data has come to light which has allowed us to approach the question of the nonvocal person's phonology from an as yet untapped perspective. This data is the collected output on TIC and Unicom of a nonvocal adolescent. Analysis of spelling errors made in the course of casual conversation reveals similarities with the invented spellings of pre-school children studied by Read (1971, 1975).

Analysis of some of the other spelling errors, e.g., clusters containing nasal consonants, is suggestive of an acoustic-phonetic basis for this subject's spelling, since his errors of omission of nasal consonants are most economically attributable to the acoustic features of the omitted segments.

This work is useful in practical terms, for the design of SPEEC and training procedures to use with it, and it is also of theoretical interest, in its relevance to consideration of the motor theory of speech perception (Liberman, et al., 1967).

A statement of the relationship between the communication rate and the efficiency of the system and user's selection rate can be made as follows:

$$\text{average time per word} = E \cdot \sum_{i=1} \cdot T \cdot$$

where E is the "efficiency" of the system (defined as number of units per word, where units are phoneme sequences in a SPEEC system, or letters in an alphabet, the calculation of E is

always based on a large corpus considered to be representative of the whole language).

T is the time the user takes to select each unit (including time of multiple encodings)

f is the proportion of times each unit will be selected.

The following principles seem to be valid for communication systems based on encoding (of which direct selection is the special case of single-encoding):

The number of "keys" which a user can operate is a completely individual matter, ranging from 1 for an extremely disabled individual, up to an indeterminate number. The number (and type, and position, and force...) of keys which provide the best key-press rate for a given individual is motorically determined for each individual. Given a number of keys greater than 1 (i.e., not a scanning device), the number of units which can be coded on these keys is unlimited, that is, it is limited by the user's ability to learn and remember the units and their codes.

Whatever the number of units the individual can master, his output rate will directly depend on the efficiency of the language system being used. In other words, whether 26 or 250 keys are available to the user, a SPEEC-400 will allow for more rapid output than a SPEEC-256, and either one will be more rapid than the alphabet or the set of phonemes, provided the user can acquire the set of codes.

The limits to efficiency (F, the number of key strikes per word) appear to be cognitive. Further work on these problems is in progress in collaboration with Dr. Michael J. Rosen.

SPEEC for Pre-Readers

Work has begun on adaptation of SPEEC for use by pre-reading children and adults, by means of an electronic lapboard with immediate auditory output (child voice) and the use of highly distinctive symbols.

APPLICABILITY: In the past, non-vocal individuals have often been diagnosed as cognitively and linguistically deficient, while it is possible and indeed likely that it is not native potential which they lack, but rather that non-vocal individuals, severely motorically involved, suffer from extreme experiential deprivation. Language acquisition requires exposure to the data of language and the ability to test unconscious hypotheses about grammar, including phonology, syntax and semantics, and communication. Cognitive maturation seems to require the same kind of access to the data of experience and the possibility of acting upon it - directly, by manipulation, or indirectly by language and thought experiments.

The motorically limited, mute child is deprived both in what aspects of the environment are available to him and in ways he can act upon it.

Early training in a non-restrictive and rapid communication mode should promote an increase in the amount and quality of language to which the non-vocal child is exposed, as well as giving him more opportunities to test his notions about language and the world. It will constitute an important step towards enriching the non-vocal child's environment and his possibilities of interacting with it and exerting control over it.

Participation in his environment, rather than passive observance of it, will have benefits for language and cognitive development, as well as the development of attitudes and behaviors that will enhance the non-vocal child's possibilities of realizing his human potential.

116 Voluntary Control of Autonomic Functions by Spinal-Cord Injured Persons: A Practical Application of Biofeedback in the Treatment of Hyperthermia and Postural Hypotension

Principal Investigator:	Earl Gaddis, M.A.	
Status:	Continuing	
Dates:	November 1977-October 1981	
Cost:	Annual $34,113 RT Annual $32,462	Projected Total $97,862 RT % of Annual Total 95%
Annual Report Reference:	#14, Page 345, R-72	

OBJECTIVES:

1. To determine the ability of spinal-cord-injured persons to voluntarily control such functions as blood pressure, skin and core temperature, and sweat production.

2. To identify factors useful to these patients in achieving such control: biofeedback, imagery, relaxation, autogenic exercises, internal and external incentives, classical conditioning.
3. To train spinal cord injured persons to use successful techniques under the stressful conditions of hyperthermia, postural hypotension, and hypertension associated with dysreflexia.

METHODOLOGY:

1. A thorough review of related research on learned voluntary control of autonomic functions was completed.
2. Questionnaires were sent to researchers and to spinal cord injured persons to assess the problems under investigation and to aid in experimental design.
3. Initial experiments on temperature and blood pressure control have been designed, utilizing biofeedback equipment (pulse-wave velocity, SPR and GSR, temperature feedback). Baseline measurements are being taken for each variable. Various techniques are being explored to determine their effectiveness in controlling these variables.
4. An experiment using iontophoresis with pilocarpine to stimulate sweat glands is being done with six quadriplegics and six normals as a control group. Quantitative sweat measurements are obtained by pre- and post-measurements of gauze and plastic wrapped over the area stimulated by pilocarpine. Areas stimulated include shins, forearms, and back of neck. The neck site represents a control for the quadriplegic as it is above the level of lesion, and one shin without the pilocarpine treatment serves as a control for both groups. Comparative measurements may indicate the intactness of the quadriplegics' sweat glands and will offer baseline material for the following experiment, which will measure the amount of sweat from the same areas under thermal stimulation. These experiments will give us an indication of how useful the conditioning of sweating could be in helping a spinal-cord-injured person control hyperthermia.
5. A pilot study will be designed and carried out after data is analyzed from the above experimental investigations. Quadriplegics will be trained to voluntarily control blood pressure and temperature utilizing those techniques proven most successful in the initial experiments.

FINDINGS TO DATE: Six normal and six quadriplegic subjects have been tested for sweating with iontophoresis. Results show no statistically significant difference in the quantity of sweat for all sites between the two groups.

We have begun to investigate the ability of the same subjects to sweat in response to thermal stimulation, using a temperature-controlled plexiglass chamber that encloses the entire subject (supine) except for the head, which is maintained at room temperature.

In this experiment, subjects are prebandaged with pre-weighed Telfa adhesive pads applied to the same skin sites that were previously monitored in the pilocarpine experiments. Chamber temperature is raised to 50°C and held for 45 to 60 minutes while measurements and recordings are made of skin temperature at five sites, tympanic (core) temperature, blood pressure, heart rate, respiratory rate, and respiratory excursion. Then the subject is gradually cooled down and the bandages are removed and weighed to determine the amount of sweat produced at each site.

Results of this study are not yet complete.

We are also working with several quadriplegic subjects in preliminary tests of their ability to learn voluntary changes in blood pressure.

Interviews with quadriplegics, with injuries more than eight years, indicated two types of patients. Some tolerate heat well and react poorly to the cold, while the reverse is true for others. Some patients have irregular sweating patterns such as sweating only on one side of the face. Postural hypotension may become a problem for these patients with long-term injuries, but is more prevalent in newly injured quadriplegics. Major concerns are with blood pressure control preceding/during autonomic dysreflexia.

APPLICABILITY: With the results from this investigation, we will be able to define the areas in which specific experiments need to be done in order to develop a practical rehabilitation-oriented program. Such a program would train patients to successfully utilize these techniques as an additional aid to independence in daily living. The results of the present project will be useful to the growing number of clinical and rehabilitation facilities that are using biofeedback and related techniques to train patients to achieve voluntary control over autonomic functions.

117 Range and Controllability of Physiological Output Signals in People With Cerebral Palsy: A Systematic Evaluation Procedure for Interface Selection

Principal Investigator:	Earl L. Gaddis, M.A.	
Status:	Continuing	
Dates:	October 1979-October 1981	
Cost:	Annual $15,272 RT Annual $13,087	Projected Total $90,990 RT % of Annual Total 86%
Annual Report Reference:	#14, Page 160, R-74	

OBJECTIVES. The objective of this project is to investigate the ability of severely physically disabled subjects to produce useful and controllable proportional (analog) output signals. (The operation of switch-type interfaces is a simple subset of the analog operations to be studied.)

Specific goals:

1. Identify, and obtain test models of, a basic but flexible set of analog transducers.
2. Design and build the circuitry needed to process, measure, and display the output signals obtained from these basic transducers.
3. Prepare an evaluation procedure for testing the extent to which each subject can produce various output signals or movements, and for **measuring the subject's ability to accurately control each one that is found to be usable**. During the course of the research this will evolve gradually and eventually provide the basis for developing a procedure that would be practical in a clinical setting.
4. Apply the procedure to a group of severely physically disabled subjects with cerebral palsy, to investigate the characteristics of the output modes that are available, and the degree of control available with each.
5. Relate these data to the known characteristics and requirements of the known range of existing interface devices, and develop guidelines for some of the factors that need to be considered when selecting and prescribing them.

METHODOLOGY. For each physiological output mode being investigated, we will set up the required transducer(s) in the appropriate position and adjust the display (usually the CRT terminal's video screen, supplemented by a musical tone whose pitch, loudness, and apparent left-right position in the stereo field may be varied as a function of the subject's efforts). A quick demonstration will show the subject the relationship between physiological output and changes in the display.

The first step will be to use the display as a simple measuring-meter to give a quantitative measure of the physical range over which the subject is capable of moving.

The next step is to let the subject experiment—by means of a simple set of increasingly structured challenges or tests—with attempting to control the movement of the display. More demanding tasks would involve maze-tracking or pursuit tasks, and test of accuracy in hitting targets of various sizes.

Throughout the sequence of tests, the computer will be monitoring and storing information on specific measures of performance, including accuracy, repeatability, resolution, overshoot and oscillation, tremor, drift, etc. In addition to actual performance scores, the computer will keep track of whatever short-term learning effects show up during the test period.

The subject will then be given an opportunity to play some "video games" with the computer, using his or her choice of output mode. During this session the experimenter will leave the subject alone in the room for fifteen minutes, to minimize any discomfort or performance pressures; the computer will continue to monitor skill and learning effects.

FINDINGS TO DATE. Original plans called for extensive use of our PDP-11 computer for processing signals from all transducers and for controlling displays and data outputs. Since the inputs and outputs of the overall system are primarily analog, however, there are advantages to handling much of the basic signal conditioning, processing, and shaping functions with analog circuitry. We decided that we could maximize the versatility of the system as a whole by incorporating the basic signal

processing and display-controller functions into a self-contained unit of modular construction. Open layout and immediate access to all controls and adjustments, combined with the flexibility of the design, permit a degree of versatility that can usually be obtained only by working with software, while eliminating delays and interruptions due to time-sharing and downtime of the computer. (We still use the computer for processing data derived from the experiments and for other special functions of the project that do not need to be carried out in real time.)

Design and construction of the system has progressed smoothly. The completed unit amplifies, normalizes, and processes the signals from various transducers and presents the resulting signals to a variety of recording and display outputs. Inputs include pressure transducers, strain gages, linear Hall-effect sensors, electrolytic analog tilt sensors, linear potentiometers, and joystick controls—both standard (displacement type) and isometric (force-actuated).

Processing of the input signals takes place after preamplification and signal conditioning, and allows various combinations of integration and differentiation, exponential or linear scaling, and several stages of filtering. Adjustable-threshold comparators (two per channel) and fixed-threshold ladder comparators (ten per channel) allow automatic counting and/or timing of the presence of signals within preset windows, as well as the derivation of "switch closures" from any proportional signal at any desired threshold level. For a given input signal, the experimenter may select various types of feedback including position, linear rate, shaped rate, acceleration, smoothing with adjustable time constant, integration, or a combination of these modes.

Display and feedback is available on a two-channel storage oscilloscope (X-Y) mode, split-screen target/cursor mode, or single-channel input with slow sweep and a pair of 100-element LED dot/bargraph displays. An X-Y plotter is also used for displaying certain functions (such as attempts to trace a pre-drawn pattern), with or without filtering. A multi-channel stripchart recorder is also used.

A two-channel audio display (not yet completed) will also be used. Various operating modes will allow two-dimensional (and possible three-dimensional) movements or force patterns to be represented in auditory space by coordinated changes in pitch, left/right location, apparent loudness, and timbre.

Most of the basic transducers have been acquired or developed, and initial experiments are being done with one person with CP and several able-bodied volunteers. A considerable amount of preliminary work remains to be done before the system is ready for practical use with subjects.

In April 1980, we met with the Harvard/MIT Rehabilitation Engineering Center and jointly established an Interface Group to investigate some of the issues involved in attempting to evaluate severely physically disabled non-vocal people for the optimum interface to a communication device or system. A number of researchers and clinicians have now combined forces through this group to start working on specific problems of mutual interest. This promises to be a useful and satisfying cooperative venture.

APPLICABILITY: Our work is beginning to result in the development of ideas for useful, practical proportional-control interface devices and systems that are not now available, and may also give rise to several types of simple, self-contained communication aids based on direct utilization of proportional control. While this project is not oriented toward the production of specific interface devices, we recognize the importance of encouraging practical applications and spinoffs from this type of research.

We are making plans for running an educational seminar in June 1982 at the Tufts campus, on **Practical Applications of Interface Research to the Problems of Non-Vocal Communication**. This will be a hands-on course for clinicians and teachers primarily, and will focus on low-cost, easy-to-understand methods and devices for harnessing proportional movements and using them with communication devices designed to take full advantage of them.

We are considering the possibility of having the tuition fee cover the cost of providing each participant with a set of simple but very useful devices in kit form; there would be lab sessions in which all participants would assemble their own equipment under expert supervision, with whatever help might be required. We would then provide initial training in the use of these systems, followed by a session dealing with specific applications geared to the individual needs of the participants. We would then move into a session of brainstorming on new applications and suggestions for further developments and improvements.

Each participant would leave the course with a full set of his or her own equipment plus the knowledge and confidence needed to begin using it with non-vocal clients, patients, or students. We would provide questionnaires and a followup interview later to evaluate how effectively the devices and the preliminary training have worked out in the field. This information would be a valuable part of the research process, and would be very useful to us in shaping further work. This course would also benefit us by giving us access to a large pool of potential subjects as well as direct contact with an interested group of working clinicians and other "secondary users."

Since the use of proportional interfaces and communication systems is still practically nonexistent in the "real world," it is particularly important to give professionals and consumers a chance to become familiar with this approach through first-hand experience, allowing them to try it out under the particular conditions with which they are most familiar and compare the results with the methods they are accustomed to using. Only when empirical results of this kind are compiled and then made available to researchers, will it be possible to begin meeting the needs of the large population of non-vocal people whose physical abilities and/or financial situations require an alternative to the existing range of communication aids.

118 Research in Posture and Support Orthosis

Principal Investigator:	**James P. O'Leary, M.S.**	
Status:	**Continuing**	
Dates:	**November 1978-October 1981**	
Cost:	**Annual $41,463** **RT Annual $33,939**	**Projected Total $123,250** **RT % of Annual Total 82%**
Annual Report Reference:	**#14, Page 180, R-75**	

OBJECTIVES: To identify the requirements of a seating system, and then categorize these parameters according to classifications of neurological impairments, and from this, a technique for standardizing the manufacturing process will be developed, so that labor spent in the final patient fitting can be held to a minimum.

The primary objective of this project is to decrease the labor required in manufacturing a supportive seat. Emphasis will be directed toward the application of more appropriate molding techniques and in selecting materials for their ease of manufacturing.

METHODOLOGY: Data collection and evaluation of existing seating systems will be based on the experiences of others in the field, as well as specifications drawn from the needs of individual patients seen at our facility. Support criteria is comprised of both the practical aspects of patient comfort and tolerance to support and the therapeutic potential of providing a particular support. A hierarchy of seating requirements will be produced from this data for each of the neurological disorder populations (i.e., MD, CP, spinal cord injured, etc.)

By developing a relatively low-cost, cosmetically acceptable, and functionally effective support, we hope to establish an easily reproducible method of treatment for maintaining a straight spine. Wilkins and Gibson, at the Hospital for Sick Children in Toronto, have suggested that maintenance of Lordorsis may be a key factor in preventing Scoliosis.

FINDINGS TO DATE: The large vacuum forming system designed earlier was modified and improved to provide more efficient use of material. Various grades of ABS and other thermoforming plastics were experimented with and tested. An evaluation of seating requirements was performed and criteria lists were compiled for three disabilities.

A variety of techniques are being employed to obtain a well defined body mold from which an orthosis may be constructed, including fiberglassing a customized mold. Polyurethane foam is being used in two different forms: (1) in an air-bag principal, and (2) in rigid form.

The correct selection and research materials have proven to be very effective in the success of developing a practical postural orthosis. By choosing the appropriate finish coverings it is possible

to mold a compound curved orthosis as a single integral unit. This replaces the current technique of trial and error tailoring by hand, which is expensive, timely and not always accurate.

During the past year, wheelchair inserts have been fabricated for clients of the Tufts Rehabilitation Institute. This effort has been monitored in order to determine fabrication time and cost, as well as to improve the technique. The clients and their inserts will be monitored over the remainder of the project in order to determine the effort of the seating procedure.

APPLICABILITY: Proper postural support increases functional independence by providing support to the client so that the abilities he/she does have can be better used. Without proper postural support many functional abilities are lost as the person uses all their energies to compensate for limited or absent support.

Increased functional independence through proper postural support includes increased ability for self-care, communication and employability.

The development of a low-cost postural support orthoses will make the system more readily available to a larger population of the severely disabled. As the use of postural support orthosis increases, decreased hospitalization and institutionalization can be expected as the complications related to poor positioning (i.e., scoliosis, respiratory difficulties) also decrease.

119 Dynamics of Communication with the Non-Vocal

Principal Investigator:	**C. Goodenough-Trepagnier, Ph.D.**	
Status:	**Continuing**	
Dates:	**November 1978-March 1981**	
Costs:	**Annual $15,577** **RT Annual $13,432**	**Projected Total $66,908** **RT % of Annual Total 86%**
Annual Report Reference:	**#14, Page 196, R-78**	

OBJECTIVES:

1. To observe and characterize the communicative interaction produced by non-vocal people representing a range of age levels, living situations and communication systems, with the "significant others" in their environment.
2. To record by means of questionnaire attitudinal factors which result from and act upon communication effectiveness, the vocal person's self-esteem and the attitudes and judgments of others about his abilities.
3. To devise, by means of these observations and questionnaire results, an evaluation framework for clinicians and researchers. This tool will be designed as a baseline measure, and as a follow-up measure as changes are introduced.

   Application of these evaluation framework, to be called a "Communication Profile," will also provide a revealing diagnostic technique; it will be designed to point out problem areas in communicative interaction as well as relationships between the behavior of the speaking persons who make up the non-vocal individual's world, and his non-communicative behavior.

   Both sides of the communication dynamics—that of the non-vocal person and the individual with whom he is communicating—will be represented in the profile and the outcome will be reflected in an "index of control," which will serve as an indicator of the non-vocal person's success as a communicator in his living/working situation.

METHODOLOGY

1. Preparation of questionnaires to assess subject's communication frequency and spontaneity, subject's self-image, use of current communication system, subject's satisfaction with current situation.

2 Observation of subject's communicative interactions with others, particularly with respect to quantity of interactions and number of different people with whom they occur; nature of interactions (request for help, for information, expressing opinion, general conversation), and outcome of interactions (are requests met, for ex.)

3 Analysis of recorded language production with respect to syntax, semantics and pragmatics.

FINDINGS TO DATE: Locus of control scales (Rotter, 1966) are well-suited to our objective of measuring subject's self-esteem, and represent an area of personality that (we predict) will change following introduction of an effective communication system. The original Rotter scale has been adapted for use with individuals using communication devices, with respect to the content of questions that have been modified within and added to the original scale.

APPLICABILITY: The degree to which the user of a communication system or device perceives himself/herself as able to initiate verbal exchange, enlist the attention and conversation of others, affect their behavior, and be dealt with as an equal social participant will be reflected in his/her willingness to invest emotion and energy in his/her own social and vocational rehabilitation. Tools which the clinician can apply to assess the patient's communicative behavior will provide the basis for therapeutic efforts to affect the communication dymanics in which he/she and his/her significant others are engaged.

Improvement in the communication situation at an early age may well contribute to acceleration in language development, with attendant favorable consequences on education and rehabilitation.

120 The Influence of a Rood Procedure Called Slow Stroking Over the Paravertebral Muscles on Autonomic Functions

Principal Investigator: Theresa Hoskins Michel, R.P.T., M.S.

Status: New

Dates: November 1979-December 1980

Cost: Annual Not Specified — Projected Total $19,778
RT Annual Not Specified — RT % of Annual Total Not Specified

Annual Report Reference: #14, Page 391, R-82

OBJECTIVES:

1 To test the following two hypotheses:

a. There is a significant difference in all measured variables of autonomic function between the experimental procedure effects and the sham procedure effects and the control procedure effects.

b There is a significant difference in all measured variables of autonomic function between the experimental procedure effects and the initial baseline measures.

2. To investigate the following two questions:

a. Is there a difference among individuals in their baseline underlying autonomic function variables?

b. Is there any relationship between initial baseline values of autonomic function and responses to the experimental procedure?

3. To determine whether some disability groups, or some individuals within certain disability groups respond favorably or unfavorably to the experimental procedure.

METHODOLOGY: Each of 19 subjects received three treatments assigned in random order on three separate occasions. Treatment A was the "Rood Procedure". Treatment B was a sham procedure which could produce opposite responses, and treatment C was a control procedure. Prior to treatment a pre-test questionnaire was administered, and baseline measures were obtained after 20 minutes of rest. Each treatment was done for 3 minutes during which measurements were taken continuously. A post-treatment period of 25 minutes was used, with measures taken every 3-5 minutes. Finally a post-test questionnaire was filled out.

FINDINGS TO DATE: Data is collected, but not yet subjected to statistical analysis of data reduction. There appears to be differences in heart rate, blood pressure, and galvanic skin response characteristics of subjects between the three treatments. Other measures of tympanic temperature, skin temperatures, and respiratory rate do not appear to reflect different responses to the three treatments. More analysis is underway.

APPLICABILITY: The experimental "Reed Procedure" is used clinically for a variety of disabilities based on an untested rationale, with unmeasured expectations of results, and with inconsistencies in subjective results. This study attempts to clarify the purposes of the clinical procedure, and the actual effects of it in terms of autonomic functions. Thus the rehabilitative procedure may become more useful for specific therapeutic purposes, and be applied in a more rational manner for a better rehabilitative outcome.

121 Follow-Up Study to Determine the Independent Living Outcomes of Persons Discharged from Medical Rehabilitation

Principal Investigator: Gerben DeJong, M.P.A., M.S.W.

Status: New

Dates: July 1980-October 1982

Cost: Annual Not Specified; Projected Total $115,450
RT Annual Not Specified; RT % of Annual Total Not Specified

Annual Report Reference: #14, Page 40, R-84

OBJECTIVES:

1. To develop, rank, and weight policy relevant outcomes reflective of independent living values and assumptions.
2. To evaluate the relative importance of selected environmental variables to independent living outcomes.
3. To evaluate the implications of the study's results for disability policy and rehabilitation.
4. To evaluate the implications of the study's results for the development of independent living evaluation models.

METHODOLOGY: The methodology entails a follow-up of persons discharged from medical rehabilitation. All participants are severely disabled, are at least 18 years of age, have only one admission to medical rehabilitation of at least 2 weeks, and have a sufficiently complete medical record.

The study has developed a set of independent living-based outcome variables consisting of (1) a living arrangement scale and (2) a productivity scale. The latter not only measures a person's potential participation in gainful employment but also a person's contribution to family and community life. The items on the scales have been ranked and weighted by a panel of consumers, providers, and others involved in the provision of independent living services. Independent variables consist of (1) socio-demographic characteristics, (2) disability-related variables, and (3) a variety of environmental barriers (e.g., unmet attendant care needs, architectural barriers) believed to have a substantial impact on independent living outcomes.

Factor analysis and regression analysis are the principal multivariate techniques used in the study.

FINDINGS TO DATE: Although a relatively new project, the ranking and weighting methodology used to evaluate independent living outcomes has been successfully tested and has proved to be a viable method for the evaluation of long-range independent living outcomes. Preliminary results from 111 subjects indicate that the availability of attendant care through a spouse, transportation barriers, and economic disincentives are among the strongest environmental determinants of independent living outcomes.

APPLICABILITY: The outcome criteria used in this study have direct applicability to the evaluation of independent living service programs. The outcome scales are easily replicable and applicable to new settings. Moreover, the study also attempts to identify those environmental interventions most likely to affect independent living outcomes.

122 Disincentives Simulation Model

Principal Investigator:	Gerben DeJong, M.P.A., M.S.W.	
Status:	New	
Dates:	July 1980-October 1982	
Cost:	Annual Not Specified RT Annual Not Specified	Projected Total $104,230 RT % of Annual Total Not Specified
Annual Report Reference:	#14, Page 54, R-85	

OBJECTIVES:

1. To develop an analytic tool to identify the interaction of various benefits and taxes facing disabled persons.
2. To evaluate how existing benefit programs affect the work reward structure facing disabled persons.
3. To determine the impact of new disincentives legislation on the economic well-being of disabled persons.
4. To identify otherwise unanticipated consequences or new disincentives arising from other proposed legislation, e.g., national health insurance.

METHODOLOGY: The practical methodological frame of reference for this study is the concept of the net cash and in-kind income curve. This curve portrays the amount of income available to a disabled person as earnings rise. The curve considers the net income available to a disabled person from all sources both cash and in-kind, after taxes and benefit reductions are taken into account. The curve will eventually be plotted with the assistance of computer technology.

FINDINGS TO DATE: New project.

APPLICABILITY: The study has direct application to the analysis of disincentives that exist in income assistance programs. The findings will be used primarily by policy makers seeking to adjust and modify current programs that now make it economically unviable for disabled persons to accept gainful employment.

123 Investigation of a Transition Preserving, Diphone Method of Speech

Principal Investigator	Richard Foulds, M.S.	
Status:	New	
Dates:	November 1979-October 1982	
Cost:	Annual $30,758 RT Annual $45,491	Projected Total $132,350 RT % of Annual Total 90%
Annual Report Reference:	#14, Page 222, R-86	

OBJECTIVES: This project wishes to consider a speech diphone segment inventory developed according to the Dixon and Maxey model, and an inventory of larger, commonly occurring phoneme clusters used in conjunction with the diphone inventory as an effective means of producing synthesized speech. The preservation of phoneme transitions which is made possible by the use of diphones, is expected to lead to improvements in synthetic speech quality since much of the speech intelligibility has been shown to be contained in the sound to sound transitions.

METHODOLOGY: The concept of using diphones as the elements of synthetic speech offers the possibility of using small segments of natural human speech which can be extracted from running discourse. The laboratory computer (PDP 11/20) has been provided with the Interactive Laboratory System (ILS) which is a nationally known data manipulation and speech processing software package.

Appropriate textual material containing the desired diphones will be recorded by a trained speaker. The speech samples (diphones) will be extracted from that spoken material by means of the ILS software and the PDP11. Initial listening tests will be performed on reconstructed speech using combinations of those extracted diphones. Once an appropriate inventory of diphones has been established (estimated at approximately 1000) additional processing will extract from the

original speech approximately 520 longer segments which are shown to have high frequency. (See RT-7 Project No. 69 for a further discussion of this aspect of the work.)

An experimental protocol has been developed whereby synthesized messages made from the diphone and larger segments will be compared to both natural speech and the Votrax VS6 formant synthesizer. Measures of both intelligibility and naturalness will be made.

FINDINGS TO DATE: Extensive work has been done in bringing into operation the ILS package, since the project began in February, 1980. In addition, a study has been completed which investigated the second formant transition properties of the Votrax VS6. The results show that the Votrax product handles phoneme transitions in a way in which discontinuities are avoided, yet in which the natural transition rules are not followed. There is strong evidence that this transition handling capacity of the Votrax leads to the "mechanical" sounding quality of the speech. This evidence supports the intention of this project to use natural transitions in speech synthesis.

APPLICABILITY: The applicability of diphones to synthesized speech is reinforced by both the potential improvement in speech quality, and the capability of low-cost semiconductors which can make use of the diphone segments. Integrated circuits manufactured by the Texas Instruments Company can make direct use of the diphone segments. Upon completion of the project, there will be an effort made to introduce the diphone synthesis technique into the commercial sector.

124 Development of a Non-Distorting Transducer System for Measuring Pressure at the Tissue Cushion Interface

Principal Investigator:	**James P. O'Leary, M.S.**	
Status:	**Deferred**	
Dates:	**November 1978-October 1980**	
Cost:	**Annual $9,773** **RT Annual $8,135**	**Projected Total $65,536** **RT % of Annual Total 83%**
Annual Report Reference:	**#14, Page 190, R-77**	

OBJECTIVE: The objective of this project will be to design and build an instrument which will accurately determine the pressure distribution under a seated or reclining patient. The transducer will be useful in evaluating equipment for the use of an individual patient, and is a research tool in the area of evaluating various seating and cushioning systems.

METHODOLOGY: The transducer requires two independent major developments to bring it to a reliable and efficient working condition. These two steps can proceed simultaneously.

1. A system to operate the transducer automatically is required. This will consist of a positive displacement pump, an electronic pneumatic pressure transducer and a valve array, all controlled automatically. The plan is to use an existing PDP 11 computer to control in the development stage. When this is fully workable, a microprocessor will be substituted to make the system portable.

2. The actual pressure transducer array needs further development to enable manufacture of a more uniform and reliable product. Latex dipping and laminating is one method being considered. Others may be sought.

   The structure will by its nature be delicate and a repair procedure will also be developed.

   When these two stages, to be undertaken simultaneously, are completed, the unit will be evaluated as a clinical tool in the fitting and prescribing of seating systems.

FINDINGS TO DATE: Activities have centered around construction of a prototype unit and its application in a pilot study which has provided an opportunity to observe the strengths and weaknesses of the concept and the design when viewed as a working system.

The transducer element for the prototype was fabricated from polyethylene packaging material (bubble pack). This approach has the advantage of being readily available in a very acceptable physical configuration. Obtaining a reliable unit for the transducer in any other form appeared to be heavily burdened with tooling cost. The significant disadvantage is that polyethylene is difficult material to seal to other materials. Conventional adhesives, solvent adhesives and heat seals will not reliably hold.

Experience with the system was gained while running an experiment to study the effect of mattress construction on pressure distribution. The test was designed to enable the unit to determine the pressure profile under the sacrum of a supine subject. Three subjects were tested on eighteen mattresses-foundation combinations. It was learned from this that the theory and mathematics of the unit pose no real problems. With the electronic transducer there should be no problem in getting adequate accuracy. The problems in fabrication and reliability were pointed up by the test. It will be necessary to design a more easily workable valve system and to solve the sealing problems. The use of the fine tubing resulted in delays while pressure in the system equalized. The next prototype will use a larger tube to ease this problem.

Current efforts are aimed at solving these problems in fabrication. It appears that a unit may be made for individually fabricated polyvinyl chloride elements and assembled into the multiple unit array which is desired. This will have a number of advantages and should involve most of the current problems.

APPLICABILITY: The provision of a clinical system to evaluate pressure distribution should result in rehabilitation consumers obtaining seating systems which serve them better, resulting in increased mobility and longer periods of activity.

125 Comparison of Myocardial Perfusion Before and After a 12 Week Course in a Physical Conditioning Program Following Acute Myocardial Infarction

Principal Investigator:	**Theresa Hoskins Michel, R.P.T, M.S.**	
Status:	**Deferred**	
Dates:	**Deferred**	
Cost:	**Annual Not Specified** **RT Annual Not Specified**	**Projected Total $98,731** **RT % of Annual Total Not Specified**
Annual Report Reference:	**#14, Page 400, R-83**	

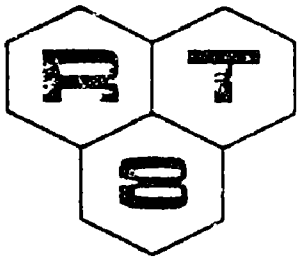
OBJECTIVES

1. To demonstrate, with thallium scan technique an improvement in myocardial perfusion following 12 weeks of cardiac rehabilitation.
2. To demonstrate a conditioning effect after a 12-week program of cardiac rehabilitation, as measured by maximal oxygen consumption, and maximal Rate Pressure Product (max HR x Systolic BP at max exercise).

METHODOLOGY: Three groups of post MI patients will be studied. Group A will be a selected group of highly motivated, non-medicated non-smokers. Group B and C will be randomized groups. Groups A and B will undergo a 12 week exercise program, while Group C will remain sedentary for the 12 week period. All patients receive an exercise thallium stress test during which max VO_2 and Rate Pressure Product (RPP) are obtained prior to any intervention. Each receives the same procedure after the 12 week period has ended. Data will be analyzed with analysis of variance.

FINDINGS TO DATE: This project was deferred due to lack of funding. However, 7 patients were completed in Group A. Four of these 7 showed no improvement in myocardial perfusion as measured by this technique, while 3 showed clear evidence of improvement on the scan which was read blindly by a practicing radiologist.

APPLICABILITY: The possibility that exercise conditioning may provide a direct therapeutic benefit in terms of improving the prognosis of coronary artery disease and reversing the pathogenesis is one suggested by animal studies, but never shown conclusively in man. This study has only recently become possible with the latest technology in non-invasive imaging of internal organs. Work which has preceded this proposed study supports the validity and reliability of the measures. If evidence supports a therapeutic benefit, cardiac rehabilitation programs would gain wider acceptance and use. If evidence proves programs have no benefit, further studies could be done to determine what type of changes should be made in current practices to produce more effective results.



Temple University (RT-8)
Medical Rehabilitation Research and Training Center*

CORE AREA

Neurological and Neuromuscular Diseases

To advance practices and knowledge related to the rehabilitation of patients impaired by neurological and neuromuscular diseases through new initiatives for program activity such as participation in program development, execution and evaluation by handicapped persons themselves, and new concepts of impairment on disability such as the one developed by the World Health Organization.

*Funding for RT-8 was terminated October 31, 1980.

TEMPLE UNIVERSITY

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Medical Rehabilitation Research and Training Center
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COMPLETED **ACCESSION NO.**

126 Visual System Disorders and Functional Correlates

Principal Investigator:	**E. Kwatny, Ph.D.**	
Status:	**Completed**	
Dates:	**November 1975-October 1979**	
Cost:	**Annual $18,723** **RT Annual $18,723**	**Projected Total $112,132** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 40, R-143**	

OBJECTIVES: The purpose of this project is to provide quantitative clinical-physiological-functional analysis of certain visual system disorders that interfere with the delivery of sufficient visual information to the central nervous system. Specifically, the objectives are threefold:

1. To establish a sequence of tests to evaluate quantitatively the status of central and peripheral mechanisms participating in the control of ocular movements. This includes the objective measurement of the function of the supranuclear control systems which integrate visual and non-visual stimuli to position the eyes so that basic and skilled functional activities may be accomplished.
2. To evaluate quantatively functional activities such as visuo-motor skills, visual perception, and reading to determine the influence of visual system disorders on dysfunction.
3. To investigate new therapeutic approaches to modify visual behavior so that it is more appropriate to functional activities.

METHODOLOGY: **Population:** normal adult subjects (18-75 years of age), hemiplegic adults (18-75 years of age); adults with neurological disease with manifestation of ocular dysfunction (18-75 years of age).

Test Procedure: (a) medical screening—a general medical history statement is taken from each subject with concentration on questions dealing with vision history, visuo-motor performance, ADL performance, and neuro-muscular status. Site of lesion, functional loss, current therapeutic program and visual system impairment is acquired from clinical notes and therapists. (b) Clinical optometric examination—this examination includes ophthalmoscopy, analysis of near and far acuity and visual field analysis (central and peripheral), and an external examination (detection of phorias and tropias, motor field and motility examination, vergence and stereopsis testing). (c) Visual system mechanisms—eye and head movements are examined during a monocular and binocular viewing of a single spot stimulus in a 60 degree field. In order to evaluate the specific supra nuclear eye movement control systems, sequences of tests including several fixation, smooth pursuit and saccade generating tasks, are utilized.

FINDINGS TO DATE:

1. Various aspects of visual system function should be assessed separately. The findings from the separate assessments are most meaningful when results are integrated to arrive at a functional analysis of the patient's visual problems.
2. Conventional clinical techniques have been adapted to provide for clinical analysis of visual system pathology in brain-damaged patients. These adaptations were made to adjust for the particular problems of this population.
3. Quantitative analysis of eye movements has been used to provide information to be included in the overall assessment of visual function; moreover, this data provides important diagnostic information for the neurologist and neuropathoophthalmologist.
4. Results from conventional visual-perceptual and visual-motor tests may be invalid in some patients unless unilateral visual neglect is considered when interpreting results.
5. Slow or inaccurate visual-motor performance has been demonstrated to be due to deficits in the visual system, deficits in the motor system, or combined deficits in both systems.

6. Findings from the comprehensive visual assessment have been used to design therapeutic programs aimed at teaching patients to compensate for visual deficits. Treatment approaches have been directed toward individual symptoms rather than diagnoses. In a varied sample of 20 brain-damaged patients, 14 patients have shown improvement in specific visual function goals (defined for each patient) and/or in other visual functions.

APPLICABILITY: Within this project, a set of visual assessment procedures utilizing (principally) quantitative methods, has been developed and applied to a diverse sample of brain-damaged adults aged 15-75 years. These procedures and methods were used to evaluate the anatomical and physiological integrity of the visual pathway, the acquisition of visual stimuli (eye position control), visual perceptual processing and visual motor skills. The procedures have been used to provide a more comprehensive view of the patient's visual function and to suggest new therapeutic approaches to modify visual behavior.

127 Ambulatory Monitoring Laboratory for Rehabilitation Medicine

Principal Investigator:	**A.W. Monster, Ph.D.**	
Status:	**Completed**	
Dates:	**November 1977-October 1979**	
Cost:	**Annual $25,050** **RT Annual $15,388**	**Projected Total $131,817** **RT % of Annual Total 61%**
Annual Report Reference:	**#16, Page 96, R-152**	

OBJECTIVES:

1. To demonstrate the routine clinical use of ambulatory monitors for a number of well defined assessment problems. (e.g., relation between physical activity and cardiac symptoms as observed in EKG).
2. To test the utility of a number of ambulatory transducer systems, recording systems, and analysis methods for a second (less well-defined) group of assessment problems (e.g., the description of the obligatory synergy response in stroke patients).
3. To develop a prototype ambulatory monitoring laboratory, organized as an evaluation service, for both inpatients and outpatients.

METHODOLOGY: The patient carries a miniature multi-(2-4) channel tape recorder on a waist belt. Commercially available recorder (Avionics, Medilog) are approximately the size of a desk calendar and weigh one to one and one half pounds. The recorder is connected to one or more transducers (e.g., electrodes, accelerometers, etc.) through signal conditioners placed within the recorder unit. The transducers monitor physiological variables such as muscular activity, the electrocardiogram, and biomechanical parameters. Interference with normal functional activities is minimal. Typically, a recording is continued for 8-24 hours, after which the tape is removed. The tape is then played back, on a separate tape scanner, at 25 to 60 times the recording speed. The computed data analysis is printed out on a high speed printer, using a standardized format. By maintaining a record of successive recording on one patient, as well as a library of normal reference data, comparative evaluations can be made.

FINDINGS TO DATE:

1. **Tape Scanner Development Project**
   Objectives: 1) to demonstrate the application of ambulatory assessment techniques in an existing cardiac rehabilitation program; and 2) to develop a modular tape scanning system capable of handling a wide variety of long-term ambulatory recordings, including EKG, on a routine basis.

   Progress: A general purpose computerized scanner, centered around two LSI-11 processors, a number of special purpose pre-processors, and a 20 M Byte disk, was implemented. This system allowed for high-speed playback/analysis of a wide variety of long-term multi-channel recordings. The modular design ensured reliability for high-volume clinical studies.

   A paper describing the first version of the EKG scanner was presented at a symposium at Stanford University and was published (Monster, Chan, O'Connor, 1978). A more advanced version was developed and published recently (Monster & Alterman, 1979).

2. **Pulmonary Monitor**

Objectives: 1) to assess the clinical utility of a number of pulmonary function transducers for long-term evaluation of pulmonary rehabilitation patients; and 2) to examine the physiological basis of selected measurement techniques for the purpose of enhancing their reliability

Progress: A one-week workshop on biosensors was attended during November, 1978. The program reflected the rapid advancement in transducer technology for long-term monitoring of a number of physiological variables. A paper was presented. Several innovators in the area of blood-oxygen sensors consented to function as informal consultants to the RT-8 project; specifically, the principal investigator visited the laboratory of Dr. Kimmich and collaborated with him on a portable oxygen sensing system, during Spring, 1980.

Discussion and exchange of information was started with the present supervisor of the Pulmonary Rehabilitation Program at Moss Rehabilitation Hospital. All patients in this program (approximately 20) participated in a standardized work-out once a week, at which time long-term monitoring was initiated. A calibration of the ambulatory equipment can readily be included in the work-out protocol. A number of breathing transducers (chest and abdomen) were examined and a vest-like plethysmograph was selected for further evaluation. Detailed information on commercially available polarographic electrodes was obtained.

A bibliography (approximately 50 items) on blood-oxygen measurements and their pitfalls in various patient populations was assembled. Studies of the literature indicated that micro-circulatory aspects of the surface-polarographic measurements are of particular interest; these may necessitate further laboratory study. The need for construction of non-standard surface multi-electrodes was examined. Consultants for the latter two problems were found. However, the project was terminated by the internal review committee, during the RT-8 phase-out period.

3. **Muscle Usage Study**

Objectives: 1) to characterize and quantify normal skeletal muscle usage patterns; 2) to correlate usage with the metabolic properties of skeletal muscle, including adaptive effects induced by neuromuscular disorders, chronic overload and abnormal motor behavior; and 3) to describe specific motor behavioral patterns, normal as well as abnormal.

Progress: A paper on eye blink behavior, based on previously obtained data, was completed and published (Monster, Chan, and O'Conner, 1979). Two papers appeared in press (Monster, Chan, O'Connor, 1978; and Monster, Chan, O'Conner, 1979). Experimental protocols for 1) the study of muscle relaxant effects on the incidence of involuntary muscle contractions in patients with spinal cord injury (R-161, page 120, Progress Report #15), and 2) the relationships between fiber type adaptation and changes in muscle usage were completed. The primary focus is on developing assessment techniques that are minimally restrictive and provide insight into functional performance of the patient. The latter is presently being studied in collaboration with D. Kernell, at the University of Amsterdam. It focuses on the changes in motor unit properties resulting from compensatory overuse of residual units after partial denervation of a skeletal muscle.

All the work on ambulatory studies of motor behavior was to be summarized in a paper aimed specifically at the rehabilitation practitioner. This undertaking was not yet completed at the time of RT-8 phase-out.

APPLICABILITY: The ultimate goal of the rehabilitation process is to enable patients to perform at their highest attainable functional level. However, present evaluation methods rarely aim to establish whether this goal is reached during every day activities under diverse environmental conditions. Ambulatory monitoring provides a new and potentially powerful approach to problems of patient-status evaluation. This approach is highly cost-effective, as it is directed toward out-patients and non-hospitalization. New methods require effective and convincing demonstration before they can be integrated within the routine repertoire of clinical evaluation methods. This project is designed to demonstrate the contributions that an ambulatory monitoring laboratory can make to the rehabilitation process.

128 Facilitation of Arm Movement in Disabled Patients with Stroke, Brain Injury, and Other Pathologies of the Central Nervous System

Principal Investigator:	**Nathaniel Mayer, M.D.**	
Status:	**Completed**	
Dates:	**August 1979-June 1980**	
Cost:	**Annual $46,854** **RT Annual $37,185**	**Projected Total $46,854** **RT % of Annual Total 79%**
Annual Report Reference:	**#16, Page 17, RT-158**	

OBJECTIVES:

1. To test the effect of sensorimotor facilitation on behavior parameters of voluntary movement such as initiation (latency responses), movement time, maximum velocity, and termination accuracy of movement.
2. To modify and augment existing electrical stimulation systems which are to be employed in facilitation of voluntary movement.
3. To test the effect of sensorimotor facilitation on electromyographic features of voluntary movement such as EMG reaction time, latency between initiation of EMG and initiation of mechanical displacement, burst or continuous pattern of firing, distribution of the integrated EMG over the movement interval, and temporal relationships between agonist and antagonist muscles.
4. To conceptualize a clinical training program which might utilize sensorimotor facilitation techniques based on the use of electrical stimulation applied in temporal relation to volitional movement.
5. To conceptualize clinical instrumentation which could deliver sensorimotor facilitation and would provide measures of outcome during the training period for purposes of objective clinical evaluation.

METHODOLOGY:

1. **Description of Subjects:** Patients with corticospinal lesions affecting the upper extremity were selected for study on the basis of a clinical examination. The decision to select a particular patient was made on clinical grounds such as etiology, duration and neurological stability of the lesion, presence of weakness, hyperreflexia, irradiation of deep tendon reflexes, nociceptive withdrawal responses, unilateral Hoffman's reflex, spastic resistance to stretch, and confirmatory Babinski and other upper motoneuron signs in the lower extremity. Patients were required to comprehend and carry out auditory verbal instructions with regard to producing movement on command. Clinical examination required the patient to simulate the type of movement he would perform in the laboratory.

   Patients were examined and classified specifically by the type of synergy pattern and movement profile exhibited using the clinical method of Fugl-Meyer et al. (A companion sensory assessment was also applied.) Based on this method, patients were classified according to whether 1) volitional movement could be performed within the dynamic flexor and/or extensor synergies; 2) volitional movement could be performed by mixing the dynamic flexor and extensor synergies; or 3) volitional movement could be performed with little or no synergy dependence. Seven patients were studied.

2. **Description of Experiment:** Each patient was seated on an adjustable dental chair and requested to rotate a lightweight rod or joy-stick to a specified visual target alongside the manipulandum. Because some patients were unable to grasp the manipulandum effectively, a universal cuff attached to the palm was used to secure the manipulandum to the hand. A wrist orthosis, set in neutral position, is also sometimes used to provide wrist control. Patients receive an auditory warning signal (randomly varied between one and four seconds) followed by a command signal to move the manipulandum to the target as quickly and as accurately as possible. Using this procedure, three randomly presented experimental conditions are applied, namely, movement without stimulation, movement associated with electrical stimulation during the entire period of mechanical latency (i.e., time of delivery of command signal to the time of beginning displacement), and stimulation applied during (but not before) movement displacement. Each patient performed in three sessions of 45 trials in each session.

   The behavioral parameters that were measured to achieve objective "1" included the mechanical latency response, movement time, maximum velocity and termination accuracy of movement. Movement time was measured from the onset of the mechanical signal to the peak of monotonic displacement. This signal arises from a proportional change in voltage across a potentiometer mounted at the pivot point of the manipulandum. Digital computer differentiation of the displacement signal provides a measure of maximum velocity during the movement trial. The displacement signal also allows an estimation of termination accuracy since the target levels are known in advance.

   The electromyographic parameters used to accomplish objective "3" included: EMG latency with respect to the command signal, EMG onset in relation to the onset of displacement, presence or absence of burst versus continuous firing patterns in the agonist muscle, magnitude of the integrated EMG (IEMG) during the movement interval, normalized distribution of the EMG over the movement interval, and temporal relationships between agonist and antagonist muscles.

3. **Parameters of Electrical Stimulation:** Sensory nerves were preferentially excited by short duration, high frequency pulses. In this study, we used square wave pulses obtained from a Disa Multistim unit with a duration of 500 microseconds at 50 Hz. In trials where stimulation was required **before** movement, the pulse train was activated electronically by the auditory command tone and shut off by a voltage threshold detector set a few degrees of displacement, i.e., the train was stopped by the initiation of movement. Under conditions which required stimulation **during** movment, the pulse train was initiated by a threshold detector triggered by the first few degrees of displacement and then terminated by another detector which was triggered at an amplitude several degrees smaller than the target amplitude. Electrical stimuli was provided via ring or flattened cylindrical electrodes (which do not overly interfere with gripping the manipulandum) placed on all fingers and thumbs.

   Using single pulses delivered to all electrodes simultaneously, the perceptual threshold (for a single pulse) was estimated, then a supramaximal stimulus intensity was delivered as determined by the recorded compound sensory action potential obtained with recording electrodes situated over the median and ulnar nerves at the wrist (volar surface). Intensity levels between the perceptual threshold and supramaximal stimulation were investigated with respect to patient tolerance to various intensities of a pulse train delivered at 50 Hz for one second. The maximum tolerable intensity was used for facilitation and this intensity was expressible as a multiple of the perceptual threshold intensity as well as in terms of percentage of the peak-to-peak amplitude of the compound sensory action potential induced by supramaximal stimulation.

4. **Data Analysis:** A two factor mixed Analysis of Variance design: repeated measures on one factor are carried out. Four conditions of stimulation and three separate testing sessions are considered as independent variables. The conditions of stimulation include 1) no stimulation; 2) stimulation before movement; 3) stimulation during movement; 4) stimulation before and during movement. The testing sessions are carried out on three different days within a two-week period. Six quantitative dependent variables are measured for the analysis. These include 1) mechanical latency (reaction time); 2) movement time; 3) maximum velocity; 4) agonist EMG reaction time; 5) agonist integrated EMG magnitude for the movement interval; and 6) the time of onset of EMG to the time of movement initiation.

FINDINGS TO DATE: Seven patients with hemiparesis secondary to stroke or traumatic brain injury were studied during this investigation period. Electrical stimulation with intensity twice the sensory perception threshold for each patient was triggered either coincident with the "go" signal until the beginning of movement, or conincident with the beginning of movement to the peak of movement, or no stimulation was given at all. Dependent variables which were studied included reaction time and movement time as well as EMG reaction time. At the time of writing of this report, statistical treatment of the data, completed on these seven subjects in 21 experiments is still being processed.

By applying a train of electrical pulses to the fingers of the hemiparetic upper extremity, we were able to demonstrate, in some patients, a distinct and well-delineated facilitation of biceps and brachialis electromyographic activity. Although statistical analysis is still ongoing, it appears that, in three of the seven patients that were studied, there was a decrease in the mechanical reaction time under conditions of stimulation prior to the onset of movement as compared with the no stimulation condition. There did not, however, appear to be a consistent facilitation of movement time. Since the study design required each subject to make 60 movements during each day of testing, we were able to observe for motor learning effects as a function of a large number of trials in these patients. The data suggest that repetitive practice appears to enhance the reaction time responses of hemiparetic patients.

APPLICABILITY: Patients with central nervous system pathology secondary to stroke, head injury and many other types of pathology, commonly develop impaired movement control in their upper extremities. Clinical techniques to this point have not been very successful in restoring movement capabilities and control for the upper extremity. The concept of facilitation embodied in this study appears to offer the potential for improvement in movement control in patients with upper extremity movement control deficits. The problems of the movement-disabled patient are particularly relevant since there are large numbers of patients disabled by central nervous system disorders such as stroke, multiple sclerosis, spinal cord injury patients and traumatic brain injured

George Washington University (RT-9)
Medical Rehabilitation Research and Training Center

CORE AREA

Psychosocial, Vocational and Performance Capability Studies In Severe Disabilities

The rehabilitation outcome of the severely disabled which is dependent on the interrelated areas of psychosocial, vocational and performance capability factors.

THE GEORGE WASHINGTON UNIVERSITY

Irene G. Tamagna. M.D., Director
The George Washington University
Medical Rehabilitation Research and Training Center
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Washington. D C. 20037

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CONTINUING

NEW

PROPOSED

The Effects of Competing Speech Signals on the Auditory Comprehension of Brain-Damaged Adults

Psychosocial Factors that Limit the Renabilitation of Patients with Chronic Arthritis

Maintaining Work Potential of Parkinsonian Patients

129 Performance Capability and Vocational Potential of the ESRD Client

Principal Investigators: Alvin E. Parrish, M.D.
Kalisankar Mallik, M.S.

Status: Completed

Dates: March 1979-February 1980

Cost: Annual $117,487 — Projected Total $120,705
RT Annual $85,055 — RT % of Annual Total 72%

Annual Report Reference: #15, Page 207, SR-10

OBJECTIVES:

1. To determine whether a standard exercise could produce alterations in serum chemistries that might separate individuals with end stage renal disease into several groups.
2. To determine whether such separation could be related to the lack of return to previous physical activities.
3. To determine whether a program of planned exercise to improve physical capabilities could be developed.
4. To determine whether abnormalities seen on exercise could be reversed by increased dialysis time.
5. To identify medical, psychosocial, and vocational factors which are potentially predictive of the occupational status (hours per week of productive activity) of ESRD clients.
6. To verify which of these factors are predictive of occupational status.
7. To develop the occupational status predictor instrument.

METHODOLOGY:

1. **Exercise Test:** Individuals were asked to walk on a treadmill for 10 minutes at a standard rate. During this time vital signs, including blood pressure, pulse and respiratory rate, were determined for intervals of 10 minutes, for a full 30 minutes. Blood samples were obtained before the exercise began, at 2 minute intervals during the exercise, and at 10 minutes post and 20 minutes post exercise. Blood samples were analyzed for potassium, pH, lactate, pyruvate, calcium and magnesium.

2. **Identification of Potential Predictors of Occupational Status:** A listing of medical, psychosocial, and vocational factors, identified by prior research and literature review as significant to the vocational rehabilitation of the ESRD client, was organized into a prediction schematic. All factors were reviewed to identify those which showed the most promise of being predictive of occupational status. Medical and other rehabilitation professionals having expertise and current working experience with the ESRD population and ESRD clients were consulted as part of the review process.

3. **Development of Data Collection Instrument:** A self-administered questionnaire was designed around factors felt to be most significant as predictors. The questionnaire underwent a similar review to insure that, when administered, it would provide data consistent with identified predictor variables. A vocational psychologist/statistician was consulted to develop an appropriate response coding system for computer analysis prior to finalizing the questionnaire format.

4. **Data Collection:** Through the efforts of the National Kidney Foundation of the National Capital Area, Inc., permission was obtained to administer the developed questionnaire to individuals undergoing dialysis treatment at a local private dialysis center. Project staff distributed questionnaires to the center population for completion while undergoing treatment and collected completed forms at the end of each dialysis shift. Participation was strictly voluntary. In all, 28 individuals completed questionnaires.

5. **Data Analysis:** Validity and reliability of variables as predictors of occupational status were determined through multiple regression computer analysis techniques. Through this analysis, 10

variables out of 82 were identified as strong predictors of occupational status.

6. **Development of the Occupational Predictor Instrument:** A revised self-administered questionnaire for predicting occupational status of ESRD clients was developed around the 10 identified strong predictor variables. A formula for scoring response was developed.

FINDINGS TO DATE.

1. **Exercise Test:** The exercise test was standardized to a treadmill rate of 1.5 miles per hour. Blood samples were drawn as described in methods. Observations thus far indicate the following: (1) that many individuals undergoing hemodialysis are unable to undertake this degree of exertion for as long as 10 minutes without stopping. These individuals show development of quadriceps, pain and weakness which may interfere with their ability to complete the test. (2) Individuals undergoing hemodialysis who are undertaking the exercise tests show a marked increase in serum lactates above the resting level, after 5-8 months of exercise, following which their lactate level drops toward normal, at a rate not unlike that of normal individuals. The lactate pyruvate ratios in these individuals also increases; again to a marked degree. Differences between ESRD patients and normal controls are statistically significant. A group of 3 patients undertook regular, although unsupervised exercise consisting of jogging, in 2 instances, and bicycle riding in the third. These individuals considered themselves in better condition following this than previously; however, the exercise test was unchanged. Three individuals were dialyzed daily for one week, with improvement in their overall condition, but no change in their exercise test.

2. Project staff was able to identify medical, psychosocial, and vocational variables which appear to be strong predictors of occupational status of ESRD clients. A self-administered questionnaire was designed around these variables with an accompanying scoring formula for predicting occupational status of ESRD clients. Due to the limited sample on which these results are based, further testing and analysis of this new instrument are recommended to verify the instrument's potential usefulness.

APPLICABILITY: The findings of increased serum lactate with exercise which appear to be the metabolic accompaniment of uremic myopathy suggests that there is an important physical component to the inability of patients with end stage renal disease to return to gainful employment and although the socioeconomic factors are important, this physical factor, unless it can be corrected, suggests that there is a definite limit for the possibility of returning these individuals to their previous activities. This needs to be studied further.

It is expected that, with further testing, as mentioned above, the developed occupational status predictor instrument may assist vocational rehabilitation professionals to develop vocational strategies which are consistent with the optimal level of productive activity an individual with ESRD can be expected to achieve.

130 Rehabilitation and Family Interaction: A Pilot Test of the Multiple Family Group on a Dialysis Unit

Principal Investigators:	**David Reiss, M.D.** **Peter J. Steinglass, M.D.**	
Status:	**Completed**	
Dates:	**February 1979-January 1980**	
Cost:	**Annual $38,914** **RT Annual $28,396**	**Projected Total $41,609** **RT % of Annual Total 73%**
Annual Report Reference:	**#15, Page 231, SR-11**	

OBJECTIVES: The major objective of this pilot study was to explore the value of multiple family groups in the rehabilitation of ESRD patients on chronic hemodialysis. The multiple family group (MFG) is a brief, inexpensive psychosocial intervention aimed at identifying needs of families of clients reducing the stress of the family in dealing with chronic disability and improving the psychosocial outcome for the client. In the typical MFG, four to six families and one to two professionally-trained leaders meet for weekly sessions lasting 90 minutes each. In this pilot study, each multiple family group was scheduled for eight consecutive weeks. Although family members of ESRD patients on chronic hemodialysis have been, from time to time, organized in discussion groups to talk about

common problems, this project was the first test, to our knowledge, of the usefulness of groups which included both clients and families coping with other types of chronic illness, hence the rationale for applying it to problems associated with chronic hemodialysis.

Three major issues were explored as part of this pilot study: 1) the feasibility of establishing such groups, including the ability to get clients and family members to participate, coordination of such groups with medical treatment programs, and the preferable length of time for such a program (time limited vs. open-ended, etc.); 2) technical issues connected with such groups such as, necessary training for leaders, most useful topics of discussion, preferable compositional characteristics of the group (e.g., ages of clients, family size, inclusion of children in group meetings, etc.); and 3) an initial evaluation of the usefulness of such groups to clients and family members who participated.

METHODOLOGY: The multiple family group consisted of 4-6 families and one to two professionally trained leaders. The group met for 90 minutes weekly for a period of eight weeks. The primary emphasis in group discussion was on the current life issues, in each family, related to the chronic disability. Clients were drawn from several dialysis centers in the Washington area. They and those members of their family which occupy the same household were the members of the group. The primary emphasis in evaluation was direct clinical evaluation of the group itself. We needed to learn more how to adapt multiple family group techniques for this type of family. As preliminary effort to make controlled comparisons, we matched clients and families who participated in the group with those from the same centers, who were not asked to participate. We attempted a case-control match based on key demographic variables and severity of illness. A variety of standard rating techniques were used to compare the two groups.

FINDINGS TO DATE: Two MFG's were established and completed an eight-week program. The groups were run by a psychiatrist and a medical social worker who had an extensive background working with ESRD clients. Group discussion concentrated on coping strategies of families. Children were included in the groups and proved to be active participants. Both clinical evaluation of these groups by the project staff and self-report evaluation of clients and family members indicated that the groups were judged to be successful. A number of clients specifically recommended the establishment of such groups in the dialysis centers where they were receiving treatment. The research staff concluded that these groups were particularly helpful in offering support to clients who were just beginning in dialysis and in strengthening and evaluating an appropriate role for the family in support of patients.

APPLICABILITY: The data emerging from the pilot study is to be used as the basis for a training exercise in which the project staff will offer a formal training experience for professionals interested in establishing such multiple family groups in their own treatment centers. Reports are also being prepared for publication in scientific journals.

131 Counseling Needs of the Families of Aphasic Patients

Principal Investigator:	**Craig W. Linebaugh, Ph.D.**	
Status:	**Completed**	
Dates:	**March 1978-February 1980**	
Cost:	**Annual $9,740** **RT Annual $7,276**	**Projected Total $17,500** **RT % of Annual Total 75%**
Annual Report Reference:	**#15, Page 193, R-53**	

OBJECTIVES:

1. To determine what information and counseling the families of aphasic patients have received.
2. To determine which problem areas are most frequently associated with aphasia and which are of greatest concern to the families of aphasic patients.
3. To determine the optimum manner for providing the information and counseling needed by the families of aphasic patients.
4. To develop an objective means of determining individual family member responses to counseling.
5. To develop an objective means of assessing the effectiveness of counseling programs.

6. To isolate a set of factors by which those families most in need of counseling services may be identified, early in the rehabilitation process.

METHODOLOGY: The procedures employed included completion of a questionnaire by 62 spouses of aphasic patients representing 17 rehabilitation agencies. The spouse of each patient along with a Speech-Language Pathologist familiar with the patient rated the patient's performance on 40 functional communication tasks. In addition, the spouses rated their confidence in each of these ratings.

The results of the questionnaires were compiled with regard to the primary areas of concern, counseling which had been made available, how counseling might have been more effectively provided, and the nature of the alterations experienced in the marital relationship by each of the couples. An "accuracy-by-confidence" analysis was performed wherein the difference between a spouse's and the Speech-Language Pathologist's ratings of the patient's communicative abilities along with the spouse's ratings of his/her confidence were used to divide the spouses into 4 subgroups. These subgroups included a high accuracy-high confidence group, a low accuracy-low confidence group. Step-wise multiple regression analyses were also conducted in order to identify any factors which may have significantly affected the spouses' ratings.

FINDINGS TO DATE: Sixty-two spouses of aphasic patients were included in the final phase of this project which was completed this year. Of these spouses, 77% reported that they had received formal counseling where formal counseling was defined as a specific time set aside to meet with some member of the rehabilitation team to discuss the patient's aphasia and related problems. Ninety-three percent of these spouses felt that the counseling they had been provided was beneficial, but only 70% considered it adequate. These findings indicate that nearly 47% of the spouses had not had their counseling needs fully met.

Sixty-two percent of the spouses reported a change in their marital relationship following the onset of the patient's aphasia. In order to assess the nature of these changes, the spouses were asked to rate various aspects of their relationship as they were prior to onset and at present. These ratings were used to determine a Relationship Alteration Coefficient (RAC) for each couple included in the study. The mean RAC for the group was 0.68 with a standard deviation of 0.87. A significant negative Pearson product-moment correlation of -0.23 ($p < .05$) between the RAC and the severity of the patient's auditory comprehension deficit suggested that greater alterations in the marital relationship were experienced by those couples in which the patient had a greater impairment of his/her ability to comprehend spoken language.

Both the spouse of an aphasic patient and a Speech-Language Pathologist familiar with the patient made ratings of the patient's performance on 40 functional communicative tasks. The arithmetic mean of the differences between the 2 sets of ratings for each patient was calculated. This difference was termed the accuracy deviation and represented the extent to which the spouse's perception of the patient's communicative ability differed from that of the Speech-Language Pathologist. The mean accuracy deviation for the spouses was 0.63 with a standard deviation of 0.33.

The spouses also rated their confidence in their judgements of the patient's communicative ability. The overall mean confidence level for the group of spouses was 1.46 with a standard deviation of 0.33, indicating that as a group the spouses of aphasic patients are quite confident of their judgements concerning their aphasic partner's communicative abilities.

An accuracy-by-confidence analysis was performed to divide the spouses into 4 subgroups as mentioned above. The value of one-half standard deviation below the mean was chosen as the high-low cutoff for both accuracy and confidence. Theoretically, these values would identify 67% of the population of spouses of aphasic patients as low accuracy or low confidence, values chosen to permit the liberal clinical identification of those spouses who might be experiencing adjustment problems. Thus those spouses with an overall accuracy deviation score of greater than 0.5 were identified as "low accuracy," and those with a mean confidence greater than 1.3 were identified as "low confidence." Fifteen (25%) of the spouses fell in the High Accuracy-High Confidence group. 16 (26.7%) in the High Accuracy-Low Confidence group. 12 (20%) in the Low Accuracy-High Confidence group, and 17 (28.3%) in the Low Accuracy-Low Confidence group.

Step-wise multiple regression analyses were conducted to determine if any of a wide variety of factors accounted for a significant portion of the variability among the spouses' accuracy

deviation scores or confidence levels. A factor related to the severity of the patient's verbal expression deficit accounted for 42.5% of the variability in the accuracy deviation scores. This finding suggests that the spouses of those patients who had greater difficulty expressing themselves verbally experienced greater difficulty making accurate judgements regarding the patient's communicative ability. None of the factors examined accounted for a significant portion of the variability among the spouses' levels of confidence.

APPLICABILITY: Ninety-seven percent of the subjects included in this project reported that they were in substantial need of counseling at the time of the onset of their spouse's aphasia. Even more striking, 65% of the spouses felt they were still in need of counseling at intervals ranging from 3 to 75 months post onset. Contrast these findings with the fact that only 77% of the spouses reported receiving counseling and of these only 70% felt the counseling they had received was adequate. These results indicate that nearly 47% of the spouses felt that their needs had not been met. Clearly, the counseling services being offered to the spouses of aphasic patients need to undergo substantial upgrading.

The final products of this project should contribute significantly to this upgrading. First, the accuracy-by-confidence analysis provides an objective means of assessing individual family member's response to counseling services, as well as assessing the efficacy of the counseling services being provided by a particular institution. Second, the guidelines for providing counseling services which have been developed based on the results of this project provide a sound, patient-oriented basis for the revision of existing services and the institution of new, more comprehensive services.

132 Identification and Quantification of Biomedical Variables which Affect Learning Behavior and Rehabilitation Outcome After Cerebral Injury

Principal Investigator: Gaetano F. Molinari, M.D.

Status: Completed

Dates: March 1978-October 1979

Cost: Annual $50,887 — Projected Total $90,000
RT Annual $37,035 — RT % of Annual Total 73%

Annual Report Reference: #15, Page 200, R-54

OBJECTIVES:

1. To test prospectively the prognostic validity, accuracy and reliability of the variables recently reported by Feigenson (7, 8) from a retrospective study, namely, that age over 80, underlying organic mental syndrome, homonymous hemianopsia on the affected side, prolonged latency from onset of symptoms to admission to rehabilitation services all mitigate against a successful recovery after brain injury.
2. To test the feasibility of a unique method of application of the visual evoked response as a prognostic tool. Application of a special adaptation of the visual evoked response to patients with hemianopsia developed under the first year's activities of this project may specifically identify hemianopsia in the aphasic patient, and quantitative assessment may predict reversibility thereby indicating a more favorable prognosis.
3. To continue developing the visual evoked response and begin preliminary or pilot studies to evaluate the potential for application of the auditory evoked response and the somatosensory response to prediction of reversibility or potential recovery from hemispheral lesions in a rehabilitative therapeutic setting.

METHODOLOGY:

1. Patients with stroke or other intracranial lesions who have lesions in the posterior (post rolandic) quadrants of the brain on either side as determined by routine diagnostic CAT scans.

   The modification of the visual evoked response developed during the first year of activity of this project is used to stimulate posterior visual pathways of the two hemispheres independently.

2. Adequate control data have been accumulated from normal volunteers so that reliable and reproducible tests of hemispheral conduction of visual stimuli and the morphology of visual cortical responses are known and recognized.
3. Additional control data from patients without structural lesions is being gathered from migrainous volunteers.
4. Patients presenting to the neurological unit with aphasia are tested with the "partial field pattern reversal visual stimulation" technique whether or not the lesion seen by either CT scan or radionuclide brain scan involves known visual pathways.
5. Additional technical refinements are in development and these developmental engineering procedures will be continued.
6. Data used in formulating a prognosis are: (a) age; (b) presence or absence of an underlying organic mental syndrome, screened by the test now in general use on the neurology service (9); (c) the presence or absence of hemianopsia either clinical or proven by visual evoked response; and (d) the latency between the onset of symptoms and presentation to the hospital, (controllable) summated with the somewhat controllable latency between accession to health care and accession to rehabilitative services.

FINDINGS TO DATE:

1. All instruments in use as measurements of intellectual function are not applicable to aphasic patients during the acute and early convalescent stages of stroke including the "Screening for Organic Mental Syndromes in the Medically Ill" (Ann. Int. Med. 86:40-46, 1977) tested in this project.
2. The hemispheral modification of visual evoked response designed and developed in this project does permit identification of visual field defects in aphasic patients as soon as they are able to sit up. The technical feasibility has been well established in 25 controls and 20 patients.
3. The absence of a cortical evoked response corresponded well with lesions identified by CT scans which affected the visual cortex, while white matter lesions of the optic radiation cause delay in latency.
4. Visual evoked responses have been studied in a total of 65 patients, 45 of whom were studied using orthodox methods for detection of early or residual impairments in retinal and/or optic nerve function.
5. In conjunction with this project a plan has been developed for the detection of total brain mass by CT scan, and for quantitative analysis of all abnormally low brain rhythms. New equipment has been installed in the Neurology Department (at no expense to RT-9) that will permit not only cortical evoked response measurement but also complete frequency spectral analysis. The combination of quantitative neuroanatomy measured by CT scanning adapted to reflect brain mass (volume) digitally and quantitative neurophysiology brain slow wave analysis, will be tested as parameters of learning capacity reflected by formal, quantitative psychometrics in a later study.

APPLICABILITY: The ability to identify early the presence of a right homonymous hemianopsia in an aphasic patient independent of the patient's ability to communicate would be a very significant advance in identifying not only prognosis but also the problems in learning behavior that would complicate rehabilitative therapy. Also the quantitative differences between reversible and irreversible hemianopic defects as quantified by VER would be a significant refinement in prognostic assessment of patients with central nervous system lesions.

133 Coronary Artery Disease Rehabilitation Program: The Controlled Trial of Structured Low Level Exercise in the Hospital Phase of Post-Myocardial Infarct Convalescence

Principal Investigator: Patrick A. Gorman, M.D.

Status: Continuing

Dates: February 1979-January 1980

Cost: Annual $27,028 — Project Total $29,240
RT Annual $20,202 — RT % of Annual Total 75%

Annual Report Reference: #15, Page 238, SR-12

OBJECTIVES: This study was a controlled trial of structured low level exercise in patients hospitalized for acute myocardial infarction. The object was to determine whether this intervention has a significant effect on rehabilitation outcomes.

METHODOLOGY: Participants were recruited from the Hospital Coronary Care Unit. Patients were screened for the following: age 30-69, male or female, acute myocardial infarction with typical clinical presentation, diagnostic ECG and/or diagnostic serum enzyme changes, clinical stabilization and willingness to enter either the control or study group.

Eligible patients were assessed by depression and anxiety scales, adjective check list for physical and psychological well being, and social and occupational background.

Suitable patients were randomized to control and exercise groups.

The exercise group received daily supervised exercise, flexibility in type, graded into 4 stages according to level of convalescence, fully described in a booklet given to the patient.

The control group did not receive exercise supervised by a physical therapist.

Follow up evaluations were performed just before hospital discharge (day 10-14) and on day 40-45 post MI.

FINDINGS TO DATE: In the period April 1979 through January 1980, the CCU had 491 admissions of which 93 or 19% had documented acute MI. Of the 25 who were eligible, only 17 could be randomized, 11 going to the intervention group and 6 to control. Because of subsequent clinical problems which interfered with evaluations/interventions, complete data are available on only 7 activity patients and 4 control patients.

Patients in the intervention group prior to discharge had mean heart rates of 85 and 90 at supine and standing rest; 98 and 105 after a 3 min. walk at 1.5 mph and simulated step climbing respectively. The mean anxiety and depression scores were within normal limits. Findings in the Control group are similar.

At the second evaluation 3-4 weeks post discharge the mean supine and standing heart rates were 70 and 80 per minute; the heart rates after a 3 minute walk at 1.5 mph and simulated step climbing were 87 and 98 per minute.

No adverse reactions occurred during the evaluations or interventions.

The complete report describes the patients' status in the areas of sexual activity, leisure activities, employment and sense of well being.

APPLICABILITY. The problem of recruiting CCU patients for controlled studies was described and analyzed in detail; this was the major obstacle to obtaining an adequate number of patients.

No conclusions can be drawn in reference to the value of physical therapy in hospitalized patients due to the small number of patients studied.

134 Rehabilitation Potential as a Function of Corticosteroid Therapy in Rheumatic Diseases: A Prospective Study

Principal Investigator:	**Robert P. Jacobs, M.D.**	
Status:	**Continuing**	
Dates:	**January 1979-February 1981**	
Cost:	**Annual $59,618** **RT Annual $51,167**	**Projected Total $75,103** **RT % of Annual Total 86%**
Annual Report Reference:	**#15, Page 265, SR-13**	

OBJECTIVES:

1. To identify clinical and laboratory manifestations of systematic lupus erythematosus that limit rehabilitation potential;
2. To assess standard clinical and laboratory parameters used to measure selected manifestations of corticosteroid toxicity;
3. To identify those manifestations of corticosteroid toxicity that impair the rehabilitation process; and
4. To develop a protocol for assessing those manifestations of corticosteroid toxicity that impair the rehabilitation process.

METHODOLOGY: This is a pilot project designed to assess the role of selected manifestations of corticosteroid toxicity in the rehabilitation process. Patients with systemic lupus erythematosus were selected for study because of the large doses of corticosteroids often required in the management of this disease and the young average age of the patient population.

1. Disease Activity:

   A quantitative scale of disease activity based on standard clinical and laboratory parameters will be used.

2. Corticosteroid Toxicity:

   A. Musculoskeletal

      1. Steroid myopathy

         a. Semiquantitative assessment of proximal muscle strength;

         b. Serum enzymes: creatine phosphokinase and isoenzymes; lactate dehydrogenase and isoenzymes; glutamic oxalacetic transaminase;

         c. Serum potassium; and

         d. Urinary creatine/creatinine ratio.

      2. Steroid-Induced Osteopenia

         a. Vertebral body bone density measurements by computed axial tomography;

b. Peripheral bone density measurements by photon absorptiometry; and

c. Serum calcium, phosphorus, alkaline phosphatase, parathyroid hormone, and 25-hydroxy vitamin D.

B. Cardiovascular

1. Lipoprotein quantification, fasting blood glucose and 2-hour postprandial glucose determinations; and

c. Nuclear cineangiography.

C. Psychiatric

1. Schizophrenia and Affective Disorders Scale (SADS) -- the lifetime version will be administered. From the semi-structured interview the patient can be rated on the Hamilton or Beck Depression Inventories. Mental status examination information is contained in the SADS interview and can be extended by the interviewer where there are positive responses.

2. Social Adjustment Scale (Weisman) -- administered at 0 and 8 months.

3. Cognitive Capacity Screening Examination.

3. Functional Status:

A. Psychosocial Function

1. See 2-C

B. Vocational Function

1. Functional Limitations Scale -- This comprehensive inventory will be used to evaluate vocational capacity and identify functional limitations, regardless of etiology.

FINDINGS TO DATE: The implementation of this study was delayed by difficulties encountered in the development of the computer program to quantitate vertebral body bone mineral content by computed axial tomography. This program has now been developed based on the method of Orphanoudakis, et al. (Investigative Radiology 14: 122, 1979) and is ready to implement. A disease activity scale has been developed. The cardiovascular assessment component of the protocol has been modified, with nuclear cineangiography replacing electrocardiographic stress testing and two-dimensional echocardiography. Nuclear cineangiography is a more accurate measure of myocardial function and not dependent on the patient's ability to ambulate or exercise to tolerance.

The study has enrolled 16 patients, all female:

age (years)	18-50 (mean 33.8)
steroid dose (mg/day)	0-45 (mean 12.3)

These patients are currently being run through the protocol, outlined above.

APPLICABILITY: Corticosteroids are used in all medical disciplines and often provide dramatic improvement of serious medical disorders. While serious toxic manifestations of these drugs are well known and respected, their effects on the rehabilitation process are often overlooked. This study is attempting to demonstrate that corticosteroids limit the rehabilitation outcome of patients requiring continuous corticosteroid therapy. By identifying those toxic manifestations that impair the rehabilitation process, intervention strategies can be developed to enhance the outcome of a total therapeutic program.

135 Role of Family in Institutional Rehabilitation of Clients with Behavioral and Physical Disabilities

Principal Investigators:	**David Reiss, M.D.** **Peter J. Steinglass, M.D.**	
Status:	**Continuing**	
Dates:	**July 1974-February 1980**	
Cost:	**Annual $97,426** **RT Annual $70,030**	**Projected Total $400,000** **RT % of Annual Total 72%**
Annual Report Reference:	**#15, Page 42, R-45**	

OBJECTIVES: The **behavioral disability** phase seeks to predict rehabilitation outcome of patients with chronic behavioral disability based on characteristics of their families: the **physical disability** phase seeks to make similar predictions for patients with spinal cord injury and stroke.

METHODOLOGY:

1. The behavioral disability phase used adolescents and young adults (A). The psychiatric patients who lived at home with both parents until hospitalization. All patients were admitted to an inpatient psychiatric service for the treatment and rehabilitation of alcohol, drug abuse and delinquency problems. Both parents were included in the study. Some phases of the study required the professional staff and some administrators in the sponsoring institutions to serve as subjects. The physical disability phase will use 30 end stage renal disease patients. All 30 patients will have lived in intact families before beginning dialysis.

2. Family, institutional and treatment processes, and outcome variables will be measures. Included in the variables will be the family's typical orientation to its social environment. Standardized interviews, symptom checklists, questionnaires and nurses' ratings will be used.

FINDINGS TO DATE:

1 In the behavioral disability phase, findings from 36 families show that laboratory assessment procedures permit families to be grouped into four categories based on the family's orientation towards novel and problematic social situations. This classification accurately predicts many aspects of the family's involvement in the treatment program: the degree to which the family is noticed by staff and other families, the extent to which the family can open itself to new advice and experience (rather than remain closed and self-protective) and the family's morale and sense of optimism about the treatment program.

2. The physical disability phase is well underway but no clear findings are available.

APPLICABILITY: Results of these studies should help rehabilitation staff to identify problem families within the first week or two of work with patients and their families. In particular, it should help to predict families who will undermine the treatment, simply fall from full attention or drop out of the program prematurely.

136 Post Coronary Group/Exercise Therapy Study

Principal Investigators:	**Patrick A. Gorman, M.D.** **Melvin J. Stern, M.D.**	
Status:	**Continuing**	
Dates:	**May 1977-February 1981**	
Cost:	**Annual $95,850** **RT Annual $67,607**	**Projected Total $350,000** **RT % of Annual Total 71%**
Annual Report Reference:	**#15, Page 58, R-48**	

OBJECTIVES: This project will compare the effectiveness of two separate treatment approaches, exercise therapy and group counseling, with each other and with a control group, in rehabilitating psychologically and/or physically disabled post myocardial infarction subjects. The object is to document changes in various vocational, psychological, physical, and social parameters following a twelve week intervention program and throughout a one year follow-up period.

The following outcome variables are examined in the three experimental groups to determine the rehabilitative effects:

1. **Vocational** - Return to gainful employment, number of hours employed, job related responsibility, income.
2. **Psychological** - Change in depression/anxiety scores; increase in 'positive' factors, i.e., 'carefree' on adjective check list.
3. **Physical** - Change in physical work capacity, heart rate and blood pressure responses and exercise induced arrhythmias and ST changes.
4. **Social** - Increased social, familial and recreational functioning; return to active sexual functioning.
5. **Morbidity** - Particularly, readmission to the hospital and/or occurrence of cardiovascular events.
6. **Mortality**

METHODOLOGY: One hundred and fifty patients were to be admitted to the study over a 3 year period. The primary source of recruitment is The George Washington University Medical Center Coronary Care Unit. This is an eight bed unit which had 408 admissions in 1974, 474 in 1975 and 587 in 1976. The number of documented myocardial infarctions has been approximately one-third of all admissions (approximately 200 patients based on the 1976 census). We estimate that of this number 20-25% (40-50 patients) will be eligible candidates for the study. We expect to access between 25-35 of these patients into the study each year. The remainder of the annual quota of 50 patients will be recruited outside the hospital through contact with internists and cardiologists who regularly refer patients to The George Washington University Medical Center Exercise

Laboratory. Announcement of the program's existence will be sent to area medical societies and heart associations and then the community at large via public service announcements in newspapers, radio and television.

The primary steps will consist of:

1. Screening of hospital records.
2. Initial physical evaluations.
3. Psychological evaluation.
4. Randomization.
5. Rehabilitation programs:
    a. group counseling
    b. exercise training program
6. Follow-up evaluations.

FINDINGS TO DATE: Recruitment of participants for the project was started on 8/1/77. An outline of the project protocol and a request for patient referral was prepared and sent to attending physicians who regularly admit patients to The George Washington University Hospital and those who refer patients to the Exercise Laboratory. This outline was also sent to the local Medical Societies, Heart Associations and to the Heads of Cardiology in the area hospitals. With the collaboration of the Public Relations Department advertising releases have been prepared for publication in local newspapers and for public service announcements on radio and T.V. The staff of the Coronary Care Unit and Progressive Coronary Care Unit have been given detailed orientation about the project in order to secure their cooperation in the recruitment process.

The project staff made regular chart rounds to identify those patients who fulfilled the criteria for eligibility. When a patient appeared to be eligible, the personal physician was contacted to secure approval for possible participation and the patient was briefly contacted and oriented and requested to attend a screening session at least 6 weeks from the time of the acute myocardial infarction.

In the first three years of the study starting August, 1977, through July, 1980, 106 patients have been admitted to the study. Thirty-five patients were allocated to group counseling, 42 to exercise and 29 to control. Of the total 61 or 58% qualified for the study on the basis of low exercise tolerance. The remainder on the basis of anxiety/depression.

By July 31, 1980, 59 patients had completed their one year follow-up evaluation. There were 6 dropouts, 3 from group counseling, 2 from exercise and one from control.

Analysis of the 59 patients who have completed their one year follow-up reveals that the attendance at treatment interventions was satisfactory (75% or better attendance) in 13/18% of the 18 exercise patients and in 23/29% of the group therapy patients.

Exercise capacity showed a significant increase only in the exercise group at the third and sixth month follow-up, but at the final evaluation similar increases were also found in the group therapy and control patients. There was a significant reduction in anxiety in the exercise group at the 3, 6 and 12 month follow-up but insignificant changes in the other groups. Levels of depression showed changes which were not significant.

APPLICABILITY: No conclusions are being made since the study is incomplete.

137 Identification of Communication Deficits in Patients with Right Cerebral Hemisphere Damage

Principal Investigator: Penelope S. Myers, M.A.
Status: Continuing
Dates: May 1977-February 1981
Cost: Annual $40,115 — Projected Total $125,000
RT Annual $28,732 — RT % of Annual Total 72%
Annual Report Reference: #15, Page 80, R-49

OBJECTIVES:

1. Develop an experimental protocol.
2. Generate hypotheses about RH communication deficits.
3. Establish the presence or absence of specific language disorder in RH patients using a standardized, published test for aphasia.
4. Assess whether or not patients and their families perceive impaired communication in patients with RH disease.
5. Develop guidelines aimed at non-speech pathology rehabilitation team members which would serve to:
   a. facilitate communication with RH patients
   b. increase awareness of potential RH communication deficits
6. Develop a framework for the analysis of RH communication deficits to be used by speech pathologists in the clinical management of RH patients.

METHODOLOGY:

1. Identification of Experimental (target) Population
   a. Sex: Male and female; Age: 18-90 years
   b. Handedness: Right
   c. Medical history: recent onset of right sided cortical lesions with no past history of neurological disease - i.e. unilateral right cerebral hemisphere damage
   d. Neurological verification: results of routine tests using computerized axial tomography (CT scans)

      All the basic clinical variables for identification of site and size of lesion including all the clinical signs and symptoms reputed to have diagnostic significance
2. Identification of Control Population
   a. Sex, Handedness, age: same as in experimental population
   b. Non-hospitalized adults with no history of neurological disorder
3. Identification of Communication Deficits: PHASES

   Phase I: Development of Experimental Protocol
   (1) Administration to pilot population
   (2) Data analysis

   Phase II: Generation of Hypothesis Based on Phase I Data
   (1) Administration to experimental and control subjects
   (2) Data analysis

Phase III: Development of Revised Experimental Protocol Based on Phase II Data

(1) Administration to experimental and control subjects

(2) Data analysis

Phase IV: Development of the Following, Based on the Data Obtained in Phase III

(1) Development of guidelines for patient management

(2) Development of a framework for the analysis of RH communication deficits

FINDINGS TO DATE:

Phase I: Completed

1. Initial test protocol, designed to provide extensive speech samples under a variety of conditions, was designed
2. Included were:
   a. **The Boston Diagnostic Aphasia Examination** (Goodglass and Kaplan, 1976)
   b. **The Hooper Visual Organization Test** (E. Hooper, 1958)
   c. A story telling test using 10 TAT pictures
   d. A 50 question interview conducted with the subject
   e. A 50 question interview conducted with family member
3. Administration of the above test battery to 25 right hemisphere patients
4. Results:
   a. Experimental population does not have aphasia, but are communicatively impaired
   b. Hypothesis generated: right hemisphere patients appear to be impaired in the synthesis and integration of external information on a perceptual and cognitive level. In addition channelling and directing internal information seems impaired

Phase II: Completed

1. Hypothesis generated in Phase I was tested
2. Results:
   a. Experimental and control subjects differed significantly on a picture description task and on a perceptual visual integration task. Results significant at the 0.005 level of confidence. Interjudge reliability among the 3 judges yielded an r value of .99.
   b. Findings lent support to hypothesis and served as the theoretical under-pinning for the Revised Experimental Protocol

Phase III: In Progress

1. Revised experimental protocol designed - includes a 9 subtest right hemisphere communication battery designed by the principal investigator
2. Above protocol has been administered to 84 normal control subjects, of whom 63 will be admitted into the study based on their cognitive screening test results. Data analysis and testing experimental subjects continues.

APPLICABILITY: The focus of this project is the identification of communication disorders involving: affect; visual imagery and internal image making; comprehension of connotative (versus denotative) language; shifts in cognitive style in which synthesis and integration of contextual cues has been sacrificed; increase in rigidity; and confabulation—none of which could be labeled aphasia and all of which impair communicative ability. The result of the study should expand the traditional diagnostic and rehabilitation services to include additional objectives for the remediation of the identified deficits. Family support programs would also be expanded to include counseling and strategies for dealing with the communicative disorders in right brain damaged patients. With improved understanding of the nature of the communication problems in the right hemisphere patient, a more realistic vocational rehabilitation plan could be made.

138 Human Engineering Factors Related to Disabilities: Use in Vocational Rehabilitation

Principal Investigators: Kalisankar Mallik, M.S.
James Mueller, M.S.

Status: Continuing

Dates: March 1978-February 1984

Cost: Annual $52,354 — Projected Total $335,000
RT Annual $37,192 — RT % of Annual Total 71%

Annual Report Reference: #15, Page 95, R-50

OBJECTIVES:

The Problem: Through Job Development Laboratory experiences with severe disabilities, some major barriers to vocational rehabilitation for disabled persons have been revealed:

1. Rehabilitation counselors are unable to visualize possible worksite modifications which could make employment possible for functionally limited clients;
2. Employers are resistant to hiring disabled workers due to a fear of cost and complexity of environmental modifications;
3. Manufacturers of products (which must be modified for disabled users) are ignorant of the human factors of disabilities which could help in designing products needing few, if any, modifications.
4. Educational personnel have inadequate information available to prepare for accommodating disabled students.

Information to fill these needs is sparse and extremely difficult to access. Consequently, many counselors and employers do not want to place the severely disabled person. Manufacturers continue to produce products which cannot be used by these people without costly, extensive customizing. Educators struggle with the complexities of facility modification without proper guidance.

The Objectives:

1. Locate all available resources, research projects in process, and related materials dealing with human factors of disabilities and environmental modifications;
2. Develop a format for presentation of this data in a way which can be easily understood and used by counselors, employers, designers/engineers of consumer products;
3. Test the utility of the new resource to these potential users;
4. Refine and complete the resource and disseminate.

METHODOLOGY: The stated objectives will be achieved through the following methodology during the six years of the project period:

1. Review of literature and development of human engineering format related to different environments (i.e., vocational, home, educational) through consultation with consumers, designers, educators, employers, engineers, rehabilitation professionals and students.
2. Compilation of a list of potential users will be established.
3. Need survey form will be developed and mailed to each user
4. Respondents to the questionnaire will be randomly divided into control and study groups. The study group only will receive a copy of the developed resource.
5. A data gathering format will be designed and mailed monthly to both control and study groups.

6. The monthly data from control and study groups will be compared to determine the impact of the resource on enhancing the potential of disabled persons.
7. Resource will be improved on basis of study data.
8. Final resource will be produced and disseminated.

FINDINGS TO DATE:

1. Consumers, rehabilitation counselors, employers, designers, engineers and students are invited, through direct mailing and personal contacts, to express their information needs in the areas of human factors of disabilities and environmental modifications;
2. From this input, a format was developed for presentation of the most desired data in a clear, illustrative manner;
3. Data was collected from completed and ongoing research projects, published references and texts, human factors professionals, consumer groups, and client records and applied to the format;
4. A committee was formed from contacts made throughout the project to evaluate the preliminary format design; necessary changes were made;
5. Layout for the resource has been designed;
6. Test copies of the resource **Designing for Functional Limitations** have been printed and distributed for feedback.
7. Information needs surveys were mailed to potential users to assemble a group of interested persons. These were randomly divided into test and control groups. Test and control groups completed monthly data cards to track information needs. Data did not indicate that major changes in the resource were needed. Many requests and favorable responses outside the study began and still continue. To this date, over 450 copies are in the hands of consumers, employers, and rehabilitation professionals.
8. Updated information and suggested improvements have been made to the resource, and it is being reprinted for distribution through RT-9, while work continues on remaining sections of **Designing for Functional Limitations**. Currently the section on educational environments, including laboratories, studios, auditoria, and libraries, is being completed.

APPLICABILITY: The dilemma of the employer seeking the environmental implications of hiring the disabled, the counselor having little expertise to offer in this area, and the misunderstood client caught in the middle is a common occurrence. The Job Development Laboratory staff has experienced these circumstances on many occasions. Through a basic understanding of human engineering and extensive experience working with clients having various severe disabilities, simple solutions have been found, for example:

1. Instability in transfer with conventional narrow transfer boards prevented on-site employment for a Job Development Laboratory client with C4-5 spinal cord injury. By vacuum-forming a 16 inch wide plastic transfer board with a "fender" for sliding over the wheel, transfer, and therefore employment, was made feasible.
2. Inability to empty a leg bag prevented on-site employment for a spinal cord injured client. Refinement of a 2½ gallon wheelchair tank designed for another Job Development Laboratory client allowed free passage of fluids without necessity of emptying tank during working day.

A resource providing appropriate guidelines for setting up functional environments for disabled persons will aid in maximizing vocational rehabilitation service delivery, as well as in mainstreaming persons in educational and daily living environments.

139 Comprehensive Job Placement Models for State Vocational Rehabilitation Agencies

Principal Investigator:	**Kalisankar Mallik, M.S.**	
Status:	**Continuing**	
Dates:	**March 1978-February 1982**	
Cost:	**Annual $59,187** **RT Annual $43,444**	**Projected Total $320,000** **RT % of Annual Total 73%**
Annual Report Reference:	**#15, Page 120, R-51**	

OBJECTIVES. The objectives of this project are:

1. To develop innovative job placement models, based on concepts of service delivery already tested and refined by the Job Development Laboratory, which are consistent with the service delivery capabilities, constraints and preferences of state vocational rehabilitation systems;
2. To develop training formats for state vocational rehabilitation personnel to support the developed placement models.
3. To assess the need for such services and to provide state vocational rehabilitation systems with developed placement models and appropriate staff training in their use.
4. To monitor and measure the effectiveness of the developed placement models' utilization in the state vocational rehabilitation system through the analysis of caseload statistics.
5. To disseminate the project's findings to all state rehabilitation agencies on the cost effectiveness of each developed model.

METHODOLOGY: To meet the project objectives, the project staff will conduct a four year research and demonstration project as described below:

1. Selection of advisory committee members;
2. Development of job placement models for use in state vocational rehabilitation systems;
3. Survey of state/federally supported vocational rehabilitation programs concerning their participation in the project;
4. Development of training materials and formats to support the placement models;
5. Collection of pre-training placement data;
6. Training of state vocational rehabilitation personnel:
    a. Providing audiovisual and training materials to the participating state vocational rehabilitation agencies' designated staff
    b. Conducting a five day training program at the Job Development Laboratory, RT-9, Washington, D.C.
    c. On-site visit to provide more intensive training
7. Collection of post-training placement data;
8. Analyzing data in terms of effectiveness of the program.

FINDINGS TO DATE:

1. **Selection of Advisory Committee:** According to the Methodology, a representative group of individuals was requested to serve as members of the advisory committee. The members (state vocational rehabilitation counselor, training officer, job placement specialist, first-line supervisor, administrator, and consumer), with diversified rehabilitation backgrounds, were selected nationally to assist the project staff in refining research and placement models and training formats, and in reviewing and analyzing training outcome data.

2. **Development of Placement Models:** According to the comments and suggestions provided by the advisory committee members, the project staff revised the following job placement models: **Control group** (The Individual Counselor Approach); Study group: Model 1 (The Team Approach), Model 2 (In-House Technical Support to Individual Counselor Approach), Model 3 (Facilities Team Approach), and Model 4 (Job Placement Specialist Approach).

3. **Survey and State Selection:** The project selected one state from each of the ten federal regions as possible participants in the research and demonstration project. Since the project's resources limited us to work with approximately five states, on November 29, 1978 the staff requested each of the ten selected states to return a questionnaire by January 3, 1979 if they were interested in participating in this study. The following are the five states which were selected (on a first-come, first-served basis) to participate in the study and control models: New Hampshire, Region I; Virginia, Region III; North Carolina, Region IV; Michigan, Region V; and Iowa, Region VII.

4. **Data Gathering Format:** A format was designed so that all required data could be easily compiled from R-300 information already collected by each state agency as required by the Department of Education. Pre-placement data has been collected and is currently being analyzed.

5. **Training:** A training format and content were developed and used to train 18 members from the five state vocational rehabilitation agencies who participated in a five-day training program at The George Washington University (Research and Training Center, Washington, D.C.) at two separate sessions, one in September, one in October, 1979. As per the methodology, on-site follow-up training visits were scheduled and are already completed for all states except N.C., which is scheduled for the month of October 1980.

6. **Post training data** is now being collected using the same Format as described in Item 4.

7. **A quarterly newsletter** has been established entitled "Intercom" to disseminate achievements made by participating states. The first newsletter was disseminated nationally in the month of August "80"

APPLICABILITY: The research staff of this project is planning to develop practical job placement models, complete with staff training packages, applicable to vocational rehabilitation service delivery systems for severely disabled persons. It is anticipated that adoption of such models into existing state vocational rehabilitation systems will facilitate gainful employment of severely disabled clients and thereby help rehabilitation practitioners in implementing the Rehabilitation Act of 1973.

140 Emotional Responses in Subjects with Right Hemisphere Damage

Principal Investigator:	**March Enders, M.D.**	
Status:	**Continuing**	
Dates:	**March 1978-February 1981**	
Cost:	**Annual $22,364** **RT Annual $16,085**	**Projected Total $47,000** **RT % of Annual Total 72%**
Annual Report Reference:	**#15, Page 180, R-52**	

OBJECTIVES.

Background: It is becoming clear from studies conducted over the past ten years that the right cerebral hemisphere has a special role in the comprehension of emotions and emotionally colored information, and probably also in the experiencing and expression of emotion.

To summarize, it is now generally thought that the right hemisphere is:

1. Superior in comprehension and expression of emotion.
2. Superior in storage of affective material.
3. Has a preferential emphasis on negative emotions.

Purpose: The present study is designed to determine whether or not right hemisphere damage results in a diminished experience of emotion in general or of certain specific emotions.

METHODOLOGY: The following subject and control groups are being studied:

Subjects: Patients with right hemisphere damage verified by CT scan, due to cerebrovascular disease, right-handed, ages 40-90.

Controls:

1. Patients with left hemisphere damage due to cerebrovascular disease verified by CT scan, right-handed, ages 40-90 but with good comprehension, i.e., able to follow at least a two-stage command.
2. Patients without brain disease, but with chronic illness such as arthritis, heart or pulmonary disease, ages 40-90.

The following test instruments and data collection will be obtained:

1. Mental status examination: subjects must score 20 of the possible 30 to qualify for the study.
2. Lorr Feeling and Mood Scale: to be given to subjects weekly to rate themselves. The patients will be rated serially beginning 3-4 weeks post-stroke.
3. OT ratings for left-sided neglect (4-point scale).
4. Ratings for emotional flatness (3-point scale), to be filled out by the patient's primary nurse, physical and occupational therapists.

FINDINGS TO DATE: 12 right hemisphere, 7 left hemisphere, and 15 control patients have been studied. The right hemisphere and control groups show very similar patterns on the Lorr Feeling and Mood Scale except for somewhat diminished levels of anger, while the left hemisphere patients do not show any significant differences. Tentatively, we have concluded that right hemisphere patients may not have an altered experience of emotion with the possible exception of anger, but may instead have diminished emotional expressiveness.

APPLICABILITY: Damage to the right cerebral hemisphere is widespread among patients with disabilities, occurring as it does in cerebrovascular disease, and as a consequence of trauma and brain tumors. Of these, a considerable number of patients of all ages may have some type of emotional dysfunction as part of their disability.

This dysfunction can be distressing, in that it may result in altered and less satisfactory relationships between the patient and his family, rehabilitation team members and co-workers. Patients with affective dysfunction can become remarkably cut off from their normal support systems because of their difficulties in understanding and expressing appropriate feelings. It can be difficult for rehabilitation team members working with these patients to assess motivation and emotional responses to the treatment situation. Family members can be particularly distressed by the change in the patient's ability to communicate with them.

In addition to the interpersonal changes caused by affective dysfunctions, distinguishing between depression and emotional flatness can be a very difficult clinical problem in patients with right hemisphere damage; preliminary results in the use of the Lorr **Profile of Mood States** suggest that tests of this kind may be useful in distinguishing between the two conditions.

Enlargement of one's understanding of these affective changes is an essential first step toward the goal of providing more effective treatment and re-education techniques for patients with right-sided brain damage. New information gained from the present study could be used to enhance the effectiveness of the rehabilitation process in several ways. Patients themselves, families, rehabilitation personnel and vocational rehabilitation counselors could benefit from increased understanding of the nature of the emotional dysfunction and how it affects the patient's functioning. In addition, any new information could be used towards improved emotional functioning.

141 Effects of Competing Speech Signals on the Auditory Comprehension of Brain-Damaged Adults

Principal Investigator: Craig W. Linebaugh, Ph.D.

Status: New

Dates: March 1980-February 1981

Cost: Annual $16,626 — Projected Total Not Specified
RT Annual $11,743 — RT % of Annual Total 71%

Annual Report Reference: #15, Page 282, R-55

OBJECTIVES: The objectives of this study are:

1. To determine the effects of competing speech signals of varying levels of intelligibility on the auditory comprehension of left- and right-hemisphere damaged subjects.
2. To determine the effects of competing speech signals of varying signal-to-noise ratios on the auditory comprehension of brain-damaged subjects.
3. To assess the interaction between the intelligibility of competing speech signals and signal-to-noise ratio relative to auditory comprehension.
4. To assess the relationship between the severity of aphasic auditory comprehension deficits and the effects of competing signals.

METHODOLOGY: Four groups of subjects will be included in this study. They include (1) left-hemisphere damaged, nonfluent aphasic subjects. (2) left-hemisphere damaged, fluent aphasic subjects. (3)right-hemisphere damaged, nonaphasic subjects, and (4) nonbrain-damaged control subjects. The brain-damaged subjects will have a single, unilateral focal lesion as determined by CT scan. The control subjects will have no history of nervous system disease. All subjects will have a pure tone average hearing level for the frequencies 500, 1K, and 2K Hz of not greater than 40 dB HL (ANSI, 1969) and with no greater than a 10 dB difference between ears.

For the experimental procedure, subjects will follow 12 commands of varying levels of linguistic complexity. The subject will be seated in a sound-treated booth, and the commands will be presented on tape through 2 loud speakers at 40 dB SL. The commands will be presented in quiet and with competing speech signals of two levels of intelligibility (speech babble, 100% intelligible dialogue) at two different signal-to-noise ratios (0, -10). The subjects' responses will be scored by two certified Speech-Language Pathologists.

FINDINGS TO DATE: Not applicable at this time. (New project)

APPLICABILITY: The ability to comprehend auditorily-presented requests and instructions is crucial to the rehabilitation of brain-damaged patients. Not only is it essential that the patient understand the speech of the various members of the rehabilitation team who are providing care, but he must also have adequate auditory comprehension to communicate effectively with his family, friends, and others with whom he interacts so that his motivation remains at an optimal level. Traditionally, the auditory comprehension of brain-damaged patients has been assessed and treated in environments where competing signals are held to a minimum. Relatively few communicative interactions, however, occur in such environments. Rather, competing auditory signals impinge on the speech signal to be comprehended and thus reduce the communicative efficiency of the brain-damaged patient.

The results of this project will contribute to rehabilitation in two important ways. First, it will provide rehabilitators with a more precise understanding of the effects of competing signals on the auditory comprehension of brain-damaged individuals. To this end, the environment in which rehabilitation is conducted can be modified to provide for optimal communicative efficiency. Second, competing signals can be incorporated into the speech-language rehabilitation of patients in order that they may be better prepared to communicate in naturally occuring environments. This may have particular significance from a vocational standpoint where the patient is seeking to return to a place of employment that has a high level of competing auditory stimuli.

142 Psychosocial Factors that Limit the Rehabilitation of Patients with Chronic Arthritis

Principal Investigator: Robert P. Jacobs, M.D.
Status: New
Dates: March 1980-February 1983
Cost: Annual $94,421 — Projected Total $283,263
RT Annual $67,391 — RT % of Annual Total 71%
Annual Report Reference: #15, Page 288, R-56

OBJECTIVES:

1. To identify the psychosocial factors that interfere with the rehabilitation of patients with chronic arthritis;
2. To assess the role of family factors in the rehabilitation of patients with chronic arthritis;
3. To identify those patients with chronic arthritis who might benefit from early psychosocial intervention; and
4. To develop psychosocial intervention strategies for those patients with chronic arthritis identified as high-risk for suboptimal rehabilitation outcome.

METHODOLOGY: Patients with chronic arthritis, including Rheumatoid Arthritis, Psoriatic Arthritis, Reiter's Syndrome and Ankylosing Spondylitis, under continuous therapy for at least three months will be included in the study.

Assessment of Disease Activity - Standard clinical and laboratory parameters of disease activity will be assessed every six months. For the purpose of this study, those parameters of disease activity that depend on musculoskeletal function will not be used. Parameters of disease activity that reflect the systemic and inflammatory nature of these diseases will be used and include duration of morning stiffness, onset of PM fatigue, sedimentation rate, and Ritchie Articular Index.

Assessment of Function and Vocational Capacity - Three instruments will be used to assess functional status every six months.

Keitel Function Test - a test of musculoskeletal function that consists of 24 exactly prescribed exercises which are judged by well-defined rating scale categories.

Arthritis Impact Measurement Scales (AIMS) - a multidimensional index that includes an assessment of physical, emotional, and social well-being. AIMS is a self-administered questionnaire that was developed in a mixed arthritis population.

Functional Limitations Scale - a comprehensive inventory used to evaluate and monitor functional limitations as they relate to vocational capacity.

Assessment of Psychosocial Function - There are two related, but separate classes of psychosocial function that will be assessed. The first are the internal psychosocial processes that will be assessed by standard measures of motivation, mood, intelligence, and the Social Adjustment Scale. The second are the interpersonal psychosocial processes that reflect the social role of the illness and will be assessed by well-studied measures of family function.

Selected participants will be asked to include family members in a comprehensive family interview and psychosocial assessment.

FINDINGS TO DATE: Not applicable

APPLICABILITY: Arthritis is a common disorder affecting about 30 million Americans of which some 5 million are disabled. Despite the frequency of arthritis and its potential to impair major life functions, the disease is usually responsive to medical and/or surgical therapy. The experience of all medical and allied health professionals caring for this patient population is that there is a subset of patients who do not achieve a functional response consistent with their therapeutic response. It is postulated that there are identifiable psychosocial factors which define this population at high-risk for suboptimal rehabilitation outcome. The results of this study will provide vital information on the prevalence of interfering psychosocial factors in an unselected ambulatory population. These

data will facilitate the development of more efficient and cost-effective medical care systems by obviating the need to include all patients with arthritis in multidisciplinary programs. Medical and allied health professionals will be offered tools to evaluate patients who do not appear to be showing appropriate progress and identify those who require the addition of potentially toxic medical intervention and those whose lack of progress is not a function of residual disease activity.

143 Maintaining Work Potential of Parkinsonian Patients

Principal Investigator: Paul Teychenne, M.D.

Status: New

Dates: March 1980-February 1981

Cost: Annual $41,399 — Projected Total $41,399
RT Annual $30,384 — RT % of Annual Total 73%

Annual Report Reference: #15, Page 297, R-57

OBJECTIVES:

1. To identify, develop and validate tests to assess the severity of Parkinson's disease using clinical and laboratory parameters: that is, tests to predict the severity of both the physical impairment (tremor, rigidity, bradykinesia and autonomic disturbance) and the mental deficit (dementia, anxiety and depression).
2. To determine if we can use the criteria for severity of parkinsonism to predict long term prognosis and response to therapy.
3. To determine if current drug therapy and relevent rehabilitative procedures can reverse the physical and mental impairment of parkinsonism.

METHODOLOGY: We will attempt to develop a scale indicating the severity of parkinsonism by assessing the results from clinical, radiological, electrophysiological and psychometric investigation. These tests are all performed as part of the diagnostic evaluation of a parkinsonian patient. Also we will assess whether using bromocriptine alone or adding bromocriptine to a patient's current therapy will decrease a parkinsonian patient's physical and mental deficit, allowing them to continue in useful employment.

Forty parkinsonian patients will be divided into three groups: Group I patients will be placed on placebo bromocriptine for a two-week period when they initially present to clinic. During this time, they will be psychometrically and clinically evaluated.

Group II patients will take active bromocriptine therapy initially and then be evaluated psychometrically and clinically when they have reached an optimal dose. Nine months later they will be placed on placebo for two weeks and re-evaluated.

Group III patients will have bromocriptine therapy withheld as indicated in the protocol studying the clinical efficacy of low dose bromocriptine therapy.

In these cases the bromocriptine placebo period will vary from two weeks to six weeks, depending on the severity of deterioration, if any, of the patient. Psychometric, clinical and laboratory evaluation will be performed before these patients start bromocriptine therapy and then repeated during the bromocriptine placebo phase.

Forty age and sex-matched normal volunteers will be psychometrically evaluated as control subjects.

FINDINGS TO DATE: Using low dose bromocriptine, mean daily dose of 14 mg, we have induced a significant improvement ($P < 0.01$) in all the features of Parkinson's disease. A 40% improvement in tremor, a 30% improvement in rigidity and a 30% improvement in bradykinesia. Bradykinesia includes an improvement in poverty of movement, ability to initiate movements, a decrease in the amount of freezing and shuffling of the gait, an improvement of balance and posture and an improvement in writing and finger dexterity. After one and a half years of treatment we have been able to maintain this improvement in the patients without any significant deterioration in clinical signs. In other words, the score for clinical signs after one and a half years of treatment are equivalent to those scores when the patient first achieved an optimum response from bromocriptine. We have also been able to achieve this persistent effect without any significant increase in the dose of bromocriptine. The mean dose of bromocriptine taken by the patient one and a half years ago was 12mg, it is now 14mg per day. A major advantage of low dose bromocriptine therapy has been the fact that these improvements are equivalent to that obtained with doses of bromocriptine such as 50mg per day and 150mg per day. These results were obtained by the Principal Investigator during his time at the National Institutes of Health. A further advantage of low dose bromocriptine is that instead of 40% of the patients being unable to tolerate the drug in our study only 10% of patients have not been able to take bromocriptine. That is, we have had 4 patients drop out of the trial while 36 continued. These drop outs occurred with the very first doses of bromocriptine and no patient has dropped out of the trial once established on bromocriptine therapy. During the trial both the patients and the assessor were not aware of whether they were taking active or inactive bromocriptine (double blind study). Adverse affects were negligible at these dosages. Two patients did develop hallucinations but this was corrected by a slight reduction of bromocriptine dose and subsequently both these patients have been maintained on low doses of bromocriptine. Linear measurements of ventricular size such as intracaudate diameter, diameter of the third ventricle, diameter of the frontal horns and measurement of cortical sulci in CT scans taken from parkinsonian patients are not different from those measurements in age-matched normal controls. Therefore, the dementia seen in Parkinson's disease appears not to be related to marked structural atrophy of the brain. It may well be related to a chemical deficit of dopamine.

We have been unable to start psychometric assessments as final approval by The George Washington University Human Research Committee is pending. The protocol was submitted to the Human Research Committee on September 16, 1980 and was stamped as Action Deferred. They require some additions to the Informed Consent which are tabulated in an addendum added to this protocol. These additions are only bureaucratic formalities and we should therefore have final approval and be able to start psychometric testing in November, 1980.

Observations made on the psychometric status of patients are revealing. We have a videostrip which shows a patient suffering from the on-off phenomena. During the on state when he is dyskinetic, mobile and loose he is very bright, intelligent and has good recent memory. When he fluctuates rapidly into an off state he becomes parkinsonian, has a shuffling gait and freezes, there is also a marked mental deficit. This is not due to associated depression. It is obvious in the tape that this patient has poor recent memory and becomes confused. This has been obvious to us in the clinic and this patient has asked us to write down instructions when he is in the off state yet has been able to recall all instructions given during an on state. Therefore it appears that the intellectual deficit in Parkinson's disease is indeed chemical and therefore may be helped by anti-parkinsonian medication such as bromocriptine. This observation has also been seen in 6 other patients who have complained of problems with recent memory during the bromocriptine placebo phase. They have been confused when arriving at the clinic, sometimes unshaven and disarrayed in their clothing. This is in marked contrast to the time when they are on active drug when they are much brighter. One of these patients works as a Ph.D. research scientist and is able to carry out this work while taking active drug but it is obvious from his demeanor, behavior and confusion during placebo administration that he would be unable to maintain his job without therapy.

APPLICABILITY: Untreated parkinsonian patients often cannot be usefully employed, have shortened life spans, their final years are unproductive, they remain a burden to themselves and to their family, and they often require total nursing care in the final years. Newly diagnosed parkinsonian patients generally retire early from productive employment because of the physical and mental limitations of their disease. Parkinsonism unnecessarily decreases the work force. Considering the high incidence and prevalence of Parkinson's disease, this decrease in the work force is not

insignificant. This disease also increases financial burden to the welfare medical system because of increased hospitalization, increased dependency on social services, increased nursing service in the home and finally full time nursing care in a nursing home. Idiopathic parkinsonism is not a disease of the elderly and can affect patients in their final 15-20 years of what would be otherwise useful employment. The incidence of idiopathic parkinsonism occurring in the young is increasing.

If we are able to improve both the clinical and mental performance of parkinsonian patients to match that of normal controls, then we should be able to keep these patients usefully employed or re-introduce them to useful employment.

Untreated parkinsonian patients have a ten year life span after diagnosis. However, replacement drug therapy with optimal use of rehabilitative services may slow or prevent the progression of the disease. It will be important that we not only prolong life, but also that we ensure this life is useful and productive.

University of Colorado (RT-10)
Medical Rehabilitation Research and Training Center

CORE AREA

Cardiopulmonary Rehabilitation

Research undertaken by the Center is practical, patient/client-oriented clinical research that is primarily derived from or utilized in the comprehensive patient care program for both in-patients and out-patients with coronary atherosclerotic heart disease. The coordinated research program dealing with major physiologic and psychologic problems in cardiopulmonary rehabilitation is designed to have a potentially direct impact on the primary or secondary prevention of disease or the prevention or modification of disability due to disease.

UNIVERSITY OF COLORADO

H.L. Brammell, M.D., Director
University of Colorado
Medical Rehabilitation Research and Training Center
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Denver, Colorado 80262

COMPLETED

ACCESSION NO.

CONTINUING

DISCONTINUED

PROPOSED

Beta-Adrenergic Blockade and Aerobic Conditioning—Effect of Low/Moderate Doses of Propranolol

Effects of Exercise Conditioning on Platelet Activation

Hemodynamic Measurements in High- and Low-Risk Prehypertensive Youth

Serial Evaluation of Cardiac Scintigraphic Studies Following Acute Myocardial Infarction: A Controlled Study

Comparison of Noninvasive Measurements of Cardiac Output Using Mass Spectrometry

250

144 Early Adjustment to Steady and Unsteady State Exercise in Patients with Cardiopulmonary Disability

Principal Investigator:	**H.L. Brammell, M.D.**	
Status:	**Completed**	
Dates:	**October 1975-May 1979**	
Cost:	**Annual $77,804** **RT Annual $77,804**	**Projected Total $250,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#15, Page 26, R-9**	

OBJECTIVES:

1. To acquire a computer-based physiologic measurement system to monitor ventilation, oxygen consumption, and carbon dioxide production rapidly and on-line.
2. To evaluate the adjustments to steady and unsteady state exercise in patients with and without cardiopulmonary disorders.

METHODOLOGY:

1. Construction of a physiologic monitoring system composed of a computerized data acquisition system and mass spectrometer (total gas and flow analysis instrument).
2. Utilizing the monitoring system to evaluate small groups of patients to:
   a. Establish normal oxygen deficit data in subjects without cardiopulmonary disease.
   b. Evaluate the hypothesis that oxygen deficit is greater in patients with functional impairment (New York Heart Association Class II or III) than in normals.
   c. Evaluate the oxygen deficit response in patients with angina pectoris.
   d. Evaluate the early adjustment to exercise in patients with varying degrees of obstructive lung disease.

Analysis of expired air during treadmill exercise, utilizing a bag collection system, carbon dioxide analyzer and fuel cell oxygen analyzer, was done on subjects. The following are some of the observations that were made or computed: minute ventilation, oxygen consumption, CO_2 production, respiratory exchange ratio, METS, anaerobic threshold, percent of maximum oxygen consumption at which anaerobic threshold occurs, heart rate, exercise electrocardiogram repolarization changes and abnormalities in heart rhythm, and blood pressure. Protocols were specific to the groups evaluated.

FINDINGS TO DATE: Studies completed with the progress of this project include:

1. Elderly female conditioning
2. Professional football player oxygen consumption evaluation
3. Marathon studies—young and old, showed a decrease in oxygen consumption max, but no change in % of oxygen consumption max at anaerobic threshold. Holter monitor study during a run at anaerobic threshold shows marathon runners have arrhythmias.
4. Anaerobic threshold in post-myocardial infarction males - results of Phase II program show no change in oxygen consumption max; marked improvement in anaerobic threshold. This has many implications for rehabilitation.
5. Adjustment to Standard Balke Exercise Test before and after physical conditioning speaks to the question of conditioning modifying the rate at which one adjusts to change in workload.

   It is apparent from these studies that the anaerobic threshold can be favorably modified in cardiac subjects. This improvement in the onset of anaerobic metabolic pathways is more marked for the percentage of maximum oxygen consumption than for the percent of maximum heart rate at which the anaerobic threshold appears. The significant improvement in the level of oxygen utilization and METS at the point of the anaerobic threshold indicates that with anaerobic training, the cardiac can perform work, recreational and conditioning activities of a considerably higher level without utilizing anaerobic metabolic pathways and increasing blood lactic acid

concentrations. In addition, since work at a level which exceeds the anaerobic threshold is associated with muscle ache, muscle fatigue, hyperventilation and often nausea, the aerobically conditioned client should be able to work at a higher intensity and remain comfortable. An increase in productivity and decrease in rest requirements while at work should result although this is not proved.

The physiologic monitoring system employs CO_2 analyzer (Beckman LB-1) fuel cell oxygen analyzer, hot-film anemometer (Thermo-Systems, Inc.) and a fully dedicated MicroNOVA computer (Data General) for on-line measurement of ventilation data: V_E, VO_2, VCO_2, RQ, tidal volume respiratory frequency and METS. These data are printed (Texas Instruments Silent 700) each 30 seconds. The respiratory mass spectrometer has been functioning in the laboratory of Dr. George Swanson where he has been conducting studies on multiple gas re-breathing techniques to assess lung water. In addition, he has been writing computer programs for the on-line non-invasive assessment of cardiac output which will permit breath by breath cardiac output data. These programs will be directly applicable to RT-10 computer support and are expected to be in place late in 1979.

At the present time, the respiratory mass spectrometer is in place and noninvasive cardiac output measurements are being made. When the computer program for cardiac output is debugged, the instrument will be taken to the cardiac catheterization laboratory and simultaneous direct (cath) and indirect (mass spec) Fick cardiac outputs will be obtained to standardize the method.

APPLICABILITY: Methods which can detect physiologic changes that have the potential of early detection of deterioration, that suggest treatment modification and thereby maintain home, community, and vocational viability have great potential impact on the rehabilitative process. The long-range goal of this project when the monitoring system is completed is to record a series of important physiologic observations longitudinally on patients with cardiopulmonary disorders and to use these physiologic data as indicators of work modification and hopefully as predictors of rehabilitative success or failure.

145 Evaluation of the Response to Maximal Exercise in Persons Taking Doses of Metoprolol and Propranolol

Principal Investigator: H.L. Brammell, M.D.

Status: Completed

Dates: June 1979-December 1979

Cost: Annual $14,795 — Projected Total $20,000
RT Annual $12,295 — RT % of Annual Total 83%

Annual Report Reference: #15, Page 84, R-16

OBJECTIVES: To evaluate in a prospective double-blind fashion the relative effects of metoprolol and propranolol on aerobic exercise in normal subjects.

METHODOLOGY: Responses of 10 normal men to maximal treadmill exercise were evaluated after placebo, propranolol, 40 and 80 mg qid, and metoprolol, 50 and 100 mg qid. Subjects sequentially received each preparation at weekly intervals in double-blinded, randomized order. Each preparation was taken for 2 days. Two hours after the last dose, subjects exercised (Bruce protocol) to exhaustion, with heart rate, systolic blood pressure, diastolic blood pressure V_E, VO_2, VCO_2, V_T, and respiratory rate measured each minute.

FINDINGS TO DATE: Heart rate and systolic blood pressure were lower with all drug doses at all stages of exercise, compared to placebo ($P < 0.01$). Although individual variation was wide, there were no significant heart rate or systolic blood pressure differences among the various drug doses. Neither drug had a significant effect on diastolic blood pressure V_E, VO_2, VCO_2, V_T respiratory rate or maximum work load achieved. Subjects' anaerobic thresholds (the point of nonlinear increase in V_E relative to VO_2) occurred at the same workload but at a lower heart rate and systolic blood pressure with all drugs, compared with placebo ($P < 0.01$).

These data show that (1) Metoprolol and propranolol both blunt heart rate and systolic blood pressure response to exercise, but neither affects maximum exercise capacity; (2) increasing the dosage from 50 to 100 mg of metoprolol or 40 to 80 mg of propranolol qid does not consistently result in more heart rate or systolic blood pressure attenuation; (3) the anaerobic threshold occurs at a lower heart rate and systolic blood pressure but at the same workload after either metoprolol or propranolol, compared with placebo.

APPLICABILITY: Pharmacologic beta-adrenergic blockade has become a cornerstone of both antihypertensive and antianginal therapy. Recently cardioselective beta-adrenergic blockers have become available; in this country metoprolol is the only marketed agent, and enthusiasm for its use in place of propranolol, a nonselective beta blocker, is growing. Because of the different effects of metoprolol and propranolol on the peripheral circulation, it would be expected that they would differ in the time of onset of anaerobic threshold. Propranolol, a nonselective beta blocker, antagonizes both the beta-1 receptors which predominate in the heart as well as blocking the beta-2 receptors which mediate vasodilatation. Propranolol may, therefore, reduce skeletal muscle blood flow at rest and with exercise. Metoprolol is cardioselective and has less extra cardiac or beta-2 effect, allowing normal peripheral exercise reponses of vasodilatation and increased skeletal muscle blood flow. Interventions which reduce perfusion to exercising muscle should cause the anaerobic threshold to occur at the lower workload and a lower percentage of maximum oxygen consumption capability. One would expect that propranolol would be associated with the anaerobic threshold occurring earlier and at a lower workload than with either placebo or metoprolol; because no difference was seen, it is likely that mechanisms other than sympathetic control—probably autoregulation in response to local metabolic needs—largely determine muscle blood flow during exercise. The fact that oxygen consumption was only minimally affected by these two drugs further supports the concept that exercising muscles were not deprived of their usual level of oxygenation despite the lower overall cardiac output, which is known to occur in beta-blockade subjects.

The results of the study suggest that selection of a beta-blocking agent can be made on grounds other than an anticipated effect on work performance.

146 Contribution of Anxiety Management Training and Physical Conditioning to Stress Reduction and Cardiovascular Fitness

Principal Investigator:	**W. Charles Lobitz, Ph.D.**	
Status:	**Completed**	
Dates:	**June 1979-January 1980**	
Cost:	**Annual $32,500** **RT Annual $32,500**	**Projected Total $35,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#15, Page 93, R-18**	

OBJECTIVES:

1. Assess the differential contributions of anxiety management training and physical conditioning to reductions in cardiac risk factors: (a) subjective stress response/anxiety, (b) Type A behavior, (c) cardiac fitness (VO_2), and (d) serum cholesterol and triglyceride levels.
2. Assess the differential contribution of anxiety management training and physical conditioning to increased relaxation and decreased oxygen consumption during an exercise stress test.

METHODOLOGY: Subjects were recruited from the staff at the University of Colorado Health Sciences Center. Subjects were screened for medical problems. No subjects were included in this study who have previously undergone either systematic physical conditioning or stress management programs. Eighteen subjects were assigned to one of three treatment conditions: anxiety management training (AMT), physical conditioning (PC), and a no-treatment control group. All subjects underwent pretesting on the following dependent variables prior to treatment:

a. The Jenkins Activity Survey, a measure of Type A behavior (Jenkins, Rosenman, and Zyzanski, 1974).

b. The Spielberger State-Trait Anxiety Measure, a measure of subjective anxiety (Spielberger, Gorsuch, and Lushene, 1970).

c. Measures of cardiac function during exercise stress testing: heart rate, blood pressure, 12-lead electrocardiogram (emphasizing R-wave amplitude, repolarization changes, rhythm and conduction, volume of expired air, oxygen consumption, expired carbon dioxide, respiratory rate, an aerobic threshold and ventilatory equivalence for oxygen and carbon dioxide.

Subjects were stratified according to scores on the Jenkins Activity Survey, scale A, and randomly assigned from within each stratum to one of the three conditions.

The pretreatment exercise stress test was conducted twice with data from the second evaluation only being used for the dependent measure; the first test was to familiarize the subjects with the equipment and the procedure. After symptom-level maximums had been established, all subjects underwent a third treadmill evaluation in which they were instructed to "exercise normally" at 75 percent of their maximum heart rate at a constant workload. After 10 minutes they were instructed in the cognitive techniques at their command for an additional 10 minutes at the same constant workload. Changes in VO_2 consumption following the "relaxed" instructions constituted the dependent measure of the subjects' ability to relax during a physical stress.

The Anxiety Management Training condition consisted of 14 one-hour training sessions, two times a week for seven weeks. The first eight training sessions followed procedures outlined in Suinn's **Anxiety Management Training Manual**; the remaining six sessions consisted of practice sessions in which subjects utilized their AMT skills. In addition they received assertion training (Bower and Bower, 1979) to reduce the external stress on subjects because of their inability to say "No" to excessive rewards. These sessions were conducted by a clinical psychologist and an intern in clinical psychology at the University of Colorado Health Sciences Center.

The physical conditioning treatment program consisted of supervised exercise periods on mechanical devices three times a week for eight weeks. All PC subjects were monitored telemetrically and exercised at 75 percent to 95 percent of the maximum heart rate attained in the pretesting exercise stress test. Physical conditioning in the exercise sessions was conducted by a staff physical therapist and a staff cardiac nurse.

Subjects in the control condition completed all pre- and post-treatment assessments before and after the eight-week period but did not receive any systematic training.

Following the eight-week treatment program, posttesting repeated the collection of data on all dependent measures. Evaluation of the effectiveness of the treatments consisted of the pre- and postchanges on each dependent variable. It was hypothesized that the AMT subjects would improve significantly more on psychological measures of stress (subjective anxiety, Type A behavior) and on the ability to relax during exercise stress tests, as compared to subjects who do not receive AMT. Physical conditioning subjects were expected to improve significantly more on measures of cardiac fitness (VO_2 consumption, serum triglyceride and cholesterol levels) compared to subjects who did not receive physical conditioning.

FINDINGS TO DATE: The specific hypotheses were tested by comparing pre- to post-treatment means for each condition by t-tests for correlated data. Hypotheses of differences between conditions were tested by obtaining pre-minus post-treatment change scores and comparing the means through t-tests for independent data. Where directional **a priori** hypotheses existed, 2-tailed tests were used. Unpredicted differences were tested with 2-tailed tests.

Both the AMT and the PE groups showed significant decreases in reported state anxiety (STAI-S; $t = 2.21$, $df = 5$, $p < .04$ and $t = 2.34$, $df = 4$, $p < .04$, respectively), whereas subjects in the control condition did not change significantly. On the trait anxiety measure (STAI-T), only the subjects in the AMT condition showed significant decreases after treatment ($t = 2.28$, $df = 5$, $p < .035$). Decreases in the STAI-T scores were significantly greater for the AMT group as compared to the control group ($t = 1.85$, $df = 10$, $p < .05$).

Subjects in the Physical Exercise condition showed significant decreases in the Type A scores after treatment ($t = 2.68$, $df = 4$, $p < .03$). Neither the AMT nor the control group showed any significant changes. A comparison of the change scores between the AMT and the PE condition

approached but did not reach significance ($t = 1.84$, $df = 9$, $p < .10$, 2-tailed). There were no significant differences between the pre- and post-treatment scores for any condition on the other three Jenkins Activity Survey scales.

Subjects in the Physical Exercise condition showed significant increases in their mean heart rate from pre- to post-treatment ($t = 2.94$, $df = 4$, $p < .025$). Subjects in neither the AMT condition nor the control condition showed significant reduction in their heart rate. Subjects in both the Anxiety Management Training condition and Physical Exercise condition showed significant decreases in their mean systolic blood pressure scores from pre- to post-treatment ($t = 6.32$, $df = 5$, $p < .06$). There were no significant changes in diastolic blood pressure for subjects in either the Physical Exercise condition or the control condition. Comparisons between groups in the pre-post difference scores were not significant for any of these three variables.

There were no significant pre-post differences in serum cholesterol levels and serum triglyceride levels for any of the three conditions. However, subjects in the Physical Exercise condition showed significant increases from pre- to post-treatment in their serum high density lipoproteins, a measure of improved physical fitness (pre-treatment mean = 50.00, s.d. = 12.86, post-treatment mean = 51.80, s.d. = 14.06, $t = 2.71$, $df = 4$, $p < .03$). Subjects in neither the Anxiety Management Training condition nor the control condition showed significant changes in their pre-post serum high density lipoprotein scores. There were no significant pre-post changes in the ventilation data (oxygen consumption during treadmill exercise) for any of the three conditions.

APPLICABILITY: Physical conditioning has been a mainstay of cardiac rehabilitation programs, both for the prevention of repeat coronary events and as a stress management strategy. Recent advances in stress reduction techniques—notably anxiety management training—have also appeared effective in reducing stress, a risk factor in coronary heart disease. This study has shown that both approaches, that is, anxiety management training and physical conditioning, are effective in reducing aspects of anxiety; that physical exercise was more effective in reducing Type A behavior scores; and that physical conditioning alone is able to raise high density lipoprotein levels. Both approaches to stress management, therefore, have beneficial effects and are complementary. A comprehensive cardiac rehabilitation program should consider including both activities in the rehabilitation effort.

147 Carbonic Anhydrase and Disequilibrium Acid-Base States

Principal Investigator: Giles F. Filley, M.D.

Status: Completed

Dates: July 1979-January 1981

Cost: Annual $8,420 — Projected Total $25,500
RT Annual $8,420 — RT % of Annual Total 100%

Annual Report Reference: #15, Page 104, R-19

OBJECTIVES:

1. To complete our method for graphical visualization of classical equilibrium blood gas chemistry to include heterogeneous equilibria.
2. To provide a new formulation for bicarbonate dehydration to include buffering effects as well as those of catalysis.
3. To measure pH changes with and without carbonic anhydrase inhibitors and in normal and abnormal blood of various hematocrits subjected to P_{CO_2} and P_{O_2} changes under conditions simulating those **in vivo**.

METHODOLOGY: A goal of this project is to evolve a graphical procedure and a set of transparencies that can be used to visualize the relative importance of the factors that determine the equilibrium. The method builds on a similar method proposed by Butler (1973) with the addition of a graphical analysis of the CO_2, bicarbonate system, and of fairly specific buffer curves for blood components. Blood, plasma, and whole blood will be considered in the initial effort, but the ideas can be extended to other body fluids such as pleural fluid, kidney fluids, inter- and intracellular fluids.

The transparencies graph and display logarithm of concentration or charge vs. pH: Graphs will be developed for water, for various individual common buffers and for various common buffers in the presence of highly ionized species such as Na+, K+, Cl-, etc. From these, a composite curve is built up to represent the total charge of the nanvolatile components as a function of pH. An additional set of transparencies displays the properties of the open and the closed CO_2 system.

FINDINGS TO DATE: Although the structure and **in vitro** behavior of carbonic anhydrase is well known, its **in vivo** function, especially in the regulation of respiration and other H+ - connected processes is obscure. Recently reported dramatic effects of Diamox on the pnea and desaturation occurring in normal subjects at high altitude and pulmonary patients during sleep seem to require explanations other than the usual one given (low arterial pH caused by the metabolic acidosis of Diamox).

Among the most critically important pH changes, namely a rise in pH_i (pH **inside** the red cell) during transit through the lung capillary (which is thought to increase the ability of normal blood to take up oxygen) has never been directly established. Failure of pH_i to rise may be a cause of hypoxemia in patients.

Our progress in devising **in vitro** models, both predictive and experimental, which imitate **in vivo** conditions makes it logical to build on these models to determine how the presence and absence of carbonic anhydrase and physiological buffers modify P_{CO_2} - induced pH changes in the plasma and red cell during physiological gas exchange.

APPLICABILITY: Not specified.

148 Cardiopulmonary Adjustments to Exercise and Other Stresses

Principal Investigator: Giles F. Filley, M.D.

Status: Completed

Dates: May 1979-May 1980

Cost: Annual $43,713 — Projected Total $120,000
RT Annual $43,713 — RT % of Annual Total 100%

Annual Report Reference: #15, Page 118, R-163

OBJECTIVES:

a. To determine in normal subjects and patients with heart and lung disease the ventilatory drive precisely at the onset of exercise and as a function of the severity of steady state exercise.

b. To validate the fundamental disequilibrium chemistry believed to underlie the operation of the intrapulmonary reflex system which drives respiration. Methods of chemical validation will include study of disequilibria in sned blood in **in vitro** systems and in the deductions from the mathematical models so far developed to study blood gas disequilibria.

c. To measure carbonic anhydrase concentration and its activity in arterial plasma obtained from normal persons and from patients in clinical states associated with arterial hypoxemia.

METHODOLOGY: How respiration adjusts to sudden changes of exercise and is maintained in proportion to the severity of exercise so that arterial P_{O_2} stays constant is not understood even in normal subjects, let alone in those with heart and lung disease. Recently, however, we have obtained evidence that intrapulmonary chemoreception of resipriatory gas disequilibria drives ventilation in normal subjects (R-161). Because the methods used to measure this drive are noninvasive, they can be used to test patients with heart and lung disease for their ability to adjust their breathing to the stress of exercise.

Briefly, subjects breathe 100% O_2 from a closed system during exercise, their ventilation and end tidal P_{CO_2} being recorded. From a bag-in-box arrangement, 5-10% C_{O_2} in N_2 or N_2O is breathed in one breath. The precise form of the inspiratory pattern of that breath is analyzed since this pattern is the most sensitive reflection of respiratory drive.

FINDINGS TO DATE: Progress toward all three objectives has been substantial.

a. The respiratory equipment needed to measure the human breath by breath response to CO_2 inhalation and its sudden removal has been improved upon so that now it is possible to deliver CO_2 during the first half or the second half of an inspiration. This was achieved by designing and building a 4-way valve activated by a vacuum line. This operates the valve so silently that the subject is not aware of its closing and opening, and rapid access to a new gas source can be achieved in less than a second.

b. Disequilibrium measurements. The acquisition of a rapidly responding miniature pH electrode and Brush recorder and the development of a system whereby a liquid phase (plasma or whole blood) in a thin film covered by a teflon membrane can be suddenly exposed to changed Pco_2 or Po_2 in a gas phase (system open to gas transfer, as in lungs), and then, a second or so later, placed in a closed system (such that CO_2 and O_2 cannot rapidly leave or enter the liquid phase, as in the systemic arteries), we have achieved the first of two physical models of pulmonary capillary blood gas exchange. (See Section C (i) for the second model.) Although still in its preliminary stages, the data we have obtained show the following:

c. (i) Carbonic anhydrase activity.
The second physical model of pulmonary gas exchange serves a triple purpose since it can also be used to quantitate the effect of carbonic anhydrase and indeed to assay for the activity of this enzyme in human specimens as small as 0.5 uliters. Briefly the pH stat (Radiometer) delivers 0.3 M HCl from a 0.25 ml syringe to 2.5 ml of a buffered solution containing the substrate at the level in mixed venous blood ($NaHCO_3$ 0.027 M) as CO_2 is continually driven off in a stream of fine bubbles imitating the role of alveoli in removing CO_2. The rate of CO_2 removal (HCO_3—dehydration) is accurately followed by an exponential curve inscribed by a pen driven by a mechanism attached to the plunger of the 0.25 ml syringe and allows the determination of the kinetic dehydration constant k_{-1} at 38° in the pseudo first order reaction at constant H^+ concentration, (H^+),

$$d(HCO_3^-)/dt = K_{-1}(H^+)(HCO_3)/K^1$$

where K^1 is the ionization constant at the ionic strength of the solution (0.127) The value of k_{-1} has seldom been measured at 38° in an uncatalyzed medium resembling plasma and the values vary widely (between 32 and 89 sec^{-1}). Our method yields the very consistent value of 70 sec^{-1} at the two pH values so far used (7.40 and 7.54).

Adding human carbonic anhydrase (20 ul of a 10^{-5} M solution, final concentration 8×10^{-8}M) to the reaction mixture cuts the half time from ~60 sec to ~15 sec (i.e. increases $k_{observed}$ 4-fold). The kinetic parameters of the enzyme catalyzed reaction (K_m and k_{cat}, the turnover number) are being worked out.

Future addition of red cells to plasma in this system and determining the kinetics of blood gas exchange in a physiological in vitro system will complement the data of the first model.

(ii) Carbonic anhydrase detection by immunologic methods.
Antibody to human carbonic anhydrase C is produced in rabbits by initially administering bilateral subcutaneous injections of a water in oil emulsion containing the enzyme. Booster injections are given on the seventh day. On day 21, a serum sample from the animal is analyzed by double diffusion technique on an agarose plate against known concentrations of the antigen. The formation of a precipitate band between the antigen and antibody wells is indication of antibody-antigen complexes. Specificity of the complex for carbonic anhydrase is shown by incubating the plate in a cobalt sulfate-sodium bicarbonate solution and then developing in dilute ammonium sulfide. A black deposit of cobalt sulfide reveals carbonic anhydrase activity. If antibody titer is not sufficient, the animal is boosted a second time and its serum tested in 7 to 10 days. Once antibody titer is sufficient the animal is bled and the serum stored in small divided aliquots at −20°C.

Two milliliters of venous blood are obtained from normal volunteers and patients with respiratory disease. A double diffusion test on 1.2% agarose slide is run on each plasma sample. From this comparison a concentration is extrapolated for the plasma. The sensitivity of this test has been shown for concentrations of 10^{-7} mm.

d. With the first step of treadmill exercise, the first inspiratory volume V_I and flow rate V_I' always increase over resting values. In air-breathing man the subsequent 2 to 3 breaths are not consistently different from the first. Not until breath 4-5 do V_I and V_I' begin to increase progressively toward the steady state. This early plateau suggests a constant neurogenic

stimulus N on which is superimposed an increasing humoral drive H. If this is so and the single inhalation of CO_2 in N_2O which depresses V_I and V_T (Fed. Proc. **35**, 633, 1976) acts by inhibiting H for that breath, the effect of such an inhalation should be nil on breath 1, = on breaths 2-3, but should depress subsequent breaths (by eliminating H) toward the neurogenic level (determined by N). These effects were found in 12 normal non-smoking subjects.

Basically, CO_2 inhalation at the beginning of exercise moves the humoral drive of respiration as exercise continues.

e. We have found carbonic anhydrase (CA) in uncontaminated human plasma (UHP) i.e., separated from untraumatized rbc, in some but not all alveolar epithelial and pulmonary capillary endothelial cells and in respiratory tissues of mouse, trout, frog and snake by (a) potentiometric, (b) immunologic and/or (c) electron microscopic (EM) methods. (1) The pit of buffers placed between the glass surface of a Severinghaus electrode and its membrane rises so long as the membrane is exposed to P_{CO_2} lower than in buffer (open system) at a rate proportional to buffer (CA); this rate was increased in UHP in all of 30 normal subjects and returned to buffer control with diamox. Lack of rbc trauma was demonstrated by plasma (Hb) analysis (benzidine). The subsequent slow pH fall with system closure (Fed. Proc. **21**, 48, 1978) was always present with EM-confirmed CA-containing tissues and disappeared with diamox. (2) Antibodies to human CA isozymes have been used to detect CA by double-diffusion and 2-dimensional electroimmunodiffusion methods and for EM study. (3) EM results of human lung biopsy and animal tissue localization studies show that CA isoenzymes are found intracellularly as well as being associated with the plasmalemma.

APPLICABILITY: Planning of an exercise regimen for patients with cardiopulmonary disease requires knowledge of the special limitation to which these patients are subject. Thus their ability to deliver adequate O_2 to their tissues following sudden exercise demands may be impaired, as recently shown by Auchincloss et al. (1976). The present investigation seems essential to the study of how such patients adjust to transient unsteady states of exercise and should help in planning rational and safe exercise programs for this type of treatment.

149 Effect of Low-Level Aerobic Conditioning on Exercise Tolerance in Left Ventricular Dysfunction

Principal Investigator	**H.L. Brammell, M.D.**	
Status:	**Continuing**	
Dates:	**June 1977-December 1980**	
Cost:	**Annual $11,240** **RT Annual $9,478**	**Projected Total $16,000** **RT % of Annual Total 84%**
Annual Report Reference:	**#18, Page 168, R-12**	

OBJECTIVES:

a. Determine the safety of low-level supervised exercise in patients with left ventricular dysfunction.

b. Evaluate the efficacy of physical conditioning with regard to:

1. improved functioning capacity.
2. change in physiologic indicators of conditioning.
3. change in psychological/emotional status.

METHODOLOGY: Twelve male patients will be selected with LV dysfunction as a result of coronary artery disease and documented by cardiac catherization. Any other cause of pump failure will be excluded.

Each subject will act as his own control: the individual changes noted as a result of exercise will be monitored.

All patients will continue under the care of their own physician and will continue to follow his recommendations as to diet and medication. Approval of private physician for participation in study will be obtained. Data from study will be made available to attending physician.

Subjects will all agree to a fourteen week study and will sign appropriate consent forms. Each patient's chart will be reviewed and summarized.

On the basis of the subject's maximum tolerated heart rate (MHR) the training heart rate (THR) will be determined. Eighty-five percent of the patient's MHR will be the THR and should give a training effect. This will be the conditioning heart rate prescribed for each subject.

Training is probably best achieved when the subject reaches his THR and sustains it for 30 to 45 minutes at least 3 to 5 times weekly. Subjects participating in this study will be exercised in groups of six at their THR 3 times weekly for 34 minutes. All of the training exercises will be aerobic; anaerobic activities will be avoided.

During the training exercise sessions the following will be monitored:

a. Subjective status. Pre-exercise the subject will be asked how he feels and will not be exercised if there is any change in cardiac status, if he has contracted any cold, other infection or has other limiting changes in his health status.
b. Blood pressure will be taken before and immediately after the session.
c. Heart rate and rhythm will be monitored before, during each exercise and throughout the post exercise period with telemetry (Electrodyne).
d. All activities will be conducted in the Human Performance Laboratory, Webb-Waring Institute. All personnel involved in the study are certified by the American Heart Association in Basic Life Support. Equipment for cardiopulmonary resuscitation is maintained in the laboratory at all times.

Two baseline evaluations will be performed within a two week period. After three weeks of supervised exercise a complete evaluation as described earlier will be repeated. A new THR will be computed and an exercise prescription change made if necessary. Subjects will then continue the exercise program for three additional weeks. If no evidence of conditioning is seen, additional weeks of conditioning will follow. A total of 12 weeks may be required to determine if an optimal conditioning effect has occurred.

At the end of the training sessions a final evaluation will again be done. From these measurements any change in physiologic parameters will be noted. The subjects will be asked for a subjective physical status evaluation and for an estimate of work capacity for vocational and recreational activities.

FINDINGS TO DATE: Five subjects have been entered into the study. Those with ejection fraction less than 25% have all done poorly. Those with ejection fraction over 25% have improved both rest and exercise ejection fraction.

Some patients with poor left ventricular function can benefit from low level exercise. Patients with ejection fractions less than 25% will not do well from a functional point of view. The general psychosocial trend has, to date, not shown the improvement in attitude, spirits, etc. that is seen in those with high level conditioning. The reason for this is not clear.

APPLICABILITY: If we can show that physical conditioning at appropriate levels is "good treatment" in patients with left ventricular dysfunction, then this information and the guidelines for its application should have broad utilization both in the management of patients in the rehabilitation program at the University of Colorado Medical Center as well as in other institutions and clinics throughout the country.

150 Effect of Physical Training on Cardiorespiratory Parameters Following Surgical Correction of Congenital Heart Disease

Principal Investigator:	**Robert R. Wolfe, M.D.**	
Status:	**Continuing**	
Dates:	**September 1978-September 1981**	
Cost:	**Annual $34,367** **RT Annual $27,342**	**Projected Total $70,000** **RT % of Annual Total 79%**
Annual Report Reference:	**#15, Page 180, R-15**	

OBJECTIVES:

1. To evaluate the functional capacity of pre-vocational youth who have undergone total correction of congenital heart defects.

2. To assess the effect of an aerobic conditioning program on cardiopulmonary measurements following total correction of congenital cardiac defects.

METHODOLOGY: Post-operative exercise testing will be performed on the following candidates: (1) youth age 6 to 18 years, (2) status 1 year post-operative or greater, (3) correlative post-operative or greater, (4) isolated catheterization proven post-operative lesions to include:

a. left to right shunts: ventricular septal defect, atrial septal defect secundum, patent ductus arteriosus

b. obstructive lesions: aortic valvular stenosis, pulmonary valvular stenosis, and coarctation of the thoracic aorta

c. Cyanotic lesions: Tetrology of Fallot, transposition of the great vessels, and total anomalous venous return.

Informed consent will be obtained. A continuous graded exercise protocol will be performed. The following parameters will be measured: (1) time, (2)heart rate, (3) ventilation (BTPS), (4) VO_2 and VO_{2max}, (5) VCO_2, (6) respiratory rate, (7) resting and exercising electrocardiogram, (8) indirect cuff systemic blood pressure, (9) tidal volume, (10) blood pressure, (11) respiratory rate, and (12) respiratory quotient.

The following parameters will be calculated from the above: (1) anaerobic threshold, and (2) O_2 pulse.

The approach to exercise evaluation, exercise prescription writing and physiologic assessment during exercise will be the same as utilized for Steady, Unsteady State Exercise Project (R-9) described elsewhere in this directory.

FINDINGS TO DATE:

1. Approximately 20 individuals underwent testing and had satisfactory data. As in last year's progress report, the data continue to fall within the normal range described in the James protocol at sea level. Conflicting statements exist, but Astrand[27] states that individuals performing heavy exercise using large muscle groups above 1200 meters have reduced work capacity. Our normal group exercising at 1500 meters for up to 18 minutes have not exhibited decreased work capacity compared with James' children in Cincinnati.

2. Screening pre- and post-operative children with significant heart disease: Forty-five patients have been tested since July 1979. To date, sufficient numbers of patients with transposition of the great vessels (TGV) and Tetralogy of Fallot (TOF) patients have not been tested to characterize their performance profiles. However, preliminary indications are that:

   a. Patients with TGV status post-Mustard procedure have subnormal performance levels, possibly due to demonstrated low maximum exercising heart rate. The Mustard procedure interferes with the normal sinus mechanism, and the resultant ectopic pacemaker has a lower maximum heart rate. In addition, it has been well documented by radionuclide and echocardiography that myocardial performance is reduced in these patients[15].

   b. The small number of patients tested with TOF have relatively normal exercise characteristics.

3. Exercise studies in valvular aortic stenosis: It has been the observation of most pediatric cardiologists that patients with valvular aortic stenosis tend to be athletically inclined and appear to be capable of normal or above normal exercise levels. Ironically, they also are a group with stringently imposed physical restrictions because of fear of sudden death[15]. This concern appears to be largely unwarranted, and contemporary philosophy is shifting toward a more liberalized exercise philosophy.

   Eighteen patients with valvular aortic stenosis have been studied. Six had associated significant cardiac anomalies and were not considered in the group results. The remaining 12 had moderate aortic stenosis (40-80 mmHg) measured at cardiac catheterization or estimated by noninvasive means. None of these patients had critical aortic stenosis requiring surgery during infancy.

Results of the aortic stenosis group are noted in Table X of annual report.

a. Maximum workload:

12 patients achieved 110 percent of predicted maximum voluntary workload.

b. Maximum heart rate:

12 patients achieved 102 percent of predicted heart rate at maximum voluntary workload.

c. Heart rate 1 minute postexercise:

12 patients were 19 percent above predicted postexercise recovery heart rate.

d. Maximum systolic blood pressure:

The systolic blood pressure as measured by the stethophone and the Narco system sphygomanometer at maximum voluntary workload was 102 percent of prediction.

e. VO_2 max L/min and cc/min/kg

The oxygen consumption at maximum exercise was 116 percent and 109 percent of prediction based on liters/min. and cc/min/kg respectively.

f. $VO_{2/p(c)}$

The ratio of oxygen consumption divided by pulse at maximum exercise corrected for age was 121 percent of prediction.

g. Anaerobic threshold $\%VO_2$ max

The anaerobic threshold was calculated by graphing the ventilatory equivalents (minute ventilation divided by VO_2 and VCO_2) and noting the upward break in VE/VO_2 without an associated break in VE/VCO_2[19]. The VO_2 at AT expressed as a percent of VO_2 was calculable in 9 patients and was 60 percent.

The performance characteristics of these patients were normal to above normal in all but one category. The HR/min PE was 19 percent above normal and is difficult to explain in conjunction with normal or above max WL, VO_2 max, max HR. The VO_2/pulse of 20 percent above normal corrected for age also suggests normal or better exercising cardiac output and level of cardiopulmonary conditioning.

These results suggest that children with moderate (40-80 mm peak systolic aortic gradient) have normal or above exercise capacities and in the absence of an abnormal exercise electrocardiogram, shouldn't be restricted from recreational or competitive sports requiring a high level of cardiopulmonary conditioning or dynamic leg exercise.

APPLICABILITY: It is anticipated that the results of this effort will materially affect the way the post-operative youth with congenital disease are managed. We would anticipate a more aggressive approach to their prescription of permissible activity and a more positive attitude toward their ability to work resulting in increased employment and establishment of cost-effective basis for similar programs elsewhere.

151 Physiologic Comparison of Holding on Versus Not Holding During Maximal Treadmill Exercise: Observations in Normal Men

Principal Investigator:	**H.L. Brammell, M.D.**	
Status:	**Continuing**	
Dates:	**May 1979-May 1981**	
Cost:	**Annual $13,366** **RT Annual $13,366**	**Projected Total $28,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#15, Page 202, R-17**	

OBJECTIVES: To determine the physiologic effect, if any, of holding on to the treadmill apparatus during exercise stress evaluations.

METHODOLOGY: Eleven normal subjects were recruited from the student and staff population of the University of Colorado Health Sciences Center. No subject had a history of heart disease. None was a smoker, and all had normal physical examinations and resting electrocardiograms. Six subjects performed maximal treadmill exercise, using the Bruce protocol; five subjects performed the Balke exercise protocol to 10 METS. All subjects exercised both holding and not holding on to the treadmill cage or support apparatus. The sequence of holding or not holding was randomized. Both the holding and the not-holding studies were performed on the same day in order to assure uniform operating conditions of the physiologic monitoring system.

Heart rate, blood pressure, V_E, VO_2, and METS were measured at each minute of each stage of exercise.

FINDINGS TO DATE: For both exercise protocols there was a substantial reduction in physiologic parameters with holding on vs. not holding. For the Balke protocol the mean reduction at 10 METS was -15.1% V_E, -17.8% METS, and -17.7 VO_2. The percent change at maximal exercise on the no-holding Bruce treadmill protocol (comparable workloads) was -16.5% V_E, -28.4% VO_2, and -28.2% METS, and -13% heart rate. The reduction in effort was uniformly greater at higher workloads than lower. The greatest reduction in the energy cost of treadmill exercise with holding on was observed in those individuals who kept the long axis of their body perpendicular to the treadmill belt as the slope was increased. One individual, a highly trained marathoner, kept his body perpendicular to the floor as the treadmill incline was increased and showed no reduction in the energy cost of treadmill exercise.

APPLICABILITY: We have demonstrated that most individuals will substantially reduce the energy cost of treadmill walking with holding on to the support apparatus which surrounds the treadmill. The energy cost of treadmill exercise when a person is permitted to hold on to the support apparatus cannot be accurately evaluated and, therefore, an appropriate activity prescription for work, recreation or reconditioning cannot be written. It is suggested that exercise stress evaluations for rehabilitation activity counseling be performed without permitting the patient to hold onto the treadmill support apparatus.

152 Effect of Propranolol on the Conditioning Response in Normal Men

Principal Investigator: Paul Overtie, M.D.

Status: Continuing

Dates: September 1978-June 1980

Cost: Annual $27,218 — Projected Total $68,045
RT Annual $24,218 — RT % of Annual Total 88%

Annual Report Reference: #15, Page 208, R-164

OBJECTIVES: To determine the effect, if any, of beta-adrenergic blockade on the response to aerobic conditioning in normal men.

METHODOLOGY: A total of 17 male subjects, 8 controls and 9 individuals given propranolol, were included in the study. Subjects were drawn from the UCHSC population between the ages of 21 and 35, had no history of heart disease, and had normal physical examinations, electrocardiograms and chest x-rays.

A thorough history and physical examination was conducted. Data were recorded on the computer history, physical and stress evaluation form used in the RT Center.

In the preconditioning period, subjects underwent two baseline exercise stress evaluations using a Quinton motor driven treadmill, Model 18-49c. Data from the second evaluation was used for baseline observations. Blood levels were drawn for propranolol, hemoglobin and hematocrit.

Pulmonary function testing included routine spirometry and flow studies. Echocardiography to determine left ventricular function (LV dimensions, ejection, fraction, contractility, indices) was performed at rest, during and immediately following maximal isometric exercise.

Exercise evaluations measured heart rate, blood pressure, 12-lead electrocardiogram (emphasizing R-wave amplitude, repolarization changes, rhythm and conduction); the volume of expired air, oxygen consumption, carbon dioxide production; the respiratory rate, the anaerobic threshold, ventilatory equivalents for oxygen and carbon dioxide, oxygen pulse and the oxygen saturation by ear oximetry.

In addition, isometric handgrip exercise testing, and isometric quadriceps exercise testing was accomplished at each evaluation. Body fat estimates from skinfold measurements were obtained before and after conditioning.

After the preliminary tests, propranolol was administered to 9 individuals randomly selected from the 17 subjects. Dose of beta-blockade was determined by serum levels at two hours post oral administration by methods previously described. A blood level of propranolol of 100 ng/ml or more at 2 hours following an oral dose was accepted as a level providing a high degree of beta-adrenergic blockade.

Eight subjects received a placebo indistinguishable in appearance from the test preparation. Blood samples were drawn from these individuals as well. The study followed a double-blind parallel design.

During the preconditioning period, with the subjects on effective beta-blockade, repeat treadmill examination, echocardiogram, isometric stress evaluation, catecholamine response to static and dynamic exercise, spirometry and flow studies as well as blood levels of propranolol were determined in both groups.

The 5 week conditioning period involved supervised exercise on devices 3 times per week with telemetry monitoring. The heart rate target was 75-90% of the maximum heart rate attained at the second evaluation (on drug, before conditioning). Both telemetry monitored and outdoor exercise sessions twice weekly lasted approximately 45 minutes including warm-up and cool-down.

Each exercise stress test was done at the same time after the propranolol or placebo dose (2-3 hours) to relate the blood levels to the degree of beta-blockade and the possible blunting or change in the conditioning response.

At the end of the conditioning period, repeat exercise testing and repeat of all the parameters listed above was accomplished. The code was broken and the drug was discontinued in the propranolol-treated group. A repeat exercise stress test was done 72-96 hours after discontinuance of propranolol and placebo.

FINDINGS TO DATE: In placebo subjects, training increased exercise duration (16±1.3 to 21.2±1.5 min, $p < 0.001$) and maximal oxygen uptake (43.6±2.9 to 52.7±3.2 cc/kg/min, $p < 0.001$). Propranolol subjects had modest improvement in exercise duration (16.0±0.6 to 17.3±0.9 min, $p < 0.05$) and no significant change in maximal oxygen uptake (41.4±1.6 to 42.0±1.3 cc/kg/min). With training, diastolic pressure at maximal exercise decreased 15 mmHg ($p < 0.01$) in placebo subjects, but was unchanged in Propronolol subjects. Training did not alter maximal heart rate in either group. Thus, since high doses of Propranolol markedly attenuated aerobic conditioning in healthy young men, beta adrenergic stimulation may be an essential factor in exercise conditioning.

APPLICABILITY: We have shown that high dose beta blockade prevents exercise conditioning in normal men. A similar, but undocumented response likely occurs in patients with occlusive coronary artery disease. If this is shown to be the case, then the physiologic benefits of conditioning will not be realized— nor will the benefits of conditioning on vocational tasks. Additional work must be done to evaluate the effect of low/moderate dose beta blockage on aerobic conditioning.

153 Sequential Evaluation of Sensitive and Predictive Accuracy of Treadmill Testing Following Myocardial Infarction

Principal Investigator: H.L. Brammell, M.D.
Status: Discontinued
Dates: May 1977-December 1979
Cost: Not Applicable
Annual Report Reference: #15, Page 160, R-11

OBJECTIVES: To test the following hypotheses:

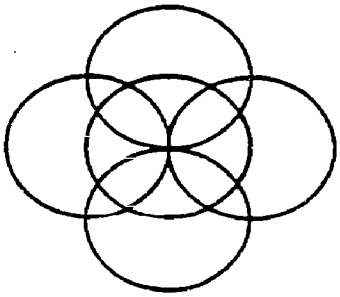
1. That low sensitivity of the graded exercise test following myocardial damage is common.
2. That the low sensitivity following the acute myocardial infarction may explain the generally low sensitivity of treadmill tests in published series.
3. That a change from a normal to an abnormal repolarization response following myocardial infarction is predictive of new coronary events.

METHODOLOGY: All patients with a history of acute myocardial infarction who have had at least one graded exercise test in which the heart rate equalled or exceeded 85% of age-corrected maximum heart rate, or who reach a maximum tolerated level of exercise will be included. No patient taking a digitalis preparation, with electrocardiographic evidence of left ventricular hypertrophy, or non-specific repolarization changes at rest will be included in the study. Patients on propranolol will not be excluded on heart rate criteria. Since many patients have been followed for several years, all exercise tests performed on each patient will be evaluated. Each electrocardiogram and graded exercise test tracing will be read by two staff cardiologists without knowledge of the patient's name or subsequent history. A system for coding each patient visit to the exercise lab has been devised.

Patients enrolled in the cardiac rehabilitation program at the University of Colorado Medical Center have their first treadmill experience approximately 2 weeks after leaving the hospital. This is repeated at approximately 8 and 12 weeks following infarct, the latter time being the first maximum tolerated test. Exercise tests are then performed at 6 months following infarction and every 6 months thereafter. The data regarding sensitivity and predictive accuracy for true positives can therefore be calculated sequentially in this group of patients.

FINDINGS TO DATE: As indicated in last year's Progress Report, this time-consuming study was judged to have a lower priority than the projects proposed. This was reflected in the fact that no progress was made in 1979—energies were diverted to research of higher yield and greater potential impact. We anticipate that higher yield research will continue to receive a higher priority and, therefore, will discontinue attempts to find time to complete this project.

APPLICABILITY: Not applicable - project discontinued.



University of Wisconsin-Madison (RT-11)
Waisman Center on Mental Retardation and Human Development

CORE AREAS

Rehabilitation of Families at Risk for Mental Retardation

Comprehensive family rehabilitation which has as its main objective the developmental aspects of retardation with the essential objective of normalizing family units in a variety of community settings that have been, to date, unapproachable utilizing traditional rehabilitation practices. This approach continues to attempt to demonstrate new rehabilitation techniques which will provide a systematic intervention point in ongoing community services delivery systems.

Rehabilitation of the Adolescent and Young Adult Retarded with Severe Behavior Deficits

The rehabilitation process of adolescent and young adult retarded and severely disabled persons with behavioral deficits which can serve as impediments to their effective vocational and/or social adjustment processes. This approach deals with the identification of and programming for severely disabled clients referred for evaluation purposes from active rehabilitation facilities programs.

Development of Community Alternatives for Severely Disabled Mentally Retarded Clients

The investigation of community alternatives with severely disabled retarded clients. In the absence of adequate community services for thousands of mentally retarded clients who have been relocated in a variety of community settings, these research techniques attempt to isolate the needs of these types of clients for habilitation and rehabilitation services. The rehabilitation program, with its current emphasis on the use of community resources in meeting the needs of each rehabilitation client, has the mandated responsibility of providing leadership in developing, implementing and integrating the diverse community services which are necessary to maximize the benefits of deinstitutionalization, both to the client and to society.

UNIVERSITY OF WISCONSIN

Rick Heber, Ph.D., Director
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COMPLETED

CONTINUING

NEW

154 Establishment of the High-Risk Population Laboratory

Principal Investigator:	**Rick F. Heber, Ph.D.** **Howard L. Garber, Ph.D.**	
Status:	**Completed**	
Dates:	**June 1966-March 1980**	
Cost:	**Annual $74,218** **RT Annual $42,596**	**Projected Total $74,218** **RT % of Annual Total 57%**
Annual Report Reference:	**#15, Page 5, R-1**	

OBJECTIVES: Establishment of a High-Risk Population Category (Milwaukee Project) is a longitudinal study of the prevalence of mental retardation in a depressed urban area and the effects of a comprehensive rehabilitation program in preventing mental retardation.

METHODOLOGY:

1. The high-risk population laboratory was established with the aid of a door-to-door survey conducted in an area of metropolitan Milwaukee which had been previously identified as having an extremely high prevalence of retardation.
2. All members of the survey family, both children and adults, received an individual intellectual appraisal in addition to receiving several experimental learning and language tests. In addition, extensive data was obtained on family, social, education, and occupational history and status.
3. From this population pool samples are selected with the characteristics required by the individual studies being undertaken by the "high risk" population laboratory.
4. The population laboratory survey, over a period of a year, contacted all women residents in the area at the time of child birth. All family members were subsequently individually evaluated when the mother was suspected of retardation on the basis of post delivery intellectual screening. This has made accessible a substantial number of mentally retarded young adults and their offspring.

FINDINGS TO DATE: The data derived from the project during the current grant period further extends previously reported data which indicated that the high prevalence of mental retardation found among disadvantaged population groups is accounted for, largely, by relatively small proportions of the population involved. (This research approach was initially established as a unique focus of the research program of the Center when little knowledge was available about the relationship of poverty to mental retardation.) Based upon this accumulated data, results show that the use of comprehensive rehabilitation of high risk families, families with a high prevalence of mental retardation, must be deemed a successful approach to the prevention of mental retardation.

Families have been followed for over ten years. The children of the treated group show no retardation and in fact no child at ten has an IQ below 85, compared to the control where 60 percent are below 85. In addition, twice as many untreated children are in special classes and/or receive special services than the treated group. A final report of this study is now prepared.

APPLICABILITY: Comprehensive family rehabilitation when used as an early intervention technique can effectively prevent mental retardation in high-risk children and can effect positive improvement in life skills of other members of the family.

In addition, the results of this study seriously question present policy with respect to the allocation of social services to population groups. Where epidemiological and process variables are ignored and only demographic variation between groups is the basis for determining resource allocation the delivery of health and social services are doomed to be ineffective and inefficient.

University of Wisconsin

155 Independence Training Program for Group Home Residents

Principal Investigator: Patrick J. Flanigan, Ph.D.
Status: Completed
Dates: October 1977-March 1979
Cost: Annual $33,676 — Projected Total $33,676
RT Annual $24,496 — RT % of Annual Total 73%
Annual Report Reference: #15, Page 29, R-43

OBJECTIVES:

1. To develop a hierarchy of self help, domestic and community-living skills required to maximize independent functioning of mentally retarded persons living within the community.
2. Preparation and evaluation of an administration manual detailing an instructional program based on sequential training techniques to be used by Daily Living Coordinators working in group homes with mentally retarded persons.

METHODOLOGY:

1. Development of a skill hierarchy through interviews and information collected from standardized adaptive behavior measures completed by 150 group home Daily Living Coordinators.
2. Presentation of an individualized skill hierarchy assessment technology and instructional program methodology for DLCs for evaluation.
3. Revision of the program followed by assessment of the revised product's validity to be established through in-home training and follow-up.

FINDINGS TO DATE:

1. The skill hierarchy and instructional program were completed following group inservice training.
2. Validation of the revised program was conducted.
3. All of the other processes have led to the development of a training manual entitled **Independence Training Program for Group Home Residents** (Outline of Final Training Manual for Group Home Trainers) which includes an Introduction and Rationale for Training Residents in their Home Environment; Profile of Skills - Skills Checklist of Clients' Seven (7) Main Areas of Independent Life Activity; Development of Training Goals and Objectives (What to Train); Program Intervention Strategies (How to Train); Prototypic Training Programs; Self Evaluation for Group Home Training Staff; Advocacy Call (How to Assist Clients in Promoting Self-Advocacy Efforts); and appendices on (1) Characteristics of Developmentally Disabled Clients, and (2) Outline of Service Delivery System for Developmentally Disabled Clients.

APPLICABILITY: Community adjustment of mentally retarded persons requires strong community living skills training. This program will allow the Daily Living Coordinator to use evaluative information to assess skill deficits and implement a training methodology to raise these skills to acceptable levels.

156 Project Deinstitutionalization: Using Extended Evaluation to Enable Institutionalized Severely Developmentally Disabled Persons to Demonstrate Their Vocational Rehabilitation Potential

Principal Investigator:	Orv Karan, Ph.D.	
Status:	Continuing	
Dates:	October 1978-March 1982	
Cost:	Annual $154,214 RT Annual $111,307	Projected Total $154,214 RT % of Annual Total 73%
Annual Report Reference:	#15, Page 42, R-46	

OBJECTIVES:

1. To determine if institutionalized severely/profoundly retarded adults can adjust to the requirements of a community based sheltered workshop for a full work day, five-day per week schedule.
2. To determine if participatian in a community based sheltered workshop has any impact on the client's behavior at the institution.
3. To determine if participation in a community based sheltered workshop will have any impact on the client's work, social, self-help, communication, and leisure-time behavior that is different from what would have been without this involvement.
4. To determine if participation in the project has any influence on the state agency counselor's judgment about a client's feasibility for Vocational Rehabilitation services.
5. To determine if the attitudes toward institutionalized severely/profoundly mentally retarded persons held by Vocational Rehabilitation personnel, of the community based rehabilitation center in which this project occurs, are affected by the participation of such clients.

METHODOLOGY: The research methodology utilized in this project consists of a longitudinal experimental group-control-group repeated measures design. The five program objectives mentioned in the last section provide the parameters within which clinical-research activities will be undertaken. The primary data base consists of the Balthazar Scales of Adaptive Behavior, the Fairview Self-Help and Problem Scales, and direct behavioral assessment.

One of the conditions for client selection was that none of them had ever participated in regular and/or continuing community activities. At the time of their selection, the clients were all living in a large mid-western institution for the developmentally disabled and receiving all of their services on institutional grounds. An additional condition was that all potential clients had to be participating in work activities programs at the institution. In all cases this amounted to approximately one hour per day or less. The only precluding condition for which a client would not be accepted would be if there were complicating medical factors present requiring close and continuing supervision.

From a list of adult residents who met the above conditions five persons were selected to participate as project clients. A comparison group was also selected from the same list on the basis of a close match to project clients. Matching variables used were chronological age, sex, intelligence quotient, years in institution, additional handicapping conditions, social age, and behavioral quotient as measured by institutional psychologists.

FINDINGS TO DATE: As a general statement, it can be stated that the five clients were able to adjust to the requirements of the community based sheltered workshop for a full day, five-day per week schedule. Initially each of them did experience some adjustment difficulties ranging from temper tantrums, inappropriate noises, voiding in the wrong places, distractability, and other behavioral discrepencies between morning and afternoon shifts. These difficulties were at their worst for a period averaging approximately six to eight weeks per client after which noticeable improvements began occurring. The most important factor related to the improvement was learning the value of money relative to how it was earned and what it could do, e.g., the food, drinks, and special privileges that were made available for the money. It was evident that once the relationship between the money and its value was established behavioral improvement began occurring.

Of particular interest were the valuable roles played by many of the other workshop clients who served as teachers and helpers for the project clients. Forms of help varied from personal escort services for two of the clients who were blind; to volunteer enrollment by one person in a signing class so she could learn to communicate with one of the project clients who was deaf; to verbal coaching for good work behavior; and to verbal reprimand for unacceptable behavior. Another interesting finding was the problem behaviors among several of the clients at the workshop decreased with the appearance of the "new" clients.

Participation in the community workshop had no apparent impact on the client's behavior at the institution which appeared to remain the same throughout the duration of the first project year. Thus, in spite of recognized clinical improvement in four out of five clients during the work day, no improvements were detected at the institution. During unstructured times, with the exception of eating, all behaviors measured suggested that the project group was indistinguishable from the comparison group while at the institution.

At the time of this writing, no client in the project achieved a level of productivity compatible with acceptance by Vocational Rehabilitation. The production rates of the project clients, based on a full work day, varied from approximately eight percent of competitive norms to an average of approximately thirty percent for the remaining clients. One client achieved fifty percent of competitive norms on several occasions but has not been able to sustain this level for more than a few days at a time. One of the optimistic notes, relative to client feasibility for vocational rehabilitation services, is that although none of the clients has yet achieved the feasibility objective, four out of five clients have shown continuing progress and improvement in their production, quality of work, and time on-task.

When shifts in attitudes of the staff occurred they were always in the direction of moving from a positive attitude to a less positive attitude. Shifts in attitude from an original negative or less positive attitude to one that was more positive never occurred. Why these attitude shifts occurred is difficult to explain, however, one interpretation that may have some merit is that the differences could be due to the contrast between the staff's unquestioned philosophical acceptance of certain popular concepts such as "deinstitutionalization," "normalization," "mainstreaming," etc., and their actual exposure to the realities involved in the implementation of these concepts.

The next phase of the project, which is about to begin, will be the movement of the clients into a community based group home. Once this phase begins it will be possible to ascertain the additional benefits, if any, of not only working in the community, but living there as well.

APPLICABILITY: There are many ways in which this research is viewed as being applicable to rehabilitation. On one level, vocational rehabilitation services for the mentally retarded have generally not been directed at those persons either residing or recently discharged from state institutions. Presently used vocational rehabilitation practices and procedures that rely heavily on verbal therapies in a traditional medical model orientation are simply not that effective for dealing with the range and severity of the problems presented by this severely handicapped group of individuals. Yet, with the passage of the Rehabilitation Act of 1973 and the passage of the Rehabilitation Amendments of 1978, Congress has made it clear that vocational rehabilitation services will be prioritized to include the more severely handicapped. In addition, now that independent living has been added to the new provisions, it is both timely and appropriate that relevant data and potentially viable service models be examined closely.

Through this project a provision of the vocational rehabilitation process that is rarely used, namely, extended evaluation, is being examined for its utility in serving and identifying potential rehabilitation candidates from an institutionalized population of severely/profoundly retarded persons. The innovative nature of this project is to develop a methodology of extended evaluation in which deinstitutionalization becomes a transitional planned process rather than one that is abrupt and often capricious. Perhaps through community based sheltered workshops and work activity programs where clients are sponsored by their state vocational rehabilitation agencies it may by possible to facilitate an institutionalized individual's adjustment to community life.

At present, the primary focus in most deinstitutionalization efforts is first on the living arrangements followed by a secondary focus on a day program. In this project the central focus has been on the work activity component followed by the identification of living arrangements once an adjustment to the work program has occurred. Many persons now living in institutional settings simply lack the basic pre-requisite skills essential for working and living in the community. Through the provision of an extended evaluation, within which efforts are made to develop these basic prerequisite skills, the state vocational rehabilitation agency may be able to play an extremely important role with this heretofore unserved population while simultaneously contributing to national deinstitutionalization efforts.

It has been estimated that it costs between $75 and $85 per day for a mentally retarded person to live in a state institution. Although exact costs are presently unavailable it would not be unrealistic to expect this amount to be reduced by as much as half if the person lived and worked in the community. In terms of cost analysis benefits alone there is more than ample justification in tax dollar savings to warrant vocational rehabilitation's involvement with this severely handicapped institutionalized population.

157 Survey of Needs of Developmentally Disabled Adults Living in A Variety of Community Settings in the State of Wisconsin

Principal Investigator:	Patrick J. Flanigan, Ph.D.	
Status:	Continuing	
Dates:	September 1978-March 1981	
Cost:	Annual $57,903 RT Annual $40,630	Projected Total $57,903 RT % of Annual Total 70%
Annual Report Reference:	#15, Page 72, R-48	

OBJECTIVES: "Survey of Needs of Non-Institutionalized Developmentally Disabled Adults" is a continuing research project at RT-11 which has as its principal objective initiating a Needs Assessment Survey of a sample of approximately 400 severely developmentally disabled adults living in a variety of community settings in various locations across the state of Wisconsin. The project, which is in its 3rd year, has as its major outcome the compilation of these survey data to provide information on the needs of the severely developmentally disabled adult in community settings and the degree to which our present legal and administrative provisions meet these needs.

METHODOLOGY: Samples of severely developmentally disabled adults ranging in chronological age from 18 to 50 were drawn so as to be reasonably representative in terms of proper size, economic well-being, urban-rural settings and other economic variables in the state of Wisconsin. Specially trained interviewers conducted individual sessions with each client in the sample. In preparation for administration of the Needs Assessment Survey interviewers were trained in all aspects of the investigation, as well as the techniques of interviewing. In addition to interviewing the subjects in the study, professional individuals serving in programs and services in the community level, especially near the residential facilities housing the clients, also provided data regarding the vocational adjustment of the clients in the community. The basic set of adjustment indices developed in the survey were designed to infer the unmet needs of the clients and included employment and financial security, social adaptation, community mobility and leisure time. The accessible segment of the severely developmentally disabled population proved to be those severely developmentally disabled adults who were (1) recently deinstitutionalized, (2) living in group homes, sheltered apartments, and intermediate care facilities, and (3) those clients in contact with a state agency such as the Department of Vocational Rehabilitation.

FINDINGS TO DATE: To date the following phases of the project have been completed: **Phase I** - Review of the Literature (detailing the characteristics and service needs of the moderately to severely handicapped population). **Phase II** - Instrumentation (requiring the construction of a three-part survey—Part I, "Client." Part II. "Client Service Characteristics." Part III. "Personnel Characteristics"), **Phase III** - Needs Assessment Survey (including interviewing 400 clients, detailing the clients' past and present services received, interviewing 200 group home parents). The final results of this Needs Assessment Survey will be analyzed with multiple correction and multiple regression methods. The correlation analyses will indicate the degree of association between client needs and characteristics and types of services presently being offered.

During the final phases of the project the results of the Needs Assessment Survey will be analyzed in comparison to several sets of legal, administrative and attitudinal variables. The final analysis will attempt to define those areas in which severely developmentally disabled adults have necessary but unmet needs as well as attempting to identify, in concert with the appropriate state agencies, where conditions could be modified in order to better meet the needs of the severely developmentally disabled adults.

APPLICABILITY: Not applicable.

158 Family Rehabilitation Therapy with Significantly Disabled Parents

Principal Investigators: Rick Heber, Ph.D.
Howard L. Garber, Ph.D.

Status: New

Dates: June 1979-March 1982

Cost: Annual $77,456 — Projected Total $77,456
RT Annual $49,200 — RT % of Annual Total 64%

Annual Report Reference: #15, Page 64, R-47

OBJECTIVES: This project was designed to provide comprehensive rehabilitation services to parents and children from significantly disabled families. While concentrating on families in which the parents or principal caretakers are severely disabled and/or mentally retarded, the intervention treatment was directed toward improving the ability of seriously disadvantaged and crisis impaired families to mediate life's daily experiences. This form of family rehabilitation revolves around a comprehensive rehabilitation program including vocational and job counseling, parent training and child care advice, remedial academic education, and advocacy and community liaison services. The advocacy for and referral to this constellation of services is part of a design to help parents to deal with employment difficulties, to train parents to work more effectively with their children, and to encourage parents to interact more effectively with their personal social world in and out of the home. By providing therapeutic family rehabilitation, we hoped to (1) significantly reduce the tendency for such families to incur disruptive home crisis, and (2) to devlop new models of family therapy through which parenting skills will be upgraded, and, as a by-product of which, parents will be supported in their efforts to promote the skill proficiencies in their children required for adequate educational growth and social adjustment.

Our model for family rehabilitation therapy, however, does not require the creation of new forms of service delivery. Our program is premised on the conclusion of The Rand Corporation (Kakalik, Brewer, Dougharty, Fleischauer, Genesky & Wallen, 1974) that although most urban centers have appropriate community agencies physically present, these services are **under** utilized. We are developing a rehabilitation model which will work through the public schools to contact families, evaluate family needs and then coordinate the delivery of services by existing social agencies. On the one hand, such a program will necessitate changes in the school's traditional role. But, on the other hand, this approach, which promotes family outreach by public school teachers offers the possibility of increasing the school's effectiveness. We see family outreach as a positive approach toward addressing and even solving, in part at least, the difficulty of educating a child when learning problems are viewed solely within the confines of the classroom.

METHODOLOGY: The success of our rehabilitation program requires that we take a comprehensive approach when viewing families and the family process. In particular, we seek to design individualized treatment programs which are based on each family's individual characteristics, strengths as well as needs. Accordingly, our methodological protocol first identified statistical parameters for both independent (family unit, parents, children, and community) and dependent (screening, assessment, treatment and follow-up services) variables. In general, we propose to interrelate the intervention across dependent measures in that we will screen and assess with respect to treatment goals and then follow-up maintenance and generalization of treatment skills. Intervention will be provided for the family unit, for individual parents and children and for the community. Efficacy will be evaluated within a cross-sequented cohort design (Schaie, 1972) which combines single subject treatment manipulations with a multivariate group evaluation of performance change.

A. Treatment Concerns:

1. Therapy will be based on an interactional systems model, in which a team of therapists will look beyond individual disabled parents and/or children to observe, and ultimately intervene with the disturbed or sub-optimally functioning interpersonal social systems of family members both in and out of the home.
2. Treatments will include various combinations of (a) didactic parent and/or child training, (b) role-playing and modeling phases, and (c) on-the-spot encouragement and critical feedback.
3. A series of programmatic treatment phases will be instituted so that client parents and children, according to their special, individual needs, will be guided day-by-day into more adaptive social relationships.

B. Treatment Components:

1. Community services:
   a. Coordination of existing services.
   b. New referrals.
   c. Revised rehabilitation counselor protocols.
2. Family process
   a. Individual counseling.
   b. Group family therapy.
   c. Counseling referrals to eliminate specific sources of home disruption (e.g., marriage counseling, alcohol abuse treatment).
3. Parents
   a. Treatment options to upgrade parenting skills
      i. Inductive-abstract approach (pilot).
      ii. Parent effectiveness training.
      iii. Behavior modification.
   b. Referrals to provide instruction in functional academic skills (e.g., reading and mathematics).
   c. Vocational rehabilitation counseling.
4. Children
   a. Individual instruction in functional academic skills.
   b. Liaison and advocacy between individual children and the public school system.
   c. Mediation/intervention (Feuerstein, Rand, Hoffman, Hoffman & Miller, 1979) aimed at disrupting inappropriate approaches to problem-solving and learning (this will take on more preventative aspects with younger children).
   d. Language training.
   e. Promotion of community recreational/leisure time options.
   f. Vocational education.

FINDINGS TO DATE: The pilot phase of this project was conducted in a low-income rural area of Wisconsin with sixty significantly disabled families. The three main phases of the study were included in this pilot work: screening, assessment, and training.

Screening. A screening procedure initiated by referrals from social and educational agencies was designed and employed to select these significantly disabled families from the general population residing in these areas. Families selected were those with parents of low intellectual and academic skills who also evidenced problems conducting an independent family life (e.g., one or more parents unemployed, one or more children in special education classes, and evidence of one or more social problems—alcoholism, child neglect-abuse). This initial screening revealed that these families indeed presented a wide array of vocational, academic and social needs, presently not being served by the community.

For example, the mothers' and fathers' occupational skills in these families were minimal. The majority of the parents were either unemployed or held unskilled laborer type jobs. Many of the mothers had been employed at one time as dishwashers, waitresses, cleaning women, factory piece workers, or doing part-time door-to-door selling. The fathers, if employed, worked as unskilled laborers in construction, cheese making, cleaning, and farming occupations. A number of the mothers and fathers were laid off or fired previous to and during the duration of the project.

Assessment. The second phase of the pilot project was aimed at specifically identifying the treatment needs of these families. An assessment procedure was designed and implemented focusing on the family processes that appear to be influencing and/or contributing to the families' inability to maintain an efficient and independent family unit. Parental, particularly mothering skills, were assessed. Children's academic, intellectual and problem-solving skills were assessed. From this assessment phase a picture is emerging that these severely disabled families are ineffective in their parenting skills and are actually employing processes that are detrimental to normal family life and specifically detrimental to the children's intellectual, language, academic, and motivational skills.

The preschool children in this pilot phase evidenced a wide range of intellectual, language and academic needs. Children in these families older than 3 years had limited intellectual abilities ranging from normal to moderately retarded (mean IQ 83.9; range 57-114). The majority of these children old enough to be screened for kindergarten flunked their local screening process.

Another major point of interest in these assessment data is that many children in these families were functioning at the retarded level by four years of age and furthermore were not receiving special preschool services. In addition, although the majority of the families qualified for welfare only a few were receiving social service payments. In part, many of these families admitted that they viewed the county welfare personnel as authoritarian, making them afraid to claim benefits or ask for services.

Training. As a follow-up to the assessment phase, a six weeks training program, designed individually for each of the families was conducted. The training program emphasized parenting skills, training the mothers in a style of interaction with their children which emphasized intellectual and language development. These data are presently being analyzed, but from the preliminary analyses it is evident that both the mothers and preschool children benefitted intellectually, academically, and motivationally from basic training in effective parenting skills.

In conjunction with the parenting program, and probably of ultimately greatest significance, was the basic advocacy services provided. Channels were developed between these families and appropriate social and educational services in the community. Parents who were reluctant and in some cases fearful to meet with these agencies were aided in meeting with and obtaining required services. Families were given information about and actually helped to receive needed social services such as welfare supplementals, medicaid, food stamps, and vocational rehabilitation services.

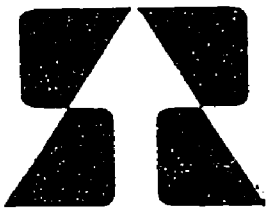
From this pilot phase, it appears that a large number of severely disabled families exist and that these families present a wide range of social, academic, and vocational rehabilitation needs. Furthermore, optional protocols will both improve the ability of future educators to work with severely disabled, and will help make more realistic rehabilitation practices of primary prevention.

This preliminary phase of the study has:

1. Determined that advocacy and community liaison efforts were a crucial and common need of severely disabled families.
2. Validated the methodology necessary to directly intervene with family process variables.

3. Demonstrated that training parents in an inductive-abstract process of interaction with children leads to significant increases in children's language and cognitive skills.

APPLICABILITY: Current rehabilitation practice bases its treatment options on a monolithic conception of at-risk families who are seen as being identical with respect to both the daily problems they face and the remediation they need. Such a view of the disabled masks individual differences in the nature, the quality and the quantity of the retarded handicap. Specifically, this lack of understanding leads to problems in planning vocational programs which confound delivery since the system has no model options. We need program planning which adopts the view that people are vulnerable to maladjustment when they lack the specific skills needed to resolve personal problems (Cowen, 1977). And we need a delivery system that maladaptive behaviors have not begun (Garber and Heber, 1970). The thrust of this approach is educational, not restorative, and individualized, not mass causality, oriented (Stone, Hinds and Schmiat, 1975).



University of Arkansas (RT-13)
Vocational Rehabilitation Research and Training Center

CORE AREAS

Rehabilitation Counseling

The discovery and development of knowledge and skills resulting in greater effectiveness of rehabilitation counselors as helpers with clients demonstrating psychological and vocational difficulties.

Psychosocial Treatment Strategies

The discovery and development of psychosocial treatment programs specifically for use by rehabilitation practitioners with clients and modified existing treatment programs for the special needs of rehabilitation settings or specific rehabilitation populations.

Program Evaluation

The discovery and development of procedures and techniques for systematically evaluating the effects of rehabilitation services on client adjustment.

UNIVERSITY OF ARKANSAS

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COMPLETED **ACCESSION NO.**

CONTINUING

NEW

DISCONTINUED

159 Research on the Psychosocial and Vocational Adjustments of Spinal Cord Injured Clients

Principal Investigator: Daniel Cook, Ph.D.
Status: Completed
Dates: March 1974-July 1979
Cost: Annual $6,398 — Projected Total $89,000
RT Annual $4,168 — RT % of Annual Total 65%
Annual Report Reference: #15, Page 188, R-125

OBJECTIVES:

1. To design a comprehensive research and evaluation strategy to assess the effectiveness of a model Regional System of Spinal Injury Rehabilitation.
2. To implement Personal Achievement Skills Training with a group of SCI at the Hot Springs Rehabilitation Center.
3. To complete a comprehensive review of the research literature dealing with psychosocial and vocational attributes of the SCI.
4. To implement a comprehensive research and evaluation strategy assessing the effectiveness of a Model Regional System of Spinal Cord Injury Rehabilitation.
5. To describe the sample of SCI persons making use of project services.
6. To assess the extent to which SCI clients' personal, social, and vocational needs are met by the rehabilitation program at the Hot Springs Rehabilitation Center.
7. To compare those SCI clients who successfully complete their vocational training programs with those clients who did not for the purpose of isolating client characteristics which are predictive of success.
8. To devise specific intervention strategies to meet the research defined needs of the SCI.
9. To complete a comprehensive review of psychosocial and vocational research pertaining to the SCI.
10. To measure the non-economic and quasi-economic contributions of the SCI to society.
11. To assess SCI clients' degree of satisfaction with rehabilitation services.

METHODOLOGY: The research design for measuring and monitoring client variables considers assessing the client's economic, environmental, social, and psychological status from entry into the project, through treatment, to project completion.

FINDINGS TO DATE: The following implications appear from the currently completed data analyses.

1. Injured at or before 18, many clients have been in a dependent status for a significant period of time and have developed few vocational commitments and behaviors.
2. Most SCI clients viewed rehabilitation as access to medical and surgical services.
3. Diversity of goals selected by SCI clients underscores the need for individualized planning with clients; independence goals are somewhat more important to clients than vocational or social goals.
4. Like other disabled client groups, project clients reported low satisfaction levels of work, psychological, and health related needs.
5. Direct counseling with clients regarding their goals and objectives for the future is also required.
6. Psychological adjustment to spinal cord injury is highly idiosyncratic.
7. Project procedures for identifying and involving spinal cord injured individuals in rehabilitation services appeared effective.

8. Based on case service funds spent on vocational training and on the underutilization of such services at the rehabilitation center it would appear that few of the SCI clients were receiving vocational preparation.
9. The association of the agency field counselors with the Arkansas Spinal Cord Commission probably was responsible for the increase in referrals. Those referrals significantly increased counselor caseloads which might account for the drop in SCI case closures during the project.
10. Because the pattern of progress for the SCI seems to be to enter and re-enter service provision sites, certain innovative services (e.g., "readiness" counseling in the home) may facilitate the vocational rehabilitation process.
11. Analysis of psychological characteristics of project clients revealed that depressive and anxiety reactions were practically nonexistent; however, one third of the sample could be classified as deniers, and one fifth met the actuarial criteria suggesting they would withdraw from people and have an inability to express hostility.
12. There were no apparent relationships between psychological adjustment and sex, time since injury, point in the rehabilitation process, or cause of injury.
13. Paraplegia was related to denial, quadriplegia to anxiety. Older SCI had significant elevations on the neurotic triad scales of the MMPI, perhaps reflecting normal aging concerns compounded by physical disability.

APPLICABILITY: Results of this project should improve services to SCI clients at the HSRC and other comprehensive rehabilitation facilities.

160 Development and Evaluation of an Interpersonal Skills Training Package

Principal Investigator: Robert L. Akridge, Ed.D.
Status: Completed
Dates: February 1975-October 1980
Cost: Annual $17,353 — Projected Total $97,000
RT Annual $10,660 — RT % of Annual Total 61%
Annual Report Reference: #15, Page 17, R-136

OBJECTIVES:

1. To construct and evaluate (reliability and validity) a "Counselor Facilitation Scale" which integrates eight counselor provided core therapeutic conditions: (a) empathy, (b) respect, (c) genuineness, (d) concrete and specific, (e) immediacy of responding, (f) self-disclosure, (g) immediacy of relationship, and (h) confrontation; and three client behavior rating scales applicable to a counseling setting: (a) self-directive behavior, (b) self-revealing behavior, and (c) internalization/externalization of behavior.
2. To develop and evaluate a trainer assisted training package (manuals, audio-visuals, etc.) organized around the scales listed in Objective 1, which could be utilized (with training and consultation) by trainers indigenous to the target groups to be trained (e.g., rehabilitation state agency personnel, rehabilitation facility personnel, peer helper operations, etc.).

METHODOLOGY:

Phase I

1. Tape recorded counselor/client sessions were rated (tapes already available in data bank).
2. Client closure status, R-300 data and client psychological test sub-scores were also available from the data bank.
3. Correlational analysis and multiple regression analysis were used to analyze the data.

Phase II

1. Selected state agencies and rehabilitation centers were asked to participate in the development of a comprehensive field test of the training program.
2. Clients of experimental group counselors (who will receive IPS training) and control group counselors (no IPS training) were tracked with systematic assessment for a period of at least 2 years.
3. Specific data gathering procedures, instruments, and methods of analysis were developed through consultation with participating rehabilitation agency personnel.

FINDINGS TO DATE:

1. The rating scales were found to be adequately reliable. Teams of novice raters achieve inter-rater reliabilities averaging in the low .80 with four hours training.
2. A training package consisting of the following was developed and field tested with all types of rehabilitation professionals such as counselors, evaluation and adjustment specialists, allied health, etc.: (a) Pre-workshop Primer, (b) Trainer's Manual, (c) Participant's Manual, (d) Follow-Up Package, and (e) supporting audio-visuals.
3. Evaluation by program participants have been very positive whether the training was conducted by the initial developers of the package or by second and third generation trainers (ARR&TC Annual Report #15).
4. Several training of trainers workshops have been conducted resulting in at least three regional continuing education programs using the package as well as several university training programs, and State Agency Staff Development programs.
5. In one formal test of the package, where all 150 rehabilitation counselors in a state agency received about 18 hours training at one of three program sites conducted by one of five trainers and several pre- and post-training measures other than participants' evaluations were taken, a three-way analysis of variance using a Program X, Trainer X treatment design yielded the following summary results: (a) the post-test scores on the IPS Content Test were significantly higher across all three replications (programs) and there was no significant trainer by treatment interaction. The absence of a trainer by treatment interaction is supportive of the objective to make the package as little trainer dependent as possible, (b) the post-test scores on the Carkhuff Communication Index were significantly higher across all three replications also with no significant trainer effects. (c) ratings of tape recorded interviews before and after 18 hours of training failed to show a significant change on either the counselor scale or client scales.

   The significant increase on the Content Test and the Simulated Response Test suggest that the concepts and skills in the IPS package can be learned by rehabilitation counselors in 18 hours of training sufficiently for them to be demonstrated in the training context but that additional training time is required for the skills to significantly transfer into an initial interview context. The program is designed for 3½ full days (28 hours).

6. Support for the basic training model which hypothesizes that higher levels of facilitative responding by a helper in an interview context is related to client self-exploration which is more self-directed, more self-revealing, and more internalized (personalized) was noted from the following table:

Behavior Rating Scale	Counselor Facilitation	(N)	Probability
Client Self-directive	.27	245	0001
Client Self-revealing	.34	263	0001
Client Internalization/ Externalization	37	230	0001

Each of the four dimensions were rated by different teams of raters. Considering the moderate reliability of the measure and the constricted performance range of the subjects on all the scales, the strength of the relationships are considered supportive of the basic training model.

APPLICABILITY: The IPS training program purports to effect an improvement in basic counselor helping skills. With such training, counselors should be expected to achieve superior results in helping clients define and achieve goals and resolve problems.

161 Survey of Client Perceptions of the Service Delivery Systems of a Comprehensive Rehabilitation Center

Principal Investigator: Richard T. Roessler, Ph.D.
Status: Completed
Dates: August 1977-March 1979
Cost: Annual $3,686 — Projected Total $50,000
RT Annual $2,431 — RT% of Annual Total 66%
Annual Report Reference: #15, Page 203, R-152

OBJECTIVES:

1. To identify problems that rehabilitation clients face at a comprehensive rehabilitation facility
    a. How do clients respond to these problems?
    b. How could they respond more competently?
    c. What additional training needs are suggested?
2. To measure client perceptions of the facility environment
    a. Is the environment perceived to be therapeutic?
    b. Is the environment perceived differently at different stages of a client's stay?
    c. What recommendations of a programmatic nature can be made to strengthen the therapeutic nature of the Center's environment?
3. To assess client satisfaction with facility services
    a. Are clients satisfied with facility services?
    b. What are the strengths and weaknesses in the facility's program from the client's point of view?
    c. What suggestions can be made to strengthen the Center's service program?

METHODOLOGY: **Analysis of Behavioral Problem Areas for the Disabled Client:** The identification of behavioral problems experienced by disabled clients is based on an analysis of the behavior/environment interactions of disabled clients at the Hot Springs Rehabilitation Center. The procedure emphasized identifying problematic situations and the variety of responses, ineffective to effective, for each of the problematic situations. Information from the study has helped Hot Springs Rehabilitation Center staff identify problems experienced by disabled clients and ways for helping the clients respond competently to the problem situations.

Analysis of Social Climate: Using Moos' Community-Oriented Program Scale, client perceptions of the environment of the Hot Springs Rehabilitation Center were assessed. The scale provides insights into several dimensions of the Center's environment: relationships, treatment program aspects, and system maintenance and change.

Service Rating: As part of the client survey, a rating form for services offered by the Hot Springs Rehabilitation Center was also completed by severely disabled students. The rating form listed the various service areas of the Center and enabled each respondent to indicate where the service fell in a range of responses from excellent to failure. The purpose of the service rating was to indicate the extent to which clients perceived Center services as effective.

Sample: A random sample of new and experienced rehabilitation clients at the Hot Springs Rehabilitation Center was included in the study. Each client group was interviewed twice: the new students, at entry and three to four months later; and the experienced students, after three and six months tenure in the Center.

FINDINGS TO DATE: The results of the student real-ideal comparisons revealed that the students wish their environment to be changed in the same general way as the staff. Both staff and students desire a Center environment characterized by (a) considerably higher levels on the relationship dimensions (more student involvement in the program, more staff support for students and student support for each other, and more free and open expression within all relationships) and (b) more order, organization, and program clarity than currently exists.

Students enrolled for a relatively short time perceived the environment in the same way as students enrolled for an average of four months. Although staff real perceptions changed over the duration of the interviews, students' real perceptions remained the same from one interviewing phase to another. Perhaps the changes which were being perceived by staff did not affect the students or had not yet been recognized by the students. Interestingly, the results of the assessment of the Center environment revealed exceptional similarity between staff and student perceptions of desired directions for change toward an environment which is more relationship-oriented, more orderly, and more organized.

On the average, students reported satisfaction with the various services. Only two of the twenty services (physician services and placement) were rated, on the average, below the mid-point on the seven point scale. Food, dormitory, evaluation and nursing services were rated as satisfactory by 50 to 75 percent of the students which suggested only a moderate level of dissatisfaction in these areas. Placement and physician services were identified as likely having multiple problems (rated as satisfactory by less that 50 percent of the students). However, only a very small number of students had received placement services, and these ratings did increase when students were interviewed the second time. Students who were successfully placed were not included in the sample surveyed for this study.

In the survey of student problems, both new and experienced students reported approximately two to three problems in the first interview. By the second interview, the number of problems reported by the two groups dropped to an average of about one problem per student. Generally, students were most concerned with problems in the areas of (a) conflicts with other students, (b) regulation conflicts, (c) medical service problems, and (d) detrimental staff attitudes and behaviors. Data from the students' second interviews revealed fewer problems and less agreement regarding where the problems lie. In the second interview, students were less likely to mention problems with medical services and more likely to mention concerns about vocational training.

Recommendations for practice which resulted from the study included the following:

1. The Center Policy Committee should implement and evaluate a system to increase staff-initiated student contacts. The staff should make every effort to communicate understanding of student problems and concerns, systematically reinforce appropriate student behavior through techniques such as compliments, and handle inappropriate behavior as promptly and systematically as possible.
2. Programs such as peer helping groups and interpersonal skills training should be undertaken to encourage students to be supportive and helpful to each other.
3. House parents and counselors should monitor and encourage student involvement in social and recreational programs at the Center.
4. A collaborative effort by staff and students to review current Center regulations is needed.
5. Student living arrangements should be established emphasizing increased responsibility and independence as a reward for appropriate behavior.
6. Medical services personnel should also emphasize the relationship aspects of their role which involves modeling good communication techniques with students. In addition, increased psychological services are needed in the medical department.
7. A method should be instituted for identifying potential dropouts based on such data as observed conflicts with counselors, staff, and other students, statements such as "no one cares - no one understands," and other information contained in the admissions file which suggests a history of failure prior to coming to the Center.
8. A study of the way in which students use their leisure time at the Center should be undertaken.

The purpose of the study would be to identify the avocational needs of the student so that a systematic avocational counseling program could be instituted.

Recommendations from this study as well as from the staff phase of the study (R-154) have served as the basis for a number of study group meetings. The purpose of the study group is to develop alternative implementation strategies, discuss the relative merits of the various strategies, and select a single strategy to implement in the Center. To date, a number of innovations in Center practice such as an Honor Dormitory, increased evaluation and psychosocial services, a review of the student handbook, etc. have resulted from the study.

APPLICABILITY: A significant phase of this project involved the translation of the problems, environmental perception and service satisfaction data into information pertinent to an administrative review of the Center. The student and staff segments of the study combined yielded over 100 recommendations for changes in Center procedures. In addition, aspects of the student data have also provided insights into areas in which training programs should be developed for disabled students. Finally, the methodology of this survey appears to have considerable potential for application as a review procedure to other comprehensive rehabilitation facilities.

162 Goal Planning in Rehabilitation Counseling

Principal Investigator: Richard T. Roessler, Ph.D.

Status: Completed

Dates: March 1976-February 1980

Cost: Annual $33,583 — Projected Total $90,000
RT Annual $21,870 — RT % of Annual Total 65%

Annual Report Reference: #13, Page 64, R 160

OBJECTIVES.

1. To develop a goal-setting module that enhances counselor diagnosis and planning skills and client participation in the development of the individualized written rehabilitation program.
2. To develop and pilot test a counselor training program in goal-setting.

METHODOLOGY: The effect of the goal-setting module on counselor diagnostic skills will be assessed through the quality of counselor vocational analysis determinations and rehabilitation plan development for a test case. In the exercise, counselors will be provided with complete evaluation data on a client from the DOT and to justify such choices on the basis of the client's Physical, Intellectual, and Psychosocial strengths and weaknesses evident in the client evaluation data. Counselors will also delineate a logical service program and timetable for achieving vocational goals and justify the selected services.

After counselors have completed the test exercises, agency supervisors who are familiar with the goal-setting skills in three areas: appropriate vocational choice determination, rehabilitation program design, and goal writing. In all, 25 counselor protocols will be rated by the two raters. The basis for ratings will be several anchored scales providing example counselor above average, average, and below average responses to the different tasks in the test case. The example materials and scales for rating counselor skill levels will be independently developed with Arkansas DVR counselors and supervisors and with personnel from RT-13 who are familiar with goal setting training.

Trained (experimental) and untrained (control) counselor group performance will be compared following the completion of training. The relationship between counselor test exercise performance scores and client satisfaction scores will be determined. A high positive relationship is expected between counselor exercise scores and the level of satisfaction with services reported by their clients.

Finally, a series of cognitive and behavioral skill measures will be developed to assess counselor incorporation of the goal-setting skills. These measures will be used in an experimental test of the program's impact on counselor behavior in a field setting.

Ratings by counselors and staff development directors of the Goal-setting training represent the initial evaluation of the package. A more intensive evaluation of the program's impact on counselor behavior is planned as part of a separate investigation.

FINDINGS TO DATE: Several user reviews have resulted in positive evaluations of the Goal-setting training program. Three reviews were conducted involving directors of staff development and rehabilitation counselors from HEW Region VI. Training materials can be divided into five main categories: acquiring necessary knowledge during the intake interview, using the medical evaluation effectively, planning psychological and work evaluation for the severely disabled, determining the vocational significance of client evaluation data, and conducting an effective IWRP interview. Each sub-section contains didactic, discrimination and experimental segments. Material for teaching the principles in the training is provided in the Instructor's Manual. The Participant's Workbook and Case Files (Case of Melinda Bracken and Shirley Steed) enable participants to practice the guidelines discussed by the instructor. For each case, a comprehensive set of materials from the intake interview to the IWRP has been developed.

An introduction to the information processing and goal-setting phases of the module was given at the National Rehabilitation Association's Annual Meeting in Washington, D.C. (September, 1977) and a journal article outlining procedures for processing and summarizing client data was published by **Rehabilitation Literature** (Rubin & Roessler, 1978).

A recent presentation on the goal-setting training package at the American Personnel and Guidance Association, entitled Diagnostic and Planning Guidelines for Vocational Rehabilitation Counseling (Las Vegas, 1979), resulted in an invitation to present the training package at the World Seminar on Employment Counseling in Ottawa, Canada in the Fall of 1980. Roessler and Rubin (1979) have also completed an article for publication in the **Journal of Rehabilitation** which draws on several of the key principles discussed in the information and goal-setting phases of the project.

APPLICABILITY: Materials developed in the project will enable counselors to meet more effectively the mandates of the Rehabilitation Act of 1973. Rather than a policy change, the goal-setting techniques will provide a way to translate current policy into systematic skills that can be integrated into the training of prospective rehabilitation counselors and the practice of current rehabilitation counselors.

163 Psychosocial and Service Outcome Correlates of Acceptance of Disability

Principal Investigator	**Richard T. Roessler, Ph.D.**	
Status:	**Completed**	
Dates:	**August 1977-March 1979**	
Cost:	**Annual $932** **RT Annual $654**	**Projected Total $10,000** **RT % of Annual Total 70%**
Annual Report Reference:	**#15, Page 239, R-165**	

OBJECTIVES. Research activity subsumes the following objectives:

1. To compare the value systems and life goals of two groups of clients, those who accept their disability (accepters) and those who do not (nonaccepters)
2. To determine whether a curvilinear relationship exists between hope and acceptance of disability and anxiety and acceptance of disability
3. To study the relationship of hope, anxiety, and acceptance of disability to completion of rehabilitation center program
4. To explore the counseling and personal adjustment training implications of empirical results of the project

METHODOLOGY: A voluntary sample (N=40) of physically disabled clients enrolled at the Hot Springs Rehabilitation Center was involved in the project. A night counselor contacted the students and requested their participation in the study.

Subjects completed a biographical form and several instruments, e.g., Cantril's (1965) Life Ladder, Rokeach's (1973) Value Survey, Taylor's Manifest Anxiety Scale, and Linkowski's (1971) Acceptance of Disability Scale. Other demographic and Center outcome data were secured from the clients and from Center records.

FINDINGS TO DATE: One phase of this study confirmed the hypothesis that moderate levels of client hope and anxiety are related to higher levels of acceptance of disability. In other words, acceptance of disability is negatively affected by too low or too high levels of either variable. Although more conceptualization and research is needed regarding strategies to raise anxiety, treatment techniques do exist to accomplish the other objectives. To decrease excessively high hope of clients, counselors must help them examine self-delusional constructs and develop realistic self-perceptions to supplant currently held unrealistic ones. Techniques for increasing hope include helping the individual change the self-depreciating cognitions associated with depression and develop expectations that personal goals can be achieved. Rehabilitation clients handicapped by excessive anxiety might profit from desensitization and relaxation training, intensive one-to-one personal counseling, or role playing and vicarious learning techniques.

Another study which was completed in this project, Goals of High and Low Accepters of Disability (Roessler & Boone, 1979), showed no significant relationship between level of acceptance of disability and type or number of life goals held. Given this similarity on type and number of goals, future acceptance-of-disability research might concentrate on contrasting high and low accepters on other variables such as (a) subjective possibilities that life goals can be attained, (b) locus of control, and (c) capabilities for reality surveillance and grounding.

The similarity between high and low accepters of disability was also found in terms of rankings of Rokeach's (1973) terminal and instrumental values. Bandura (1977) offered several possible explanations for the values and goal similarity of the two groups. He first pointed out that general intentions such as broad life goals or values "provide little basis for regulating one's efforts or for evaluating how one is doing" (p. 162). Bandura (1977) also pointed out that individuals may differ on the level of mastery that they attribute to themselves; i.e., on their belief that they could realize those goals and values in their lives. The mastery concept relates to the alternate hypothesis suggested by the goal study which emphasized subjective probabilities of success, locus of control, and capabilities to interpret reality accurately as possibly discriminating between high and low accepters of disability. These implications for performance of rehabilitation clients have been utilized in the development of a new research proposal (R-177, Psychological and Environmental Correlates of Successful Completion of Vocational Training in a Comprehensive Rehabilitation Center).

APPLICABILITY: Implications of the study for counseling can be stated in several broad principles. First, it appears in this research that accepters and nonaccepters of disability may be more similar in personal life goals and values than might be expected from other research. Hence, it may be more profitable to look toward other variables such as expectancies (locus of control and interpersonal trust), subjective probabilities of success, and interpretations of disability when attempting to facilitate adjustment to disability. Although it is important to help clients clarify their goals and values, it may be even more important to help them develop goals they believe they can achieve without excessive personal cost and personal orientations which emphasize seeing oneself as capable of initiating action and others as trustworthy in the sense of tangibly following through on promised rewards. Roessler and Henderson (1978) pointed out several ways that counselors could increase client perceptions of personal effectiveness through task structuring, counselor reinforcement of internal control statements by the client, problem solving training, and staff expectations.

164 Analysis of the Effectiveness and Efficiency of a Comprehensive Rehabilitation Center's Vocational Evaluation Unit

Principal Investigator: Daniel Cook, Ph.D.
Status: Completed
Dates: June 1976-September 1979
Cost: Annual $12,733 — Projected Total $47,000
RT Annual $7,710 — RT % of Annual Total 61%
Annual Report Reference: #15, Page 438, R-166

OBJECTIVES: To determine the effectiveness and efficiency of pretraining work evaluation unit recommendations made at a large comprehensive rehabilitation center by:

1. analyzing client center outcome according to type of evaluation unit recommendations made,
2. analyzing client closure status by type of evaluation unit recommendation made, and
3. analyzing client post-service salary level by type of evaluation unit recommendation made.

METHODOLOGY: Two samples of Center clients were formed, a random sample of 100 clients exposed to work evaluation during 1974, and a sample of 305 clients who completed special instrumentation and were enrolled at the center 1977-1978. A specialized form which included select demographic and psychological information as well as evaluation unit recommendation made, actual center training assignment, and Center disposition was completed for each client. Data were analyzed via various descriptive and nonparametric techniques.

FINDINGS TO DATE: Replicated findings from both samples indicated no signficant relationship between type of evaluation unit recommendation made, and rehabilitation center program completion. Program completion was significantly related to a rehabilitated ("26") closure status. Program completers had significantly higher post-service weekly salaries than voluntary dropouts and persons discharged as non-feasible for services. Notably there was only a 23% match between type of client vocational training received and kind of job accepted based on comparison of first two digit **Dictionary of Occupational Titles** coding for training and jobs. The most successful prediction of center completion for the 1974 sample was a recommendation to long-term evaluation (38% accurate), the most successful predictor for the 1977-1978 sample was a recommendation to direct training (44% accurate).

APPLICABILITY: Results of this study suggest tenure in the center is most predictive of future employment and quality of employment. Results also suggest that diagnostic effectiveness might be improved by shifting from recommendations to specific types of vocational training to isolating potential program noncompleters from completers.

165 Statewide Field Testing of a Case Movement Model in a Vocational Rehabilitation Agency

Principal Investigator	**Paul G. Cooper, Ph.D.**	
Status:	**Completed**	
Dates:	**October 1978-December 1980**	
Cost:	**Annual $9,047** **RT Annual $5,700**	**Projected Total $15,000** **RT % of Annual Total 63%**
Annual Report Reference:	**#15, Page 463, R-171**	

OBJECTIVES.

1. To improve case monitoring capability and practice in state vocational rehabilitation agencies.
2. To improve state agency capabilities for the development of relevant planning information.
3. To demonstrate the utility of case movement modeling as a tool for planning and resource allocation in state rehabilitation agencies.
4. To investigate and compare alternative approaches to modeling case movement

METHODOLOGY: The tasks necessary for successful completion of this proposed project fall into two general categories—Development of a data collection and retrieval system and Data Analysis.

1. **Development of a data collection and retrieval system:** The data collection procedures were to be incorporated into the system changed resulting from another state research and demonstration project for the field testing of a case weighting system (R-170). The data collected consisted of detailed status change information on all clients in Arkansas Division of Rehabilitation Services after July 1, 1979. This entailed modifications in the state client data system, master list update procedures, and client data recording formats. Since the project for field testing the case weighting system has similar data requirements, these system modifications resulted from efforts on that project.
2. **Data Analysis:** Two specific approaches to case movement modeling were investigated. First, the Markov modeling approach developed as part of R-153 was further tested. Second, a Monte Carlo simulation of case movement was designed and compared to the Markov modeling approach. This effort required sophisticated computer programming by R&T center staff but required no additional data over that necessary for the Markov modeling approach.

FINDINGS TO DATE. The results of this project indicate that both Markov modeling and simulation are computationally feasible techniques for describing case movement in a rehabilitation system. Complete results are documented in a dissertation by Dr. Stephanie Davis entitled "A Comparison of Markov and Stimulation Models of Case Movement in a Vocational Rehabilitation Agency" which is available from the Arkansas Rehabilitation Research and Training Center as a research report.

APPLICABILITY: The strong effect of federal/state policy on case movement is clearly illustrated by the change in federal regulations which dictated a higher proportion of severely disabled clients on state caseloads. According to the 1976 and 1977 RSA report of caseload statistics, this influx of more severely disabled c[illegible]nts into the system is partly responsible for a decline in rehabilitation rate. It is also suggested that policy requiring new administrative duties by counselors has produced a decline in the number of new cases (U.S. Department of Health, Education and Welfare, 1976). This effect was accentuated by insufficient increases in funding levels which did not offset inflationary trends (U.S. Department of Health, Education and Welfare, 1977).

Through the development of a viable model of case movement in the rehabilitation system, more accurate predictions of case flow characteristics may be made for projected changes in federal or state policy. For example, if such a model had been available prior to the Rehabilitation Act of 1973, administrators might have had a more accurate picture of the results of an increased emphasis on severely disabled clients so that services to this group might be expanded more efficiently. Suppose an outreach effort is designed to produce 10% more clients per year. The results of this effort with respect to case movement may be predicted through the use of a viable case movement model. Likewise, such a model could be used to predict the long term ramifications of a decrease in the number of accepted clients. In summary, a viable and tested case movement model may be used to predict changes in certain case flow characteristics induced by changes in policy or services provided.

166 Contributions of Personal Achievement Skills (PAS) to Work Adjustment Training: A Replication and Extension

Principal Investigator: Richard T. Roessler, Ph.D.

Status: Completed

Dates: April 1979-February 1980

Cost: Annual $14,853 — Projected Total $15,000
RT Annual $9,274 — RT % of Annual Total 62%

Annual Report Reference: #15, Page 311, R-176

OBJECTIVES:

1. To replicate the results of a previous study of the contribution of PAS to work adjustment (R-135).
2. To extend the evaluation of Personal Achievement Skills to assessment of the skill development of rehabilitation clients.
3. To implement the training as a regular feature of the work adjustment program at Woodrow Wilson Rehabilitation Center if results of the study are promising.

METHODOLOGY: A random sample technique was used to assign 24 clients to one of three Personal Achievement Skills groups (8 per group) and 8 clients to regular work adjustment services. All clients were selected from the current roster of clients enrolled in the work adjustment program at Woodrow Wilson. Both groups were pre and post-tested over a period of twelve weeks by graduate students in psychology from James Madison University (Harrisburg, VA.) Under the supervision of the Director of Psychological Services at Woodrow Wilson Rehabilitation Center.

Three teams consisting of a leader and co-leader, both of whom are instructors on the work adjustment staff or members of the Psychological Services Department, conducted three PAS groups, three days a week for one and one-half hours each session, over a 12-week period. All leaders and co-leaders were trained prior to the start of this program by Arkansas Rehabilitation Research and Training Center faculty.

Outcome criteria for the evaluation include the following:

1. The Carkhuff Scales (Interpersonal Communications) (Carkhuff, 1976).
2. The Means-Ends Problem Solving Measure (Platt & Spivack, 1975)
3. Rosenberg's (1965) Self-Esteem Scale.
4. The Goal-Setting Interview.
5. Cantril's (1965) Life Ladder Measure.

Pre and post-testing of clients followed a structured interview approach interspersing the skill measures with the self-perception measures. Interviewers were trained to conduct the procedure by members of the research team and practiced the procedure with rehabilitation clients before beginning pre-test interviews. Interviews with experimental and control clients were conducted on a scheduled basis which was approved by the Woodrow Wilson Rehabilitation Center. During both pre and post-testing sessions interviewers did not know the group membership of the clients.

FINDINGS TO DATE: In February, 1979, the Personal Achievement Skills Training with students began in the work adjustment center. The research study required that four groups be selected at random from students currently enrolled in the work adjustment center. Three of these groups were experimental groups (n=8), and one group was a control group (n=8). The three experimental groups represented different levels of intelligence with group one having the lowest intelligence (IQ=52-61); group two, moderate intelligence (IQ=62-74); and group three, higher intelligence (IQ=75-97).

Since only 32 students were available for the study, the experimental and control groups were smaller than planned. Initially, 50 students, all with an IQ above 70, were to be involved in the study. However, enrollment patterns in work adjustment resulted in a large proportion of the participants having a lower IQ than usually recommended for PAS training. In the past, it has been suggested that an IQ of 70 be a cutoff for Personal Achievement Skills Training.

Client gains were assessed in each of two skill areas, problem-solving (Platt & Spivack, 1975) and interpersonal communication (Carkhuff, 1976). Based on the results of the study, students in the Personal Achievement Skills groups gained no more in either of these areas than did the control students. Since all participants responded at both pre and post-testing with one to two methods for resolving problems presented in the problem-solving measure, it can be concluded that PAS training did not result in improved problem-solving skills.

A similar lack of effect was found with the interpersonal skills measure administered in the study. At both pre and post-testing, students in the trained and control groups responded with level 2.0 responses on Carkhuff's (1976) nine point scale. The level 2.0 response is basically an accurate response to the content of a statement with no reference to the feeling. Trained students were expected to be more sensitive to the feeling element of communication as a function of participating in Personal Achievement Skills Training.

Over the course of the study, participants in both the trained and control groups retained a moderate level of self-esteem. No statistically significant gains were reported from a previous PAS study with rehabilitation clients (Roessler, 1978). Similarly, no signficant changes were noted for the trained groups on the Self-anchoring Life Ladder. As mentioned in the pre-test profile, the trained and untrained groups at both pre and post-testing tended to report a positive outlook with five years in the future being closer to their best possible life than either their status now or their status five years in the past. Previous research reported gains in life outlook for rehabilitation clients (Roessler, Cook, & Lillard, 1976) in PAS training.

Consistent with other studies of Personal Achievement Skills, statistical trends toward a treatment effect as measured by two self-report measures of goal-setting were found. In essence, results on the goal-setting measures indicated that participation in Personal Achievement Skills seems to facilitate goal attainment on the part of rehabilitation clients.

Several more impressionistic evaluations of Personal Achievement Skills were completed. Group leaders assessed the training experience positively and enjoyed using the program with students. Written student evaluations regarding PAS echoed the positive perceptions reported by the staff. A large majority of students (over 90%) indicated that they felt the program was beneficial, that they would participate in a similar group, and that they would recommend such a group counseling program to a friend.

The following recommendations for future use of Personal Achievement Skills resulted from this study:

1. Reexamine the applicability of the PAS approach for training individuals with lower IQ's.
2. Provide staff with more intensive training in Personal Achievement Skills Training focusing on not only course content but also on the techniques of self-control of behavior, goal setting, and interpersonal skills.
3. Provide staff with release time to conduct the PAS program.
4. Evaluate the appropriateness of the measures of psychosocial gain, and
5. Provide more ongoing training support from RT-13 during the course of the PAS sessions.

APPLICABILITY: Rehabilitation of individuals with disabilities includes not only vocational but also prevocational training. As a prevocational training approach, Personal Achievement Skills has demonstrated in several rehabilitation settings its positive effect on client self-perception. This study not only sought to replicate PAS' effect on self-perception but also to estimate the training's effect on client communication, problem-solving, and goal-setting skills.

167 Systematic Caseload Management in Rehabilitation Counseling

Principal Investigators:	**Stanford Rubin, Ed.D** **Roy Farley, Ed.D.**	
Status:	**Continuing**	
Dates:	**March 1976-February 1981**	
Cost:	**Annual $25,241**	**Projected Total $60,000**
	RT Annual $16,874	**RT % of Annual Total 67%**
Annual Report Reference:	**#15, Page 32, R-151**	

OBJECTIVES: The overall objective of this project is to develop the Systematic Caseload Management (SCM) training package. The training contained in that package is directed at upgrading rehabilitation counselor skills related to the management of an entire caseload of rehabilitation clients.

SCM training covers three major phases: Planning, Time Management and Progress Review. **Planning** focuses on the specification of goals and action plans to be accomplished by the counselor. The counselor plans for the use of his/her time, resources and all counselor tasks. **Time Managment** deals with the effective allocation of rehabilitation counselor time for the critical tasks performed by the counselor to meet client, counselor and agency needs. **Progress Review** is the regular assessment by the counselor of his/her accomplishments to determine if the planned goals have been achieved. These three phases are directed to the following three basic questions: (1) What is to be accomplished and how? (2) When is the task done? and (3) Was the task done and if not what should be done to accomplish it?

During SCM Training the counselor will be introduced to the knowledge and skills necessary to plan, manage time and assess progress. There are also trainee participation exercises designed to promote the learning of the principles through direct experience. Additionally, the trainee will be provided with working tools for implementing the principles of effective planning, time management and progress review.

METHODOLOGY:

1. Three training modules will be developed. The first training module will be directed at teaching effective planning skills. The second training module will be directed at teaching effective time management skills. The third training package will be directed at teaching effective program review skills.

2. Assessment devices will be developed to assess the following areas of training:

   a. Cognitive Gain: Tests will be developed to measure trainee comprehension of the concepts and principles presented in the training modules.

   b. Skills Gain: The degree to which the trainees learn the skills advocated in the training modules will be determined via direct observation of their capability to emit the desired behaviors. Necessary rating scales will be developed.

   c. Attitudinal Evaluation: An evaluation form will be developed to measure the trainee's satisfaction with the training.

3. Assessment of the Training Modules.
   In order to determine the effect of training, the following will be performed:
   a. A random sample of rehabilitation counselors will be drawn and divided into an experimental (training) and a control (no training) group.
   b. Knowledge of appropriate behavior and ability to emit such behavior will be assessed prior to training.
   c. The experimental group will receive the Facilitative Management Training.
   d. The control group will receive no training.
   e. Following completion of training the counselor trainees will be assessed to determine if any cognitive or behavioral development has occurred. Also, the attitudinal evaluation described above will be administered to the experimental group.

FINDINGS TO DATE: The development of the package has been completed and includes a trainer's guide, participant's workbook, and a typescript manual.

Planning for the evaluation phase of the project is being undertaken now.

APPLICABILITY: The results of this research could have considerable impact on the practice of rehabilitation counseling, particularly in terms of reducing caseload size, increasing case processing effectiveness, and improving non-client interaction. For the first time, a comprehensive model should be available within which the counselor can be maximally effective in the role and functions prescribed by the system and by client needs.

168 Rehabilitation Intake Interviewing Skills (name change from Information Exchange Effectiveness in Rehabilitation Counseling)

Principal Investigator: Stanford E. Rubin, Ed.D.
Status: Continuing
Dates: March 1976-February 1980
Cost: Annual $57,756 — Projected Total $126,000
RT Annual $36,003 — RT % of Annual Total 62%
Annual Report Reference: #15, Page 48, R-158

OBJECTIVES: The overall objective of this project is to develop the Information Exchange Package. The training contained in that package is directed at teaching rehabilitation counselors:

1. the types of information that should be collected during the intake interview,
2. the types of information that should be disseminated to a client during the intake interview,
3. an effective intake interview information collection style, and
4. an effective intake interview information dissemination style.

METHODOLOGY:

1. Two training modules will be developed. The first training module will be directed at teaching effective information collection skills. The second training module will be directed at teaching effective information dissemination skills.
2. Assessment devices will be developed to assess the following areas of training:
   a. Cognitive Gain: Tests will be developed to measure trainee comprehension of the concepts and principles presented in the training modules.
   b. Skills Gain: The degree to which the trainees learn the skills advocated in the training modules will be determined via direct observation of their capability to emit the desired behaviors. Necessary rating scales will be developed.
   c. Attitudinal Evaluation: An evaluation form will be developed to measure the trainee's satisfaction with the provided training.

3. Assessment of training modules. In order to determine the effect of training, the following will be performed:

   a. A random sample of rehabilitation counselors will be drawn and divided into an experimental (training) and control (no-training) group.

   b. Knowledge of appropriate information dissemination and information collection behavior and ability to emit such behavior will be assessed prior to training.

   c. The experimental group will receive the Information Exchange Training.

   d. The control group will receive no training.

   e. Following completion of training the counselor trainees will be assessed to determine if any cognitive or behavioral development has occurred.

FINDINGS TO DATE: The development of the package has been completed and includes a trainer's guide, participant's workbook, and typescript manual.

Planning for the evaluation phase of the project is being undertaken now.

APPLICABILITY: Increasing rehabilitation counselor skills in information collection and information dissemination should make them better providers of services to the severely disabled. This training program which is designed to increase such counselor skill should therefore eventually impact on client satisfaction with agency services.

169 Refinement and Evaluation of a System for Weighting Case Closures

Principal Investigator:	**Paul G. Cooper, Ph.D.**	
Status	**Continuing**	
Dates:	**October 1977-September 1980**	
Cost:	**Annual $132,638** **RT Annual 0**	**Projected Total $276,000** **RT % of Annual Total 0**
Annual Report Reference:	**#15, Page 448, R-170**	

OBJECTIVES: Successful rehabilitation as indicated by the "26" closure has traditionally been the single most important goal of the vocational rehabilitation system. Not only was the goal measurable and easy to interpret but it also adequately reflected the priorities of the state-federal program. Continuously changing program goals and an expanded concept of successful rehabilitation have now rendered the "26" closure inappropriate as the sole measure of success. Newer and more complex goals require more advanced measurement and program evaluation technology. The development of caseload weighting systems is one approach to the problem. The overall purpose of the project is to refine and evaluate the outcome measurement/weighted case closure system currently used by the Arkansas Division of Rehabilitation Services. This refined system may then be used by RSA and/or state rehabilitation agency policy makers and program developers as a model for the eventual implementation of a national weighted case closure system. Information regarding the current Arkansas system clearly indicates that immediate and extensive evaluation of the system as it now exists would be counter-productive. Thus the approach to be used by this project includes a historical review of the Arkansas system and an update of the current state-of-the-art incorporating input from rehabilitation professionals having knowledge of weighted case closure systems, rehabilitation counselors and supervisors who have personally worked under the Arkansas system, and a representative from the Arkansas Consumer Advisory Council for Rehabilitation Services.

There are five specific project objectives:

1. Describe and evaluate the current Arkansas system for client outcome assessment and weighting case closures (ASOM - Arkansas Service Outcome Measure).
2. Update the literature review and state-of-the-art relative to weighting case closures.
3. Refine the Arkansas Service Outcome Measurement instrument and the system for its utilization and interpretation.
4. Implement and evaluate the refined instrument and utilization system.

5. Analyze data and disseminate findings.

METHODOLOGY: The project described herein represents a comprehensive program conducted by the Arkansas Rehabilitation Research and Training Center to develop a case weighting system for vocational rehabilitation agencies. In order to effectively design a system which meets the needs of the agencies, several groups of rehabilitation professionals were consulted. These included the agency advisory committee consisting of counselors, supervisors, and line administrators from a state agency; the technical assistance group which consisted of researchers, program evaluators, and other rehabilitation professionals; and the project advisory committee which consisted of top ranking state agency administrators, regional office representatives from Rehabilitation Services Administration in Washington.

As a result of the consultation with these groups and comprehensive literature review, specific objectives of the project were defined. The caseload weighting system developed represents an attempt to provide the information necessary for more adequate recognition of outstanding performance by counselors and other service units within vocational rehabilitation agencies. Specifically, the caseload weighting system is designed to provide input into the counselor evaluation process. The system will provide counselors, supervisors, program evaluators, and administrators with the additional information structured for optimum utility and the evaluation of the service delivery system. Client data will be collected and maintained via an integrated management information system designed as a part of the project. Training packages in the utilization of the system will also be completed.

FINDINGS TO DATE: The caseload profile consists on standardized scores and percentile ranks for each counselor on seven dimensions of counselor performance. These are the weighted outcome index, caseload potential, effort, average potential, productivity, total closures, and number of successes. These profile points are intended to give a concise overview of the caseload relative to other caseloads in the agency. It is planned that counselors and supervisors receive cumulative profile summaries at regular intervals (monthly or quarterly) throughout the fiscal year. For each dimension of the profile two types of scores are plotted on the same graph—percentile ranks and standardized scores with mean 50 and standard deviation 10. The percentile ranks allow comparison of a given caseload with all others in agency while the standardized scores give a better perspective of the amount of deviation from the norm.

In summary, it is planned that supervisors, counselors, and administrators receive on a periodic basis from their data processing section a 6-point profile of the caseloads in their area of responsibility. This profile will consist of (1) caseload outcome index, (2) total caseload potential, (3) average case potential, (4) caseload odds ratio (the expected number of successes divided by the expected number of failures), (5) effort index, and (6) productivity indexes. The outcome index, effort index, and productivity index will be cumulative from the first of the fiscal year, while the three difficulty or potential measures—total caseload potential, average case potential, and caseload odds ratio—will reflect caseload difficulty based on active cases at the time of reporting. Percentile ranks will be given with all scores so that any caseloads may be compared with the agency as a whole. It must be reiterated that this proposed system is not designed to replace the existing system of evaluation for the service delivery system but only to augment it. It is hoped that the caseload weighting approach will provide a more comprehensive look at the effectiveness of rehabilitation services.

APPLICABILITY: The overall objective of this project is to refine, demonstrate, and evaluate a weighted case closure system. In reaching this objective, two specific benefits will be realized. First, the project will result in an up-to-date synthesis of theoretical knowledge and practical experience relating to weighted case closure systems. Second, the project will result in a system whose origin and conception resulted from state agency need. This system will have been refined using methodologically sound research principles and will have been demonstrated and evaluated on a full-scale basis within a state agency. Should this evaluation prove favorable the system may serve as a model for other agencies wishing to implement a weighted case closure system.

The products of this project are designed primarily for the consumption of rehabilitation policy makers and program developers. That is, the system to be refined and evaluated will serve as a guide, to those in authority, for the implementation of a weighted case closure system. These policy makers and program developers may be either national or state level professionals. The implementation of any weighted case closure system will affect the evaluation of individual

rehabilitation counselors, hence it must necessarily affect their motivation for quality performance. Since one of the purposes of any weighted case closure system is to give differential "credit" for the successful rehabilitation of "difficult" and "easy" cases, those counselors working primarily with severely disabled clients should see their efforts more equitably rewarded.

The products of this research will form a basis for continued investigation, refinement, and demonstration of weighted case closure systems. It is anticipated that the refined system resulting from the project may serve as a model for other agencies. Thus the products of this project may be utilized directly by state vocational rehabilitation programs as well as indirectly by other researchers wishing to further refine the state-of-the-art for weighting case closures.

170 Comprehensive Follow-Up of Arkansas Rehabilitation Clients Served by the Hot Springs Rehabilitation Center, 1965-1978

Principal Investigator: Daniel Cook, Ph.D.

Status: Continuing

Dates: October 1978-June 1981

Cost: Annual $55,004 — Projected Total $130,000
RT Annual $33,251 — RT % of Annual Total 60%

Annual Report Reference: #15, Page 475, R-172

OBJECTIVES.

1. To review the literature on follow-up studies with regard to formulating questionnaire items with the greatest generalizability.
2. To develop a questionnaire/telephone procedure to assess current client psychosocial adjustment.
3. To conduct a full-scale follow-up study and relate current psychosocial and vocational adjustment to the type of service received by the client population:
    a. over 450 spinal cord injured clients referred to Arkansas Rehabilitation Services,
    b. over 2,500 clients who received services at the Hot Springs Rehabilitation Center 1966 to 1968, and
    c. approximately 300 mixed disability clients enrolled at the Hot Springs Rehabilitation Center 1977-1978.

METHODOLOGY: A seven page 38-item follow-up questionnaire was developed. Follow-up procedures consisted of locating former clients by obtaining last known addresses from rehabilitation center files and rehabilitation district offices. Former clients' current addresses and telephone numbers were located by either a) searching the telephone directory of city of last known address, or c) locating former clients' emergency contacts, or c) locating relatives or persons with former clients' same surname in city of last forwarding address. If located, former clients were briefly interviewed by phone and alerted to the mail follow-up questionnaire. Standard mail follow-up procedures, including postcard reminder, at regular intervals, were used.

FINDINGS TO DATE: Of the 953 ex-clients in the survey population, we were able to locate and sample 225. Significant findings included:

1. Fifty-six percent of the ex-clients were working at follow-up and 73% had held some employment since leaving HSRC.
2. Forty-nine percent of the ex-clients who were working at follow-up had been employed on the same job for 5 years or longer.
3. Sixty percent of the working ex-clients believed that VR services were helpful in getting their jobs.
4. Seventy-three percent of the former clients were not employed in occupations directly related to the vocational training that they had received at HSRC.
5. Forty-seven percent of the unemployed ex-clients indicated that they had received no encouragement from their families in their efforts to become employed.

6. Sixty percent of the unemployed ex-clients were receiving some form of public assistance, compared to 6% of the working ex-clients, and
7. Counselors' ratings of psychosocial and vocational goal attainment and overall adjustment at HSRC were significant predictors of work status at follow-up and 12-year employment history.

APPLICABILITY: Follow-up studies are a federally mandated evaluation activity. However, follow-up studies present formidable methodological problems not addressed by legislated evaluation standards. Results will provide information on improving client service delivery.

171 Development and Evaluation of a Self-Report Instrument to Assess Basic Life Skills: The Psychosocial Development Matrix Questionnaire

Principal Investigator: Robert L. Akridge, Ed.D.
Status: Continuing
Dates: November 1978-October 1980
Cost: Annual $12,820 — Projected Total $25,700
RT Annual $7,800 — RT % of Annual Total 61%
Annual Report Reference: #15, Page 251, R-173

OBJECTIVES:

1. To identify and/or construct a set of test items which provide a sample of basic life skills consistent with the model developed in projects R-164 and MD-9 (Psychosocial Development Matrix Questionnaire);
2. to evaluate the utility of the **Psychosocial Development Matrix Questionnaire** (PDMQ) for client assessment and program evaluation in rehabilitation;
3. to evaluate the reliability of the PDMQ;
4. to evaluate the validity of the PDMQ;
5. to develop normative PDMQ data for the general population and for particular disability groups (after acceptable reliability and validity is established).

METHODOLOGY:

1. Have a group of Adjusrment Specialists rate each item for content validity;
2. administer the instrument to a large number of handicapped individuals and non-handicapped individuals to establish norms;
3. conduct factor analysis and item analysis to ascertain internal consistency and construct validity;
4. correlate PDMQ factor scores with other related instruments to establish concurrent validity and construct validity; and
5. compute alpha coefficients to establish the reliability of each sub-score and total score.
6. conduct discrimination studies to determine the power of the PDMQ to discriminate between well defined groups (disability groups, treatment groups, diagnostic groups, etc.).

FINDINGS TO DATE: Rehabilitation administrators, counselors, and adjustment specialists were generally in agreement in endorsing the content validity of the PDMQ items. Factor analytic studies and other multivariate analysis of data resulting from administering the total 114 item PDMQ resulted in a number of shorter scales. Basic coping skills in the psychosocial domain were found to cluster at three levels of actions resulting in the following three sub-scales: (a) Self-Control - 10 items - alpha = .91, (b) Interpersonal Relations - 15 items - alpha = .95, and (c) Life Planning (environmental coping) - 15 items - alpha = .95. The sum of these three scales provides a general index of basic life skills from the client's perspective. The reliability of the total scale is .96. The PDM also yields attribute or style of behaving scores on the following five dimensions: (a) openness to experience, (b) cognitive complexity, (c) affective responsiveness, (d) purposefulness, and (e) proactiveness.

Several validity studies have been conducted as an adjunct to collecting basic norm data. Some of the correlational analyses with other instruments include: The Human Service Scale, Rosenberg's Self-esteem scale, Rotter's I-E Scale, and client behavior rating scales on the following dimensions: self-directive, self-revealing, internalization/externalization. Four prediction studies were conducted using individual PDMQ items as multivariate predictors of group membership. The instrument was a very powerful predictor of the following: (a) disability groupings, (b) competitive, non-competitive, or no work experience, (c) appraising one's financial status as high, middle, or low, and (d) a four-way typology made up of high or low self-evaluation on self-report inventories and high or low performance (evaluation by others).

An experimental edition of PDM Scales and User's Manual is available from the Principal Investigator. Over 60 rehabilitation professionals have requested the test materials during the past two months. This feedback from the field plus the additional norm data will be incorporated into further refining and improving the instrument.

APPLICABILITY: Rehabilitation has been a leader among the Human Service professions in developing a skills training approach to helping people. Too often, however, the available assessment technology still emphasizes a traditional "medical model" approach which serves to establish eligibility but fails to provide information which is useful for developing client programs. The PDMQ items represent intermediate objectives for programs in the psychosocial domain.

172 Evaluation of the Effect of Behavioral Consultation within a Comprehensive Rehabilitation Center

Principal Investigators:	**John N. Marr, Ph.D.** **Suki Hinman, M.A.**	
Status:	**Continuing**	
Dates:	**January 1979-August 1981**	
Cost:	**Annual $119,039** **RT Annual $72,188**	**Projected Total $198,400** **RT % of Annual Total 61%**
Annual Report Reference:	**#15, Page 264, R-174**	

OBJECTIVES:

1. To place a consultant inside a large comprehensive rehabilitation facility to facilitate change in service delivery procedures. Consultation objectives:
   a. To teach staff in the evaluation section to identify and specify deficit and surplus behaviors of Rehabilitation Center clients.
   b. To teach Center counselors to write (on the basis of the behavioral descriptions from the evaluators, interviews with the clients, and information from the field counselors) individual rehabilitation programs in terms of specific behaviorally-stated objectives for each client.
   c. To teach staff in those service sections who have identified a need for training, a course in interpersonal facilitation including methods of increasing attractiveness of the staff as secondary reinforcers and methods of effectively decreasing behaviors that impede rehabilitation progress.
   d. To consult with staff in work adjustment and vocational training areas on identification of behavioral surpluses and deficits, on methods of shaping and chaining to accomplish vocational goals, and on methods of extinction, overcorrection, and contracting to decrease behaviors impeding vocational training.
2. To evaluate the effectiveness of the consultation activities.

METHODOLOGY: The principal investigator executed a letter of agreement with the Center administrator, administratively assigning the consultant to him as a Center staff member who would receive supervision from the principal investigator only for research purposes. Priorities for consultation were designated as objective 1a-1d above, but the consultant was also instructed to respond, when time allowed, to any other staff requests for assistance that were judged relevant to the behavioral consultation mission.

Because activities conducted by staff in the various sections targeted for training occur in an interrelated context, certain preliminary procedural changes were necessary before the discrete training activities of Objectives 1a-1d could possibly have any meaningful or lasting impact on the actual delivery of services to clients. Accordingly, crucial portions of the Center's client program information-flow system were first redesigned to insure that all relevant service-providing staff would be cognizant of a client's behavioral objectives, and to facilitate the process of reporting progress toward those objectives back to the responsible counselor. This included development of Individualized Written Center Plan (IWCP) forms and the revision of both daily and monthly response documents.

Under Objective 1a vocational evaluators were then taught to describe specific surplus and deficit vocational **behaviors**, rather than to summarize or interpret client performance. (A systematic approach to training vocational evaluators to routinely evaluate non-vocational behaviors was beyond the scope of this project.) Under Objective 1b Center counselors were trained to describe specific client behavioral surpluses and deficits, and then to write, on the basis of those descriptions, explicit behaviorally-stated client-centered objectives for each client. Counselors were taught the procedures individually using actual cases and were trained to criterion by the consultant in Phase I; a new counselor began Phase I approximately every 4 weeks. Phase II (initiated on a counselor's completion of Phase I), wherein the consultant and Supervisor of Counseling jointly provided feedback to counselors singly and in groups, was designed as a fading process in order to transfer responsibility for program maintenance from the consultant to Center staff. In the current Phase III counselors receive all feedback from the Supervisor of Counseling (with the unseen and fading input of the consultant), who is also updating personnel files to reflect Center expectations concerning continued quality of IWCPs. A multiple-baseline-across-staff design is being used to evaluate the effectiveness of Objective 1b training, the number of behavioral descriptions and objectives being sampled at 8-week intervals from the beginning for the study to date.

To achieve Objective 1c, houseparents and nursing personnel (RNs, LPNs, aides, orderlies) were taught a 12-week interpersonal facilitation course developed by the principal investigator. The consultant's assistant met with five small groups (4-6) of staff weekly to lecture, role-play, and assign practice exercises. Instruction focused on increasing staff potency as secondary reinforcers by increasing interpersonal attractiveness to clients, but also included an introduction to basic behavioral techniques used to increase appropriate client responses while decreasing those competing behaviors which impede rehabilitation progress. The effectiveness of medical and dormitory staff training was assessed in three ways: (1) a paper-and-pencil measure of client-perceived social climate was administered pre/post on each dormitory, (2) observational data on ten relevant classes of behavior were collected for a 2-hour period on each staff member before and after training, and (3) two clients from each dormitory recorded interval data (using 30-minute pocket timers) on six classes of interactions with staff one day per week for 16 weeks prior to, 12 weeks during, and 16 weeks following staff training. The client data collectors, AID (for An Interpersonal Diary) workers, were pre-trained to a criterion of .90 accuracy.

An administrative decision was made several months into the project, when it became clear that a systematic approach to the final consultation objective would simply not be possible within the time-frame of the study, not to attempt to achieve Objective 1d. As time allowed, however, the consultant did respond on about a dozen occasions to special requests for assistance in those areas on a one-time basis.

FINDINGS TO DATE: All Center counselors were trained individually to write IWCPs with behavioral descriptions and objectives; following Center procedure, they now write an IWCP for each new client assigned to them. Two research assistants at a different site were trained by the consultant to score counselors' permanent products for specific behavioral descriptions and client-centered objectives. In preparation for formal data analysis, they are independently rating counselor plans sampled at 8-week intervals. Informal review of counselor plans indicated that up to 12 months after completing Phase I of training they are still writing specific behavioral objectives for their clients. In addition, unsolicited reactions of field counselors have been very favorable, and requests have been received from the field for similar training.

All houseparents and the majority of nursing personnel participated in the 12-week interpersonal facilitation course. (At the request of their supervisor, three additional sessions were held for houseparents on analyzing and reporting dormitory disturbances in terms of antecedents,

specific client behaviors, and consequences including their own responses.) Data from all three sources (pre/post social climate survey, pre/post 2-hour observation by consultant, "continuous" interval-recording by clients) have been compiled, and data analysis is underway. It is worthwhile to note that the client data collectors (AID workers) proved to be capable of reliably rating their interactions with staff in an unobtrusive manner, and that on retesting for accuracy (up to 11 months after training) they were found to consistently meet the 90 criterion.

The consultant also responded to occasional invitations for input into long-range Center planning, and to a number of special requests for assistance of the types originally planned under Objective 1d. While most of the latter related to a particular client on a one-time basis, two requests were for the design and implementation of continuing, easily-researchable Center-wide programs. Similar modified overcorrection procedures (in written form) were developed to teach clients the responsible behaviors of retaining their keys and their important documents such as identification cards. The respective programs, implemented 10 months apart, have successfully reduced the monthly loss of dormitory keys by 60%, and the montly loss of ID-meal cards by 55%.

APPLICABILITY: This project, which placed a behavioral consultant within a rehabilitation facility as a staff member who concentrated on developing new programs, training staff and responding to behavioral needs of staff, should serve as a demonstration of the effectiveness of providing relevant training to staff while on the job, the effectiveness of using client workers in research, and the effectiveness of various behavior management procedures developed to fit specific needs of the Center. A proposal for a new project programmatic with R-174, intended to maintain and extend the changes in Center procedures accomplished thus far but designed in the context of the service delivery system as a whole (rather than artificially isolated segments thereof), is currently in preparation.

173 Comprehensive Investigation of the Vocational Abilities and Motivational Characteristics of Rehabilitation Clients

Principal Investigator:	**Brian Bolton, Ph.D.**	
Status:	**Continuing**	
Dates:	**March 1979-June 1982**	
Cost:	**Annual $33,521** **RT Annual $20,135**	**Projected Total $109,000** **RT % of Annual Total 60%**
Annual Report Reference:	**#15, Page 284, R-175**	

OBJECTIVES: The following broadly stated objectives were formulated to delineate a comprehensive description of the psychological variables that are central to understanding the vocational behavior of rehabilitation clients. The ultimate purpose of this investigation is the generation of a knowledge base upon which vocational guidance strategies can be premised.

1. To construct norms for rehabilitation clients for standardized instruments that measure various aspects of the work personality, e.g., intellectual capabilities, work values, vocational interests, psychomotor skills, etc.
2. To compare subsamples of clients, e.g., by disability, age, sex, educational level, etc., in order to isolate the background characteristics that impede or accelerate the vocational adjustment of disabled clients.
3. To analyze the structural complexity of the various domains of the work personality, e.g., intellectual, interest, values, etc., to quantify the extent of differentiation that has occurred and make comparisons to nondisabled populations.
4. To analyze the intellectual characteristics of disabled clients and examine the interrelationships between intellectual functioning and other aspects of the work personality.
5. To analyze the interrelationships between psychosocial adjustment and vocational development, especially as reflected in appropriate work values. While it has long been recognized by rehabilitationists that restricted vocational development may impede the rehabilitation process, it is not known to what extent vocational immaturity is confounded with difficulties in psychosocial adjustment.

6. To analyze the relationships between the major dimensions of rehabilitation clients' work personalities and their rehabilitation outcomes, i.e., closure status, occupational level, salary, etc.
7. To analyze the relationships between the major dimensions of rehabilitation clients' work personalities and their vocational adjustment, i.e., job satisfaction and satisfactoriness as measured by the Minnesota Survey of Employment Experiences.
8. To outline the implications of research on the vocational behavior of disabled clients for rehabilitation counselors.

METHODOLOGY: In conjunction with the Arkansas Rehabilitation Service's RIDAC Project (see R-169) more than 2,000 applicants for services received some form of evaluation. One or more of the following evaluations were received: medical, psychological, psychiatric, vocational, and General Aptitude Test Battery. The psychological and vocational evaluations include the administration of tests and inventories of especial relevance to the assessment of the work personality of disabled persons. Approximately 1,200 clients received psychological evaluations that measure work values and occupational interests.

The instruments that were administered as part of the RIDAC evaluation or will be administered in conjunction with the follow-up phase of the investigation are classified according to the common elements in the models of vocational behavior proposed by Gellman and Hershenson.

Background: Standard demographic data such as sex, age, education, disabling condition, work status, etc., is routinely collected on the R-300 form.

Work Personality and Competencies: Two classes of instruments were used (a) abilities (or measures of maximum performance) and (b) work motivation (or measures of typical performance). The Wechsler Adult Intelligence Scale (WAIS) is the standard clinical instrument for the assessment of intellectual functioning. Using 11 subtests, a variety of verbal and performance skills are tapped. The Purdue Pegboard provides a reliable measure of the major components of manual dexterity and hand-eye coordination. Two projective techniques were employed to assess brain damage and personality integration, the Bender-Gestalt and the Draw-A-Person. A special form of the Sixteen Personality Factor Questionnaire (16PF-E) was used to quantify the primary dimensions of normal personality functioning. The Work Values Inventory (WVI) and the California Occupational Preference Survey (COPS) provided multi-dimensional profiles of these two important aspects of the work personality. The General Aptitude Test Battery (GATB), Minnesota Clerical Test (MCT), and Bennett Test of Mechanical Comprehension were adminstered on a selective basis.

Vocational Choice and Placement: Information concerning job placement, occupational level, salary, etc., is available on the R-300.

Work Adjustment: The Minnesota Survey of Employment Experiences measures job satisfaction, satisfactoriness, and collects detailed information about client's employment situations.

FINDINGS TO DATE:

1. The Assessment of Vocational Motivation of Physically Disabled Clients. The assessment of vocational motivation is a concern that is central to the primary goal of the vocational rehabilitation process. An analysis of the Work Values Inventory (WVI) profiles of 445 physically disabled clients revealed that (a) they are motivated by intrinsic as well as extrinsic values, (b) their work values are independent of age, education, and intelligence, and (c) their profiles of work values provide relatively unique information for counseling purposes. Three approaches to the interpretation of the WVI that may be used by the rehabilitation counselor are outlined: the normative strategy, the individualized strategy, and the predictive strategy. It was concluded that the WVI is a potentially useful instrument for assessing the vocational motivation of physically disabled clients.
2. Second-Order Dimensions of the Work Values Inventory (WVI). An item factor analysis of the 45 items of the Work Values Inventory for 445 physically disabled clients produced six second-order dimensions: Meaningful Work, Interpersonal Satisfaction, Economic Security, Responsible Autonomy, Comfortable Existence, and Esthetic Concerns. These second-order factors provide a summary of clients' work motivation at a higher level of generality that is consistent with the WVI primary structure. The six factors are virtually independent of age, education, and intelligence and can be hand-scored by a simple procedure.

3. Follow-up studies in Vocational Rehabilitation. This report examines the methodology and results of selected follow-up studies in vocational rehabilitation, and discusses the implications of these studies. Research investigations that have been concerned with the vocational and psychosocial adjustment of former VR clients are summarized, methodological aspects of these studies are reviewed, and potential uses of follow-up results in the improvement of VR services are outlined. The ultimate objective of the VR program is the long-term adjustment of disabled persons; this objective can only be evaluated fully by locating ex-clients and assessing their life circumstances several years after services have been completed. For those former clients who have experienced adjustment difficulties, it may be possible to provide additional services in conjunction with the follow-up process. All rehabilitation practitioners and administrators should be interested in the results of VR follow-up studies because the data such studies provide are essential to understanding successes and failures in the service delivery system. Following are the major conclusions derived from the studies reviewed in the report:

   a. Approximately two-thirds of general caseload rehabilitants are employed at follow-up, between 2 and 4 years after case closure. This finding, based on a fairly consistent pattern of results across a variety of studies, indicates that benefits from VR services are sustained by the majority of former rehabilitants.

   b. About one-half of nonrehabilitated former clients eventually obtain employment, suggesting that unsuccessful case closure should **not** be equated with rehabilitation failure. It is clear that nonrehabilitated clients may derive considerable benefit from the provision of VR services.

   c. Approximately one-half of the former clients of workshops and comprehensive centers are employed at follow-up, from 1 to 12 years after discharge from the facility. However, employment rates vary considerably, depending upon the nature of the program and the average difficulty of the caseload. It can be concluded that a substantial proportion of severely disabled, hard-to-place clients benefit from intensive rehabilitation service programs.

   d. Three studies examined the relationship between time elapsed since case closure or facility discharge and employment rates. No differences were observed between recently closed or discharged ex-clients, and those who had received services 2, 3, or 4 years earlier. This finding suggests that employment success (or failure) occurs within the first year after closure or discharge for most ex-clients, and emphasizes the importance of careful job placement and periodic supportive contacts with former VR clients.

   e. It may be inferred from unemployment rates at follow-up that many ex-clients could benefit from additional VR services. This conclusion received direct support from the Michigan studies, in which one-third of the former clients indicated that they desired further assistance. The nature of the needed additional services are suggested in the ex-clients' perceived barriers to employment, e.g., employer resistance, lack of self-confidence, etc.

   f. Three studies found a relationship between family support and encouragement for the client, and successful vocational adjustment at follow-up. The implication of this finding for the VR practitioner is obvious: The client's family should be actively involved in the rehabilitation program from planning through case closure, and in any subsequent services.

   g. Other than severity of disability and general case difficulty, no client characteristics appear to be consistently predictive of successful adjustment at follow-up. In various programs and facilities, selected prognostic variables may be useful in planning the program of VR services, but these variables must be identified in the particular settings.

   h. Successful vocational adjustment at follow-up appears to be related to better psychosocial adjustment, but the magnitude of the relationship is modest. The appropriate conclusion, which is supported by other research, is that improved psychosocial adjustment should be regarded as an outcome of major importance in vocational rehabilitation rather than simply assumed to be an invariant function of employment success.

APPLICABILITY: The results of the investigation will have direct implications for the vocational guidance of disabled clients, especially regarding the use of adjustment services, vocational training, and job placement.

174 Psychological and Environmental Correlates of Successful Completion of Vocational Training in a Rehabilitation Center

Principal Investigator:	**Richard T. Roessler, Ph.D.**	
Status:	**Continuing**	
Dates:	**April 1979-March 1981**	
Cost:	**Annual $15,802** **RT Annual $9,666**	**Projected Total $34,500** **RT % of Annual Total 61%**
Annual Report Reference:	**#15, Page 331, R-177**	

OBJECTIVES.

1. To identify those factors which distinguish between clients who make good progress in vocational training at a comprehensive vocational rehabilitation center and those clients who make poor progress.
2. To suggest psychosocial, evaluation, and training strategies for increasing client success in vocational training.

METHODOLOGY

1. Conduct a structured interview with 50-60 Hot Springs Rehabilitation Center students who have an Individualized Written Center Plan soon after evaluation's recommendation that they move directly to vocational training (April-December, 1979).
2. Obtain counselor and instructor rating of work adjustment (amount of supervision required, realism of job goals, teamwork, acceptance of rules/authority, work tolerance) and global rating of progress in training (July, 1979 to February, 1980).
3. Conduct second structured interview with those making good progress and rated high on work adjustment and those making poor progress and rated low on work adjustment to determine effect of vocational training experience and reasons for good or poor progress (August, 1979 to February, 1980).
4. Monitor student progress in Center and with field counselor (December to July, 1979-30).
5. Conduct phone interviews with Center dropouts to determine current status and reasons for dropping out of training (July, 1979 to May, 1980).
6. Complete data analysis, report writing, and proposal development based on implications of study for further research and training efforts.

Variables:

Person: Personal competency: IQ, Problem-solving, Social competence, Personal Constructs: Perceived job discrimination, Expectancies: Degree of confidence in ability to succeed in work, Values: Acceptability of welfare as a source of financial support.

Environment: Stressful life events occurring outside the Center, Center-specific problems, Financial disincentives to work.

FINDINGS TO DATE: A structured interview was conducted with HSRC students who have an Individualized Written Center Plan upon completion of the evaluation process. Representation samples of those students receiving direct-to-training (DT) recommendations (N=37) and long-term evaluation (LTE) recommendations (N=40) were interviewed. This data has been scored, and statistical analysis of study variables are underway. Direct-to-training (DT) students are young ($\bar{X}$=29) males (54%) who represent a wide variety of disabilities. Long-term evaluation (LTE) students were also young ($\bar{X}$=26) males (62%) who represent a wide variety of disabilities.

Work adjustment ratings were collected from the student's center counselor and training area instructor for all clients still in the sample two months after the initial interviews. Ratings were obtained for 32 DT (86%) and 30 LTE (75%) clients. Analysis of these data is underway.

Data was obtained in second interviews for all available subjects approximately 4-6 weeks after the WARF ratings. Scoring of this data is 90% complete. Upon completion of scoring, statistical analyses will be conducted.

Current activities of the study include monitoring of client progress through the center and in the field, completion of scoring, continued data analysis, and report writing.

APPLICABILITY: Information from the study may have direct relevance to the evaluation, selection, and preparation of clients for vocational training in comprehensive rehabilitation centers. Findings will also be of considerable interest to other rehabilitation professionals involved in the areas of work evaluation, personal adjustment training, and vocational training.

175 Performance in Vocational Training Programs and Relationships Between Individual Needs and Vocational Reinforcers

Principal Investigators: John Marr, Ph.D.
James Moore, M.A.

Status: New

Dates: March 1980-February 1981

Cost: Annual $21,582 — Projected Total $21,582
RT Annual $14,695 — RT % of Annual Total 68%

Annual Report Reference: #15, Page 349, Proposed

OBJECTIVES: To evaluate tenure and satisfaction of students in vocational training at a large comprehensive rehabilitation center as a function of individual needs and vocational reinforcers by:

1. Analyzing observed tenure of students as a function of measured satisfaction in training,
2. Analyzing tenure and satisfaction in the training program as functions of correlation between individual needs and of reinforcer patterns of the training environment,
3. Analyzing tenure and satisfaction in training as functions of correlation between individual needs and of reinforcer patterns of the actual occupation for which students are training,
4. Analyzing tenure and satisfaction in training as functions of correlation between training reinforcer patterns and occupational reinforcer patterns,
5. Analyzing the moderating effects of satisfactoriness for training and the student's perception of employment probability on relationships between individual need/vocational reinforcer correspondence and measured satisfaction in training, and
6. Analyzing combinations of the variables of satisfaction, satisfactoriness, and perception of employment probability as predictors of tenure in training.

METHODOLOGY: A sample of 72 vocational students was formed by administering the Minnesota Importance Questionnaire to rehabilitation clients admitted to the Hot Springs Center from November 1979 through March 1980, and by accepting for inclusion all students who produced a valid MIQ profile. Each student was followed through his/her Center program and approximately one month after assignment to a vocational training area, the student completed the Minnesota Satisfaction Questionnaire tailored for a training environment and a locally prepared questionnaire to assess perception of employment probability. At the same time, the Minnesota Satisfactoriness Scale was completed for each student on the basis of a structured interview with the student's instructor. Shortly after student data were collected, a Minnesota Job Description Questionnaire, tailored for a training environment, was completed by two vocational instructors and/or supervisors for each training area represented in the study.

Thus, the MIQ provides a measure of individual needs, the MSQ provides a measure of satisfaction in training, and the MSS provides a measure of the student's satisfactoriness for training in the assigned area as judged by each student's instructor, and the MJDQ produced Training Reinforcer Profiles for each represented training area. Data on student tenure will be obtained from permanent records and expressed as number of days of training completed and percentage of training completed. Each student will be classified as either completing or not completing his/her training program.

Data analysis will be correlational in nature. Primary emphasis is to be placed on the analysis of correlation between individual needs and vocational reinforcers and the function of such correlation in predicting satisfaction and tenure of students in training. The Pearson procedure will be used to determine correlation of various need/reinforcer indices with satisfaction and with tenure, and multiple regression techniques will be used in the analysis of problems which specify a combination of predictor variables. Discriminant analysis will be applied for problems which involve classification of students as completers or noncompleters as an outcome measure.

APPLICABILITY: This study should establish the general feasibility and usefulness of the theory of work adjustment as a framework for research in the area of vocational training. It would also specifically demonstrate that additional emphasis on the concepts of occupational needs and reinforcers should be included, along with the traditional emphasis on occupational abilities and requirements, in rehabilitation organization and counseling practices, with particular regard toward solving the problem of voluntary noncompletion of vocational training programs by students enrolled in such programs at the Hot Springs Rehabilitation Center and similar facilities.

176 Identification of Variables Affecting Completion of Rehabilitation Programs in a Comprehensive Rehabilitation Center

Principal Investigator: Daniel E. Cook, Ph.D.

Status: New

Dates: March 1980-September 1982

Cost: Annual $29,735 — Projected Total $76,815
RT Annual $17,665 — RT % of Annual Total 59%

Annual Report Reference: #15, Page 484, Proposed

OBJECTIVES:

1. To analyze and compare preservice prediction techniques as to the viability of identifying clients most likely to complete a rehabilitation center training program, voluntarily dropout from training, or to be nonfeasible/disciplinary discharges from the center.
2. To compare and contrast prediction techniques in predicting post-center employment and salary level.
3. To determine the relationship between staff behavioral norms and client perceptions of those norms on client center completion and employment.
4. To determine the importance of the match between client and staff perspectives toward client psychosocial and vocational adjustment in accounting for client outcome.
5. To establish the reliability and validity of two quick measures of rehabilitation client psychological adjustment developed by ARR&TC faculty and to contrast client adjustment across time with outcome.

METHODOLOGY: Select prediction variables are to be used to form prediction equations and probability estimates concerning three criteria: center graduation, post-service closure status, and post-service salary. Four different prediction techniques: multi-linear regression/discriminant analysis, non-optimal weighting, reciprocal averaging prediction and cluster analysis will be compared. Using standard psychometric procedures, the reliability and validity of two quick measures of client psychological adjustment will be ascertained. Finally, the results of special instrumentation will be analyzed using standard statistical techniques to determine client staff behavioral norm congruence.

177 Independent Living Rehabilitation

Principal Investigator: Vernon Glenn, Ed.D.

Status: New

Dates: January 1980-January 1985

Cost: Annual $55,052 — Projected Total $200,000
RT Annual $36,112 — RT % of Annual Total 66%

Annual Report Reference: New since report #15

OBJECTIVES: Serve as a research and training resource to the CSAVR Committee on Comprehensive Services for Independent Living.

To initiate effort in the utilization of R&T Center resources to focus on the research and training needs in independent living rehabilitation services.

The following broad based objectives were formulated:

1. Working cooperatively with the Council of State Administrators of Vocational Rehabilitation's Committee on Comprehensive Services for Independent Living and assisting them in developing policy statements and administrative procedures for implementation of independent living rehabilitation services.
2. Conducting literature reviews and identifying concepts of independent living rehabilitation and appropriate relationships that should be established with other programs serving the disabled.
3. Develop academic and inservice training programs that respond to the training needs of state agency personnel in delivering independent living rehabilitation services.
4. Identify knowledge gaps in independent living rehabilitation services and initiate and conduct research in these areas.
5. Develop evaluation measures for follow-up on independent living rehabilitation services.
6. Provide technical assistance to state rehabilitation agencies.

METHODOLOGY: Working cooperatively with the CSAVR Committee on Comprehensive Services for Independent Living, issues and concerns of state agencies will be identified.

As the issues are identified the R&T Center will focus on projects that contribute to resolving the issues.

FINDINGS TO DATE: As a result of CSAVR Committee meetings, six major issues in independent living rehabilitation were identified and sub-committees have been appointed to develop these issues in more detail. The issues/concerns identified are:

1. Legislative responses and/or initiatives in reference to appropriations
2. Relationships with other programs (NIHR, DOL, etc.)
3. Evaluation and reporting procedures
4. Clearinghouse of information, which also provides or arranges for technical assistance to agencies and consumers; also includes service delivery options
5. Training and attitudinal change of personnel
6. Establishing standards for program audits and reviews

An academic program has been initiated through the RT Center and the University of Arkansas to train independent living specialists at the Master's degree level.

Several research and training projects are now being developed by the RT Center that will have implications for independent living rehabilitation.

APPLICABILITY: Findings from the CSAVR Sub-Committee studies will be applicable to all state agencies in administering independent living programs.

Students trained through the academic program will provide direct services to clients served through independent living programs.

178 Development of a Model for the Evaluation of Short-Term Training

Principal Investigator:	**Daniel Ferritor, Ph.D.**	
Status:	**New**	
Dates:	**July 1980-June 1982**	
Cost:	**Annual $25,473** **RT Annual $15,143**	**Project Total $76,419** **RT % of Annual Total 59.4%**
Annual Report Reference:	**New since report #15**	

OBJECTIVES:

1. Develop a short-term training model including the major variables which influence training effectiveness, the types of instrumentation needed to measure critical variables and an evaluation design to assess short-term training.
2. Evaluate the immediate and long-term benefit of selected short-term training program.
3. Develop products which could be used independently by trainers to evaluate a variety of different short-term training programs. The products should include a participant reaction evaluation instrument, guidelines for constructing instruments to measure specific learning outcomes and a training package to promote more effective use of the evaluation instruments.

METHODOLOGY: The project is divided into three major phases of activity. Phase I involves the collection of information on current practices in short-term training evaluation. Included in this phase is an extensive review of the training evaluation literature. In addition to the literature review, a questionnaire on current training and training evaluation practice will be mailed to R&T trainers, RCEP trainers and trainers in state offices of Vocational Rehabilitation.

Phase II activities focus on the development and field testing of instruments which can be used in a variety of short-term training programs. The instruments to be developed and tested in this phase of the project will include trainee background information forms, training evaluation forms, and forms to examine post training work environments.

In Phase III of this project we will test the general model of short-term training evaluation as well as the forms and the instruments developed in Phase II. The model and the forms will be tested on three training programs developed by ARR&TC Center.

FINDINGS TO DATE:

1. A literature search of rehabilitation short-term training evaluation has been completed. Preliminary analysis suggests that much of the training evaluation activities still focus simply on immediate post-training participant reactions.
2. A questionnaire concerning current training activities and training evaluation practices has been developed. The questionnaire, to be mailed to a sample of R&T trainers, RCEP trainers, and state agency trainers, has been submitted to CSAVR for review. Pending a favorable review, the questionnaire should be ready to be mailed in the early Fall, 1980.
3. Negotiations have begun between project staff and state agency staff in Region VI concerning the possibility of conducting an extensive evaluation of the Advanced Facilitative Case Management training package developed by the ARR&TC Center. If the outcome of these discussions is positive, we plan to begin a field evaluation by the Spring, 1981.

APPLICABILITY: The results of this study will be useful to those involved in rehabilitation training as well as those interested in the evaluation of training. The knowledge gained from this study should be useful to trainers throughout the field. The instruments developed and tested should be able to provide information which can be used to upgrade the quality of training in a wide variety of training settings. Finally, the project's concern with follow-up evaluation activities should assist trainers to identify those aspects of training which seem to be related to long term job performance.

179 Facilitative Interaction Techniques in Renabilitation Counseling

Principal Investigator:	**Roy Farley, Ed.D.**	
Status:	**Discontinued**	
Dates:	**March 1976-February 1980**	
Cost:	**Annual $21,493** **RT Annual $13,963**	**Project Total $98,000** **RT % of Annual Total 65%**
Annual Report Reference:	**#15, Page 78, R-159**	

OBJECTIVES:

1. To continue the refinement of the Facilitative Case Management model of rehabilitation counseling through research.
2. To develop a training package for rehabilitation counselors that will facilitate the counselor's interaction skills by teaching them to:
    a. identify moment-to-moment responses that are used to exchange information with the rehabilitation client.
    b. identify response modes.
    c. analyze interaction profiles.
    d. identify facilitative and nonfacilitative uses of responses.
    e. examine alternative modes of responding.
    f. identify preferred modes of responding.
    g. evaluate their own interaction style.
3. To evaluate the effectiveness of the training package.

METHODOLOGY:

1. The training program will be developed to include the following three components:
    a. A didactic component which will be presented via lecture and modeling utilizing items (b), (c), and (f) above. The didactic component will include the following general outline:
        i definition of terms.
        ii rationale.
        iii objectives.
        iv principles for the effective use of each skill.
    b. A discrimination component designed to train counselors to discriminate between effective and noneffective techniques. This will be done via modeling, role-playing activities, and utilizing items c., d., and e. above.
    c. An experiential component designed so that participants will be provided the opportunity to practice and experience the use of various techniques. This will be done via role-playing activities.
2. Evaluation of the training package.

    In order to determine the effect of training, participants' behavior will be assessed in the following three areas:

    a. Cognitive gain: tests will be developed to measure participant's comprehension of the concepts and principles presented during the training and in the pre-workshop manual.
    a. Attitude: an evaluation form will be developed to measure the participant's attitude toward the training. This evaluation will involve an assessment of the participant's:
        i belief of the concepts and principles presented.

ii affective reaction toward the training.

iii predisposition to act on the principles taught

c. Action (on-the-job performance): the degree to which the participants can actually perform the desired actions taught during the program will be determined via direct observation of their capability to emit the actions. Necessary rating scales/forms will be developed.

The following general research methodology will be performed:

a. A random sample of rehabilitation counselors will be drawn and divided into an experimental and control group.

b. Knowledge of appropriate behavior and ability to emit such behavior will be assessed prior to training.

c. The experimental group will receive training.

d. The control group will receive no training.

e. Following completion of training, the counselor trainees will be assessed to determine if any cognitive or performance change has occurred. Also, the attitudinal evaluation described above will be administered to the experimental group.

FINDINGS TO DATE: This project was subsumed under project 158, Intake Interviewing Skills for reporting purposes. A training package for non-rehabilitation counselors has been developed which includes a trainer's guide, participant's workbook, and typescript manual. Hence project 158 with the subsumption of 159 has two training packages covering interviewing skills, one for rehabilitation counselors and one for nonrehabilitation counselors.

APPLICABILITY: This project should result in findings which could be used by rehabilitation agency staff development supervisors, rehabilitation counselor supervisors, and rehabilitation counselor educators.

The results of the research should have greatest relevance to the practice of rehabilitation counseling. If the proposed training program results in increased counselor effectiveness, ongoing training programs could be adopted in various rehabilitation settings.

West Virginia University (RT-15)
Vocational Rehabilitation Research and Training Center

CORE AREAS

Program Evaluation

Techniques and strategies to improve the capacity of vocational rehabilitation in program assessment and evaluation, and data management and utilization to increase the effectiveness of the rehabilitation program in meeting the needs of those it serves.

Improved Service Models

Investigating various aspects of the vocational rehabilitation system with the aim of providing information and models which will permit rehabilitation to increase the effectiveness of its services and service delivery system.

Programmatic Barriers to Vocational Rehabilitation

Identification and assessment of all types of program barriers to vocational rehabilitation at all levels, e.g., state and national.

Affirmative Action and Consumer Involvement

Strategies and techniques for enabling vocational rehabilitation of handicapped individuals for maxmizing the impact of legislation leading toward total integration of handicapped into the world of work.

Institute on Rehabilitation Issues

The study of significant issues of concern to the rehabilitation community.

WEST VIRGINIA UNIVERSITY

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COMPLETED

ACCESSION NO.

CONTINUING

NEW

PROPOSED

180 Analyzing Performance Competencies of Severely Handicapped Clients

Principal Investigator:	Richard T. Walls, Ph.D.	
Status:	Completed	
Dates:	May 1976-April 1980	
Cost:	Annual $17,250	Projected Total $76,000
	RT Annual $12,795	RT % of Annual Total 74%
Annual Report Reference:	#15, Page 17, R-33	

OBJECTIVES: The overall objective and purpose of the study is to determine which skills clients need to learn to be placed in and survive in competitive employment. More specifically the objectives of the present design are:

1. To construct a matrix of vocational skills, taking into account skills proposed by the vocational behavior checklists currently in use nation-wide.
2. To add skills as necessary to fill gaps and allow comprehensive vocational assessment and training of VR clients.
3. To determine reliability (a. stability and b. interobserver) and validity (a. content and b. criterion related) of **The Vocational Behavior Checklist** skills matrix.
4. To train 20 work adjustment or training specialists in the use of **The Vocational Behavior Checklist**.

METHODOLOGY: In an attempt to determine the number of behavior checklists available and in use, an advertisement was placed in several periodicals requesting ". . . behavior checklists used in tabulating behaviors of skills" of various populations. The same request was sent to a number of individuals as well as to 883 state schools and rehabilitation facilities.

We received more than 200 checklists in return from individuals, facilities, and training programs. These lists varied widely in the extent to which they represented carefully specified and observable behaviors. Further, the item formats and scoring requirements differed markedly. In addition, while some were concerned with only one or two classes of behavior, others included behaviors in fifteen or more classes. Each of these classes of behavior might contain only a few specific behaviors or a hundred or more specific behaviors representative of that class. Some classes of behavior commonly represented in these checklists were: eating, toileting, dressing, health, grooming, communication, mobility, dexterity, vocational, recreational, socialization, orientation, motor skills, self-help, daily living, independence, alcohol or drug use, household, and work skills. Of the more than 200 checklists, 166 of them have been reviewed in an annotated bibliography (Walls, Werner, Bacon, and Zane, 1977).

FINDINGS TO DATE: All of the items related to the assessment of vocational behaviors were reviewed and evaluated. Although these classes of skills were sometimes labeled "Prevocational," "Occupational," "Job," or "Work" behaviors, any items associated with employment were considered to be in the broad "vocational" classification. Vocational items from 21 checklists were sorted into seven categories, and overlapping or duplicate items eliminated. These seven categories are Prevocational Skills, Job Seeking Skills, Interview Skills, Job Related Skills, Work Performance Skills, On-the-Job Social Skills, and Union-Financial-Security Skills.

All of the items that were retained were used to guide the writing of the present 343 behavioral definitions (skill objectives) to include **conditions** of performance, specific **behaviors**, and **standards** of performance. In almost all cases this rewriting and modification was extensive, since many of the checklists used only a short phrase to describe each behavior and/or did not include conditions and/or did not include standards. Further, many gaps were filled by creating completely new items. Many new skill objectves were derived from our work with vocational rehabilitation clients in sheltered workshops, deinstitutionalization training, rehabilitation facilities, and field based vocational rehabilitation programs.

An example of one of the skill objectives follows:

Condition:	Given a wood rasp, coping saw, miter box, hack saw, carpenter's hand saw, wood plane, claw hammer, screwdriver, "C" clamp, open end wrench, brace and bit, utility knife, pliers, tin snips, staple gun, paint brush, carpenter's rule, sandpaper, level, square, and ratchet and socket, placed in a random order.
Instruction:	"Point to the (name of tool)."
Behavior:	Client will point to the tool named.
Standard:	All 21 tools must be pointed to correctly, each within 30 seconds, on three of four occasions.

APPLICABILITY: Results of the experiment and training based on the experiment should be of greatest benefit to training supervisors and VR counselors. The ultimate benefactor is the client. Comprehensive vocational skills assessment can help all parties to effective placement. Behavioral statements of skills are not as likely to be misinterpreted as scores on trials, constructs, rating scales, or global objectives.

Further, the findings of this project may be utilized by vocational rehabilitation personnel who must observe, evaluate, and improve client performance. Since vocational rehabilitation services address themselves to a wide variety of client activities, this project will provide a useful function in organizing available performance checklists in terms of activities relevant to getting and keeping a job.

181 Sheltered Workshop as a Community Recycling Center

Principal Investigator:	**Michael D. Wesolowski, Ph.D.**	
Status:	**Completed**	
Dates:	**May 1979-April 1982**	
Cost:	**Annual $12,518** **RT Annual $9,134**	**Projected Total $60,000** **RT % of Annual Total 73%**
Annual Report Reference:	**#15, Page 476, R-46**	

OBJECTIVES:

1. To survey sheltered workshops throughout the country to find out how many are engaged in waste recycling, to what extent, and how it has helped the workshop.
2. To demonstrate that sheltered workshops for severely disabled clients can successfully function as a community waste recycling center.
3. Having demonstrated the feasibility of a community waste recycling center in a sheltered workshop, other projects will be initiated in VR workshops throughout West Virginia and other states that will further demonstrate that sheltered workshops can function profitably as community waste recycling centers.

METHODOLOGY: Participants: The Wage and Hour Division of the U.S. Department of Labor supplied a list of 3,057 rehabilitation workshops in 41 states and the District of Columbia. Of the 3,057 questionnaires sent out, responses were obtained from 788 (25.8%) of the workshops.

Questionnaires: A cover letter explaining the purpose of the survey accompanied each questionnaire. The questionnaire asked questions primarily concerned with profits from recycling, materials recycled, and methods used to collect and process materials. Follow-up letters to prompt returns were not used; however, any returns giving unusual or unclear answers were followed-up with a phone call.

FINDINGS TO DATE: Of the 788 total responses received, 307 sheltered workshops indicated that they did recycling. Each material (paper, metal, and glass) was analyzed for a mean selling price, a range, and standard deviation. A list was compiled of the other unique items that sheltered workshops recycled.

Analysis of Sheltered Workshops Recycling Paper: Of the total 307 sheltered workshops reporting that they recycled, 157 indicated they recycled paper. Of this 157, a mean selling price for paper to be recycled was $2.23 per 100 pounds. There was a standard deviation of 4.32 and a range of 0 for a low to $45.00 per 100 pounds for a high. The high price of $45.00 for 100 pounds of paper was for computer paper.

Sheltered Workshops Recycling Metal: Of the total 307 sheltered workshops recycling, 127 indicated that they were recycling some sort of metal. A total of 10 different kinds of metal were recycled. A summary of the number of workshops recycling each metal, the mean selling price per 100 pounds, the standard deviation, and range of prices are listed in Table 1.

Sheltered Workshops Recycling Glass: Of the total 307 sheltered workshops recycling, only 35 indicated that they did recycling of this material. This low number might reflect the danger involved in handling glass. It must be sorted by color and crushed before many companies will buy the glass. A mean selling price of $1.06 per 100 pounds was reported with a standard deviation of 1.15. A range for glass resale was 0 for a low and $5.00 per 100 pounds for a high price.

Sheltered Workshops Recycling Other Materials: Many workshops indicated other materials that were recycled besides paper, metal, and glass. Many cotton and fiber materials were recycled throughout the southern portion of the United States. Recycling corrugated cardboard and computer cards realized a profit for many sheltered workshops. Also, some workshops recycled through tires and other products. The following list shows some of the other interesting items recycled:

plastics
clothing
lumber
electrical meters and appliances
kaowool
yarn and thread
furniture
wreath easels
pallets
thread cones
pop cartons
batteries
telephone parts
mardi gras beads
coat hangers
bicycles
bailer twine
plastic gloves
nuts and bolts
paper clips
steel drums
skids
foam rubber
polyester
beer cases
printing plates
photographic chemicals
sawdust
fluorescent lamps

Copy of Report Requested: Of the total 307 responding "yes" to the recycling question, 277 indicated they wanted a copy of the final report. Along with the 373 requesting a copy of the report from the "no" responses, this yields a total of 650 workshops requesting a report from 788 responses. This is 82 percent of the total respondents requesting more information about recycling. The results of this study should provide added insight into the area of recycling for sheltered workshops.

Individual State Analysis: Further data analysis was done on an individual state basis. These data were analyzed to see if some regions of the United States or individual states recycled certain materials over others.

The best geographical area for recycling activity occurred around the Great Lakes. The states of Minnesota, Michigan, Illinois, Indiana, and Ohio did recycling with paper, metal, and glass. The Great Lakes might be used as a means of transportation for these materials. Michigan has a mandatory deposit on all beverage containers of soda and beer. This deposit has reduced this kind of litter but has raised storage problems for the local businessmen who have to return money for the containers to the customers.

The southern states do more recycling of textile materials than the northern states. This recycling effort could be influenced by the cotton crops and local textile industries.

For further discussion see: Wesolowski, M.D. and Bacza, G. The sheltered workshop as a community recycling center. **Rehabilitation Literature**, 1980, **41**, 180-183.

TABLE 1—Metals Recycled by Sheltered Workshops

Type of Metal	# of Workshops Recycling	Mean Price per 100 lbs.	Standard Deviation	Range Low/High
1 Steel	31	$ 2.00	4.10	0/20.00
2 Aluminum	76	8.06	8.43	0/25.00
3 Copper	23	12.17	16.23	0/50.00
4 Brass	14	12.54	14.31	0/40.00
5 Tin	10	2.10	4.92	0/16.00
6 Gold	2	No Profit		
7 Silver	2	30.00		
8 Bimetal	6	.69	.46	.10/1.38
9 Bronze	1	.00		
10 Zinc	3	7.67	9.29	.01/18.00

APPLICABILITY: Sheltered workshops interested in getting involved in recycling activities should benefit from these findings. These findings should alert workshops to the potential gains and pitfalls associated with the recycling business in workshop settings.

182 Negative Incentives: Contingencies which Discourage Disabled Individuals from Seeking or Completing Rehabilitation Services and Subsequent Employment

Principal Investigator: Richard T. Walls, Ph.D.

Status: Continuing

Dates: May 1976-May 1981

Cost: Annual $7,685 — Projected Total $18,000
RT Annual $5,359 — RT % of Annual Total 70%

Annual Report Reference: #15, Page 90, R-34

OBJECTIVES: The major question is which types and amounts of cash and in-kind benefits (at what benefit-loss rate) discourage eligible individuals from engaging in and completing VR services. Further, to what extent is this a problem in VR, and, if it is a substantial problem, what are some possible remediating actions?

METHODOLOGY: Subjects. The subjects are 304 potential VR clients of varying age, sex, and disabling conditions. Of these persons, some were receiving some kinds of cash and/or in-kind benefits at referral to VR. The others were receiving benefits from any of the sources at referral.

Design. The design is a simple two group format. The clients receiving benefits at referral are considered the experimental group and the clients not receiving benefits at referral are considered the contrast or control group. The independent variable is, thus, benefits at referral versus no benefits at referral. Obviously, the amounts and types of benefits vary markedly within the experimental group since no attempt to stratify the random sampling procedure was attempted. This implies blocking on different patterns or clusters of disability, sex, age, or most importantly, type and amount of benefits will probably aid in clarifying the findings. However, the major result will consist of a comparison of frequencies of successful closures for the experimental versus control group. Thus, the dependent variable is the closure status of the individuals. Factors associated with closure such as competitive employment, homemaker employment, earnings, etc. will also be considered.

Since a final report on the major question will not be completed until Summer 1980, this is simply an interim report of some of the relations determined from the initial data collection. No relations between benefits and VR closure are reported herein.

FINDINGS TO DATE: The individual questions and analyses reported present a consistent picture. Demographic variables for this sample, such as age, sex, education, disabling condition, and work history, as well as psycho-social variables, such as internal-external orientation and achievement motivation, appear to show little systematic relationship to benefits and VR outcomes. However, as noted, education shows at least some relationship to VR outcome. In contrast, there are strong relations between benefits and VR outcomes.

As an overall check of these conclusions a stepwise discriminant analysis was computed with competitive placement (subset of status 26 outcome) versus noncompetitive placement (all other outcomes) as the criterion variable. The potential predictive intake variables entered into this stepwise analysis were sex, age, race, work time, education, rural-urban, rent-own, internal-external orientation, achievement motivation, family income, total number of sources of benefits, total dollars benefits, and amount of benefits that would be retained if a job at the minimum wage were obtained. Only four variables contributed to an 82% hit rate (correct discrimination of individuals in the two groups). Number of sources of benefits accounted for 38% of the variance in that 82% hit rate. Other contributing variables were family income, years of education, and amount of benefits that would be retained if a job at the minimum wage were obtained, accounting for 31%, 18%, and 13% of the hit rate, respectively.

Number of sources of benefits was the most potent predictor of VR outcome. The more sources of benefits, the less likely is successful closure in general, and the less likely is competitive labor placement. The other most discriminating variable is family income. If the family is below the poverty level, there is less likelyhood of rehabilitation and competitive employment. These two variables are related in that those below the poverty level are likely to have more sources of benefits. As Paglin (1979) indicates, it may be misleading if in-kind benefits are not taken into account in calculating poverty estimates.

APPLICABILITY: Theoretically, findings from the study would be of significant social importance. A critical problem facing our legislators today is the establishment of effective governmental assistance programs. A great deal of pressure exists to establish a financial aid system which is helpful and yet equitable. If the findings from this study prove to be of significance, they should guide those who need more than intuition to construct this legislation.

Present policies of financial aid serve as environmental contingencies which serve to influence the actions of those who receive benefits. If the present set of contingencies which exist support behavior which is detrimental in the long run to either the individual or the assisting agencies in question, it is important to change them.

183 Development of a Valid Multiple-Factor Instrument to Assess Severity of Handicap (Preliminary Diagnostic Questionnaire)

Principal Investigator:	**Joseph Moriarty, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1976-April 1980**	
Cost:	**Annual $12,253** **RT Annual $7,696**	**Projected Total $225,000** **RT % of Annual Total 63%**
Annual Report Reference:	**#15, Page 121, R-35**	

OBJECTIVES: The overall objective of this project is to develop, standardize, and validate a practical, cost-effective instrument to measure handicap severity. Such an instrument should ideally yield a profile for an individual that would measure components of handicap severity as follows: (1) degree of handicap in mobility; (2) degree of handicap in self-care; (3) degree of handicap in motivation and psychological independence; (4) degree to which individual perceives problems to exist in personal, social, family, and vocational adjustment; (5) impact of demographic variables on employability; and (6) related factors.

METHODOLOGY: Establishment of a methodology for this study will include the following establishment of a panel of technical consultants, completion of literature search, evaluation of instruments or items for inclusion in a pilot battery, content analysis of resultant items, analysis of pilot inventory by reading specialists, preliminary field test of pilot battery with no less than 30 severely disabled clients, revisions of the inventory, reliability checks, concurrent validity tests, alternative weighting procedures, and norm development.

FINDINGS TO DATE: During FY 1979, the researchers engaged in the following tasks related to the intermediate development of the P.D.S.

Sub-scale Construction: Researchers have developed a battery of potential items for inclusion in the seven sub-scales of the P.D.S. As of November 1978, the P.D.S. had undergone nine substantive drafts based both on editorial analysis and field testing of the instrument.

In addition to field testing the P.D.S. with VR clients, researchers administered two sub-scales, the Preliminary Estimate of Learning Ability and the Work-Related Knowledge, to undergraduate students at the University during the second semester 1977-78. Sub-scales were then correlated with appropriate intelligence scales.

Researchers devised a scoring system for the P.D.S. and prepared the data for computer analysis. On the basis of preliminary testing and re-testing, the P.D.S. was modified to maximize coverage of the sub-areas, and accommodate item difficulty and scoring exigencies. Also the instrument was re-formated for readability and other stylistic concerns.

Statistical Techniques: To analyze the content of the various drafts of the P.D.S., sub-scales and items are being statistically analyzed to determine measures of reliability and validity. A point by serial correlation was run on the P.E.L.A. and the Work-Related Knowledge (N=98). Twenty of the thirty items on the P.E.L.A. surpassed the .40 level of correlation, and no items had negative values. On the Work-Related Knowledge, 13 of 18 items were above .40. At the same time, successive field testing of the P.D.S. with center clients and field-office clients is on-going in order to solicit the input of potential users of the instrument. Moreover, the scores on the sub-scales of the P.D.S. will be converted into stanines for the purpose of reporting individual profiles.

APPLICABILITY: Once the multiple-factor instrument has been developed with an accompanying manual to facilitate its use, two forms of the manual will be developed for direct application to rehabilitation. Form A of the manual will be for client-serving personnel, such as counselors and vocational evaluators to aid in documenting eligibility, to sensitize client-serving personnel to differential needs of individual clients, and to assist in the development of the Individualized Written Rehabilitation Program for each client. Form B of the manual will be oriented toward program evaluators to use as a supplement to number of closures, to help specify agency policy and priorities in terms of intake practice, potentially, and to assess employability gain vs. employment.

184 Factors Influencing Work Adjustment of Disabled Workers

Principal Investigator:	**M.S. Tseng, Ed.D.**	
Status:	**Continuing**	
Dates:	**May 1977-December 1981**	
Cost:	**Annual $28,706** **RT Annual $21,932**	**Projected Total $126,000** **RT % of Annual Total 76%**
Annual Report Reference:	**#15, Page 135, R-36**	

OBJECTIVES:

1. To determine the nature of vocational rehabilitation clients' occupational entry into the competitive labor force after vocational rehabilitation closure, by generating a relative profile for the vocational rehabilitation client population within the total labor force which shows characteristic patterns of their entry jobs in terms of fields, skill levels, and wage levels.

2. To identify the work adjustment or adaptation problems uniquely encountered by disabled workers after placement.
3. To examine disabled workers' work adjustment in terms of satisfaction/dissatisfaction and satisfactoriness/unsatisfactoriness relative to their occupational functioning.
4. To determine the extent to which disabled workers' work motivation might be related to their work satisfaction and performance.
5. To identify variables which might serve to moderate disabled workers' work motivation-satisfaction relationship.
6. To investigate if certain job content and context elements might tend to function as satisfiers or dissatisfiers to disabled workers.
7. To identify factors which might contribute to disabled workers' successful (or satisfactory) work performance.
8. To identify third-variables which might contribute to more satisfactory explanation of disabled workers' work satisfaction-performance relationship.
9. To determine the extent to which disabled workers' work adjustment after rehabilitation closure might be attributable to the absence, as opposed to the presence, of vocational training during the rehabilitation stage.

METHODOLOGY:

1. The project objectives are to be accomplished through three consecutive phases of investigation. Phase 1 involves intensive analysis of a state R-300 data set and the corresponding labor statistics. Phase 2 is a survey stage within which a sample of disabled workers (former VR clients) and their respective employers are contacted. Phase 3 is to be an experimental study within a sheltered workshop.
2. A sample of approximately 4,600 VR clients who were successfully closed (Status 26) and placed in competitive employment (work statuses at closure 1, 3, and 4) during FY 1975-76 in West Virginia is involved in Phase 1. Phase 2 requires a sample of approximately 200 clients who have been successfully rehabilitated (closure status 26), with one half of them having received vocational training (status 18) and the other half not, and their respective employers. A sample of approximately 20 sheltered workers (work status at closure 2) who have been successfully closed by VR (status 26) is to be involved in Phase 3.
3. Phase 1 addresses itself to 5 VR outcome variables (weekly earnings at closure, field of occupation at closure, etc. - the primary variables) and some 34 VR intake and process variables (age, sex, major disability, months from acceptance to closure, months in training, etc. - the secondary variables). Phase 2 taps 24 primary variables (including such employment variables as occupational title, weekly earnings, satisfiers and dissatisfiers of job elements, work satisfaction, and work proficiency and such personal attributes as locus of control, self-esteem, self-acceptance, perception of success, work motivation, and work personality) and 9 secondary variables (sex, age, major disability, highest grade completed, etc.). Primarily two independent variables, self evaluation of work proficiency and pressure for production, and two dependent variables, work satisfaction and work performance, are to be investigated in Phase 3.
4. Univariate, bivariate, and multivariate descriptive and inferential statistics are used for data analyses.

FINDINGS TO DATE: The first phase of the project carried out to date reveals the following characteristics for a state R-300 data set for FY 75-76.

1. Of the clients closed in Status 26, approximately 71% were placed in competitive employment (work statuses at closure, 1, 3, and 4).
2. As compared to those who were successfully closed but not placed in competitive employment (work statuses 2, 5, and 6), clients who were successfully closed and placed in competitive employment (work statuses at closure 1, 3, and 4) were found to have significantly different means on 6 ordinal intake variables and 2 ordinal process variables. They were on the average:

a. younger, with a mean age 33.8 as opposed to 41.5 ($p < .001$).

b. having more dependents, with a mean number of dependents 1.2 as opposed to 0.6 ($p < .001$).

c. from smaller families, with a mean number in family 3.3 as opposed to 3.5 ($p < .05$).

d. more educated, with a mean grade level 9.9 as opposed to 8.6 ($p < .05$).

e. earnings more at referral, with a mean weekly earning $35.10 as opposed to $5.60 ($p < .001$).

f. representing higher monthly family income at referral, with a mean 3.0 which is equivalent to $275 as opposed to 2.8 which is equivalent to $240 ($p < .01$).

g. participants of longer period of training, with a mean months of training 3.3 as opposed to 1.0 ($p < .001$).

h. recipients of more services, with a mean total number of services 2.4 as opposed to 2.3 ($p < .001$).

3. The frequency distribution of the competitive closures (work statuses at closure 1, 3, and 4) based on the 9 one-digit occupational categories was, in rank order, as follows: (a) code 3 service occupations (35.5%); (b) code 2 clerical and sales occupations (18.4%); (c) code 9 miscellaneous occupations (10.6%); (d) code 0-1 professional, technical, and managerial occupations (10.5%); (e) code 8 structural work occupations (9.5%); (f) code 6 machine trades occupations (4.5%); (g) code 7 bench work occupations (4.2%); (h) code 5 processing occupations (3.9%); (i) code 4 farming, fishery, forestry and related occupations (2.9%).

4. The distribution of those who entered the service occupations (one-digit code 3) based on the corresponding two-digit occupational codes was, in rank order, as follows: (a) code 31 food and beverage preparation and service (30%); (b) code 38 building and related service (18.0%); (c) code 35 miscellaneous personal service (17.8%); (d) code 30 domestic service (15.4%); (e) code 36 apparel and furnishings service (6.4%); (f) code 33 barbering, cosmetology and related service (4.8%); (g) code 37 protective service (4.2%); (h) code 32 lodging and related service (2.9%); (i) code 34 amusement and recreation service (0.5%).

5. The occupational distribution of those placed in the clerical and sales occupations (one-digit code 2) based on the corresponding two-digit codes was, in rank order, as follows: (a) code 20 stenography, typing, filing, and related occupations (25.5%); (b) code 29 merchandising, except salesperson (23.0%); (c) code 21 computing and account-recording (17.8%); (d) code 26-28 salespersons, commodities (16.4%); (e) code 23 information and message distribution (7.1%); (f) code 22 material and production recording (6.2%); (g) code 24 miscellaneous clerical (2.7%); (h) code 25 salespersons, service (1.3%).

6. The occupational distribution of those placed in the miscellaneous occupations (one-digit code 9) was as follows: (a) code 91 transportation, not elsewhere classified (28.6%); (b) code 90 motor freight (24.0%); (c) code 93 extraction of minerals (18.4%); (d) code 92 packing and materials handling (17.0%); (e) code 95 production and distribution of facilities (6.2%); (f) code 97 graphic art work (1.7%); (g) code 94 logging (1.5%); (h) code 99 vending stand operation (1.5%); (i) code 98 other (0.8%); (j) code 96 amusement, recreation, and motion picture not elsewhere classified (0.4%).

7. The occupational distribution of those in the professional, technical, and managerial occupations (one-digit code 0-1) was as follows: (a) code 09 education (20.5%); (b) code 07 medicine and health (18.2%); (c) code 18 managers and officials, not elsewhere classified (16.7%); (d) code 19 miscellaneous professional, technical, and managerial (12.6%); (e) code 16 administrative specialization; (f) code 00-01 architecture and engineering (6.3%); (g) code 15 entertainment and recreation (4.6%); (h) code 04 life sciences (4.0%); (i) code 12 religion and theology (2.9%); (j) code 02 mathematics and physical sciences (2.1%); (k) code 14 are (2.1%); (l) code 10 museum, library, and archival sciences (1.3%); (m) code 13 writing (1.0%); (n) code 11 law and jurisprudence (0.4%).

8. Application of Bayes' theorem of conditional probabilities relating rehabilitation outcome competitive versus noncompetitive closures (knowing prior probabilities of these closures to be 0.71 and 0.29 respectively with a sample of 6,436 clients), to the client intake characteristic vector

elements sex (male 1, female 2), marital status (never married 1, married and other 2), work status at referral (competitive 1, noncompetitive 2), and primary disability (visual 1, auditory 2, orthopedic 3, amputation 4, mental 5, other 6) revealed the following:

a. Whenever there is a combination of 111 in the first three elements of the client intake characteristic vector, assignment to the competitive closure is associated with the highest probability (posterior probability) of being correct ($p \leq 0.99$). This implies that clients who are males, never married, and competitive at referral work status-wise are most likely to be closed by VR in the competitive work group after appropriate rehabilitation services are rendered, regardless of their primary disability.

b. For males (1 in the first element of the vector) whose work status at referral is noncompetitive (2 in the third element), single clients (1 in the second element) are more likely to be closed in the competitive group as compared to married clients (2 in the second element). The posterior probability of correctly assigning the "112" cases to the competitive closure ranges from 0.91 to 0.95, whereas the posterior probability of correctly classifying the "122" cases to the competitive closure ranges from 0.80 to 0.88.

c. Whenever there is a combination of a 2 in the first element and a 2 in the third element of the client vector, assignment of the case to the noncompetitive closure has a posterior probability ranging from 0.29 to 0.67. This implies that if a client is female and her work status at referral is noncompetitive, it is more likely that her work status at closure is noncompetitive, when successfully closed (with posterior probability greater than 0.29 which is the known prior probability associated with the noncompetitive closure).

d. In connection with the above finding especially with respect to marital status, there is a distinctive difference between those who are never married (the 212 cases) and those who are married (the 222 cases). The "212" cases are associated with lower posterior probability of noncompetitive closure ranging from 0.29 to 0.43, whereas the "222" cases are associated with higher posterior probability noncompetitive closure ranging from 0.53 to 0.67. This means that as compared to single females, married females whose work status at referral is noncompetitive are more likely to be closed by VR in the noncompetitive work group.

9. Application of Bayes' theorem of conditional probabilities relating rehabilitation outcome competitive versus noncompetitive closures (with known prior probabilities associated with these closures to be 0.71 and 0.29, respectively with a sample size of 6,436 clients) to the rehabilitation process vector which consisted of four vector elements—restoration service (no 0, yes 1), college training (no 0, yes 1), maintenance service (no 0, yes 1), and service to family member (no 0, yes 1) revealed the following:

a. Whenever there is a combination of 111 in the last three elements of the process vector, assignment of the case to the competitive closure is associated with the highest probability (posterior probability) which is greater than 0.99. This indicates that clients who receive a combination of college training, maintenance service, and service to family member would most likely be placed in competitive employment at closure, regardless of whether they receive restoration service (the first element of the process vector) or not.

b. The process vector (0000) signifies the absence of all four rehabilitation services considered in the analysis, while the vector (0001) signifies the presence of service to family member but the absence of the three remaining services. The former vector has a posterior probability of 0.77 associated with competitive closure, whereas the latter vector has a posterior probability of 0.87 associated with competitive closure. The net difference between these two vectors is the service to family member showing a corresponding difference in posterior probability of $p=0.87 - 0.77=0.10$ for competitive closure. This implies that service is worth approximately ten percentage points in connection with closing the client in the competitive work status.

10. Skill level associated with occupations at closure for a sample of 4,584 clients, who had been closed placed in competitive employment, were analyzed based on the fourth digit of the occupational codes which represents a worker trait in terms of the relationship of the job to data having these weights 0 synthesizing, 1 coordinating, 2 analyzing, 3 compiling, 4 computing, 5 copying,

6 comparing, 7 and 8 no significant relationship. The occupational skill level analysis revealed the following:

a. The occupational divisions which require, on the average, the highest levels of skill were life sciences (mean skill level 0.8); law and jurisprudence (mean 1.0); religion and theology (mean 1.4); art (mean 0.8); entertainment and recreation (mean 0.5); administrative specialization (mean 1.2); managers and officers, n.e.c. (mean 1.0); and miscellaneous professional, technical, and managerial (mean 1.4).

b. Among the nine major occupational categories, professional, technical, and managerial occupations (with mean skill level 1.7) would require, on the average, the highest level of skills, whereas processing occupations (mean skill level 7.5) require, on the average, the lowest degree of skills in so far as the relationship of job to data was used as a basis for measuring for the skill level. Clerical and sales occupations (mean skill level 3.5) ranked only next to professional, technical, and managerial occupations in terms of the mean skill level required. They were followed in rank order, by machine trades occupations (mean skill level 4.0); structural work occupations (mean skill level 5.6); bench work occupations (mean skill level 6.2); miscellaneous occupations (mean skill level 6.4); farming, fishery, and forestry occupations (mean skill level 6.6); service occupations (skill level 7.3); and processing occupations (mean skill level 7.5).

11. A wage level analysis carried out with a sample of 4,516 closed placed clients revealed the following:

a. The top ten occupational divisions having, on the average, the highest weekly earnings at closure were, in rank order, fabrication and repair of plastics, synthetics, etc. (mean weekly earnings $257.40); law and jurisprudence (mean $217.50); extraction of minerals (mean $181.16); processing of chemicals, plastics, etc. ($173.15); architecture and engineering (mean $161.53); electrical assembling, installing, and repairing (mean $159.04); processing of petroleum, coal, etc. (mean $157.00); life sciences (mean $156.42); excavating, grading, etc. (mean $150.25); mathematics and physical sciences (mean $149.30).

b. Professional, technical, and managerial workers who constituted 10.5% of the competitively closed cases ranked at the top with a mean weekly earning at closure of $123.42. Service workers who represented the largest group of competitively closed cases at 35.5% in the sample, made the next to the lowest mean weekly earning of $74.19 (ranking 8). Farming, fishery, and forestry workers who belonged to the smallest group of 2.9% in the sample ranked at the bottom of hierarchy (rank 9) with a mean weekly earning of $66.02. The other six major occupational categories occupying ranks 2 through 7 were, in order, structural work occupations (mean weekly earning $122.60), miscellaneous occupations (mean $117.58), processing occupations (mean $113.17), machine trades occupations (mean $109.57), bench work occupations (mean $99.06), and clerical and sales occupations (mean $88.04).

c. Comparisons of retention cases (cases whose work statuses at referral being 1, 3, or 4) and nonretention cases (cases unemployed at the time of referral or those whose work statuses at referral being 2, 5, or 6) on weekly earning at closure using the t-test for independent samples revealed that only 7 out of 72 occupational divisions represented by occupations at closure did differentiate the two groups significantly beyond the .05 level. In other words, there were no significant mean differences on weekly earnings at closure between the retention and nonretention groups for 65 out of 72 occupational divisions investigated. This means that within our client population we could expect the retention and nonretention cases to be homogeneous in terms of their weekly earnings at closure for a large number of occupations. This inference is, in fact, contrary to the speculation that work experience would have an overwhelming influence on wage levels. Moreover, among the 7 occupational divisions in which the mean weekly earnings of the two groups showed significant differences ($p < .05$), the majority of them (4 to be exact) were in the professional, technical, and managerial category and almost all of them (except one, logging) had negative t values reflecting significantly larger mean weekly earnings for the nonretention group over the retention group. This is, indeed, a somewhat surprising finding.

d. To show a relative profile of our client population within the general labor force especially with respect to their weekly earnings at closure, a selected number of occupations (in terms of production workers by industry) were examined in regard to their respective national, state (West Virginia), and VR client weekly earning wages. The industries involved were stone, clay, and glass; primary metals; fabricated metals; machinery; electrical machinery; transportation equipment; food and kindred products; apparel; printing and publishing; chemicals, rubber and miscellaneous plastics; bituminous coal mining; and electric, gas, and water. Generally speaking, for all but two of these industries, the state and national averages were found to be roughly from 1 to 2 standard deviations above the average weekly earnings of our clients. In these two industries, apparel and chemicals, rubber, and miscellaneous plastics, the average weekly earnings (at closure) of our clients were found to be approximately the same as the state and national averages of their respective fields.

The second phase of the project carried out to date reveals the following findings:

1. A total of 110 former VR clients constitutes the sample for the second phase of the project. The breakdown of these subjects in terms of the variables sex, age, and employment status at the time of survey was as follows: 68 males (61.8%); 42 females (38.2%); from 16 to 78 years of age, with a mean age of 31.2; 35 unemployed (32.1%), 11 employed part-time (10.1%), 63 employed full-time (57.8%), and 1 with missing datum.
2. In four out of the eight employment adjustment areas more than 50% of the disabled workers in the sample encountered difficulties. They are, in the order of relative frequencies, transportation (81.0%), negative attitudes of the fellow workers (68.6%), limited privacy (60.0%), and time rigidity (55.2%). The rest of the employment-related adjustment areas caused less difficulties for the disabled workers. They are, in rank order, impersonal setting (46.2%), conforming to the fellow workers (45.7%), demands of supervision (34.3%), and work rules (26.7%).
3. Correlational analyses showed that the composite employment adjustment was associated significantly with these variables--locus of control, powerful others ($r = .49$, $df = 97$, $p < .001$); locus of control, chance ($r = .45$, $df = 97$, $p < .001$); age ($r = -.34$, $df = 98$, $p < .001$); number of hours worked per week ($r = -.23$, $df = 93$, $p < .05$); weekly earning, the first job after rehabilitation closure ($r = -.21$, $df = 95$, $p < .05$); and job satisfaction ($r = -.21$, $df = 96$, $p < .05$).
4. When asked how well they liked their jobs (Hoppok Job Satisfaction Blank Item 1), 78.8% of the disabled workers answered positively ("like it," "enthusiastic about it," "love it"). How much of the time did they feel satisfied with their jobs (HJSB Item 2)? More than seven-tenths (71.1% to be exact)felt satisfied "a good deal of the time," "most of the time," or "all of the time." How did they feel about changing their jobs (HJSB Item 3)? More than a half of them (53.9%) indicated that they were "not eager to change jobs, but would do so if a better job can be found," and approximately two-tenths of them (21.6%) were in no mood of changing their jobs (i.e., "can't think of any jobs for which I would exchange" or "would not exchange my job for any other."). Comparing with other people (HJSB Item 4), approximately one-half of them (51.4%) indicated that they liked their jobs about as well as most other people like theirs, and more than four-tenths (41.9%) of them were of the opinion that they liked their jobs "better" or "much better" than most people liked theirs or "no one likes his job better than I like mine."
5. Higher level of job satisfaction (as measured by the Hoppock Job Satisfaction Blank) was found to be significantly associated with better job content ($r = .68$, $df = 86$, $p < .001$), better job context ($r = .65$, $df = 84$, $p < .001$), higher level of self acceptance ($r = .47$, $df = 95$, $p < .001$), higher social desirability or need for approval ($r = .35$, $df = 72$, $p < .01$), higher self esteem ($r = .29$, $df = 91$, $p < .01$) higher protestant work ethic ($r = .24$, $df = 92$, $p < .05$), firmer belief that one has control over one's own life ($r = .24$, $df = 96$, $p < .05$), firmer belief that powerful others do not have much control over one's life ($r = -.24$, $df = 92$, $p < .05$), and stronger motive to work ($r = .20$, $df = 95$, $p < .05$).
6. The disabled worker who received higher employer rating on the satisfactoriness of overall performance on the job was found to possess firmer belief that chance forces do not have control over his/her life ($r = -.57$, $df = 24$, $p < .01$) and firmer belief that powerful others do not have much control over his/her life ($r = -.40$, $df = 24$, $p < .05$).

APPLICABILITY: This project produces much needed data on the circumstances of those former VR clients in the world of work. It is hoped that the data can be utilized in such areas as (1) sensitizing the rehabilitation personnel to the relative VR contribution to the nation's labor force, (2) post-closure follow through services, especially in reference to the competitive employment, (3) job development and job placement, (4) program evaluation using client post-closure job functioning as a criterion, and (5) other applications relative to the rehabilitation services involving jobs.

185 Field-Based Microcomputer-Assisted Vocational Rehabilitation Counseling System

Principal Investigator: M.S. Tseng, Ed.D.
Status: Continuing
Dates: May 1978-April 1981
Cost: Annual $31,719 — Projected Total $123,000
RT Annual $23,719 — RT % of Annual Total 79%
Annual Report Reference: #15, Page 176, R-37

OBJECTIVES:

1. To design a prototype of a microcomputer-assisted vocational rehabilitation counseling system which would consist of adequate microcomputer hardware and software and vocational rehabilitation information software.
2. To test the prototype system for its efficiency, reliability, capabilities and limitations.
3. To demonstrate the operation of the prototype system to the preservice rehabilitation counselors and, on the basis of their feedback, to carry out modifications if necessary to maximize the operability and utility of the system.
4. To implement the prototype system in the field for the inservice rehabilitation counseling professionals, including managers as well as counselors.
5. To evaluate the impact of the prototype system in the field.

METHODOLOGY:

1. A preassembled general-purpose microcomputer hardware together with the supporting software is to be selected from among the systems which are available on the market.
2. Vocational rehabilitation information software packages compatible to the microcomputer system acquired are to be designed in such a way as to enable a rehabilitation counseling personnel in the field to (a) input the client data to the system and have the client profiles relative to certain predetermined and known norms plotted and returned to him/her, (b) input the client intake and/or process data to the system and have estimates or projections of certain process and/or outcome measures calculated and returned to him/her, (c) request the system to store, update, and process caseload statistics reports produced and returned to him/her, and (d) input interest and abilities test data to the system and receive interpretations in the form of suggested vocational alternatives for a client.
3. In order to determine such a system's characteristics as speed, reliability, compatability, and flexibility, system analyses are to be conducted.
4. The system is to be evaluated and modified, if necessary, on the basis of the feedback of approximately 10 preservice rehabilitation counselors who would be interfaced with the prototype using such evaluation criteria as the ease of use, utility to the counselor, effort expenditure, etc.
5. The implementation of the prototype system in the field is to involve a group of approximately 10 inservice rehabilitation counseling professionals.

FINDINGS TO DATE:

1. A microcomputer system has been procured (OSI C3-OEM microcomputer system with 56 K bytes of RAM, ROM, triple CPU, dual double-sided 8-inch diskette drive providing 1 megabyte storage on-line, serial and parallel I/O, ACT-V 12-inch CRT display, OS-CP/M Disk Operating System, FORTRAN-IV compiler).

2. In conjunction with the caseload management component of the system an effort has been made to develop an effective and uniform means of computer-assisted data entry, retrieval, and analysis by examining and comparing varying recording elements and times of recording associated with Forms R-300, West Virginia DVR-100, and Maryland R-13.

   In conjunction with the caseload management aspect of the system, varying recording elements of forms R-300, West Virginia DVR-100, and Maryland R-13 were compared, and a uniform method of computer-assisted data entry and retrieval were extracted. BASIC programming of these elements is in progress.

3. On the vocational decision-making component of the system, an interest and an abilities test have been selected and evaluated for use with VR clients (COPS & CAPS, EDITS Pub. 1976).

   Test interpretation programs, which will suggest vocational alternatives for IWRP writing are under development.

APPLICABILITY: When successfully completed this project will introduce a prototype of the microcomputer-assisted vocational rehabilitation counseling system to the field of rehabilitation counseling.

A field professional will have:

1. an extrinsic means with which client data can be quickly stored, retrieved, and analyzed,
2. a high-speed clerical tool with which client records can be maintained and updated,
3. a reporting system through which weekly and/or monthly caseload statistics reports can be generated with minimum effort, and
4. an instant access to large quantities of information.
5. An aid in test interpretation and vocational decision-making which will consider individual client characteristics.

186 Developing a Model for State-Wide Study on Ineligible Cases (08)

Principal Investigator:	**Ranjit K. Majumder, Ph.D.**	
Status:	**Continuing**	
Dates:	**May 1978-April 1981**	
Cost:	**Annual $37,596** **RT Annual $27,194**	**Projected Total $56,000** **RT % of Annual Total 72%**
Annual Report Reference:	**#15, Page 198, R-38**	

OBJECTIVES: The primary purpose of this study is to develop an analytical model for studying ineligibility that would be effective in assisting states to reduce or better understand the nature of these closures.

Since this study involved data analysis to determine significance among variables, no hypotheses have been formulated. Rather, in broad data analysis, it appears more appropriate to discuss the types of analysis to be conducted in terms of objectives. The specific objectives are:

1. Determine any relationship between referral source and the number of cases closed from (a) applicant-referral statuses, and (b) extended evaluation.

2. Examine the distribution of 08 closures from (a) applicant status (00), (b) referral status (02) and extended evaluation (06) by reason for closure.
3. Analyze the relationship between reasons for closure and other key characteristics or factors, including: (a) referral source, (b) disability—for both severely and nonseverely handicapped, (c) age, (d) sex, (e) education, (f) SSI/SSDI status, (g) race.
4. Examine case service funds and time spent in statuses to ineligibility based on status (00, 02, 06) for specific disabilities.
5. Examine the extent to which there is a generalized attitude of rehabilitation workers toward 08 closures, particularly those who are classed as uncooperative, unmotivated, and refuse services.
6. Determine the congruence between reason for closure as identified by the VR counselor and by the study.
7. Study reason for closure by client perception of program to determine any factors within the program that may be a programmatic barrier.
8. Develop a protocol or checklist that will assist rehabilitation workers in their periodic review of ineligibility for individual clients and in conducting state-wide studies of ineligibility for all clients.

In line with the need to examine the characteristics of severely and nonseverely handicapped, these two groups will be studied separately and differences or relationships determined. If examination of these data do not show promising results in terms of information about ineligibility, the study would include a small sample of case records within the chosen state in order to attempt to further clarify ineligibility.

METHODOLOGY:

1. **Population and Sample:** The population will be composed of all 08 closures from one state in Region III. This population will be used for the macro analysis. A 10% random sample will be selected for micro analysis as outlined in Procedure.

2. **Procedure:**
   a. Using R-300 data, the flow patterns of clients within the 08 closure category will be analyzed based on the distribution of closures from statuses 00, 02, and 06, by closure reason. Reason for closure will then be analyzed, based on age, sex, SSI/SSDI status, marital status, and work status. Further, an attempt will be made to determine if there are any distinguishable features between 08 closures and the clients who reach status 12.

   b. Based on the findings from "reason for closure" (reasons being, unable to locate; handicap too severe; unfavorable medical prognosis; refused services; failure to cooperate; no disabling condition; no vocational handicap; and other) as determined from R-300 data, additional analyses will be performed, involving both client and counselor. Four classificatory dimensions—demographic, status, attitudinal, and organizational variables—will be considered in the questionnaire development plan.

   No attempt will be made to investigate clients closed as "deceased," "transferred to another agency," or "institutionalized," unless one of these closure categories represents more than 5% of the closures from either status 00, 02, or 06. In case of a larger than 5% closure rate, a sample will be drawn and contacts made to determine appropriateness of closure reason.

3. **Analyses:**
   a. A one-way ANOVA will be used to study the differential amount of time and case service funds expended on various disability groups. This procedure will also be used to detect any differential closure patterns due to age, sex, education.

   b. A 10x3 chi square analysis will be conducted to determine differences in reason for nonacceptance and closure from the separate statuses of 00, 02, and 06. Additional chi square analyses will be conducted using status, sex, SSDI, and SSI, and education to determine difference.

c. The questionnaires will be compiled and analyzed for both client and counselor as appropriate.

Appropriate interviewers will be selected from among counselors or counselor trainees. Interviewers will be provided with an orientation of the instruments, and will be monitored for reliability.

FINDINGS TO DATE: This year's major effort was in finalizing the instruments to be used for counselor survey, client survey, and case review. In order to accomplish this, these preliminary instruments were put through a pilot testing process.

On a sample of 20 rehabilitation counselors, the counselor survey instrument was administered. Their response was based on a random sample of 50 ineligible (08) cases. Items 1, 2, 3, and 7 are related to severity of handicap and unfavorable prognosis. Items 10, 11, 12, and 13 relate to clients' refusal of services. Items 14, 15, 16, 17, 18, 19, 20, 21, and 22 are aimed at clients' failure of cooperation. Item 23 relates to transportation problems; and items 24 and 25 relate to clients' emotional and communication problem.

Two more items were included later to address the reason for closure with no vocational handicap. These were: item 26—medical report does not indicate any significant handicap; and item 27—the disability is not related to vocational handicap.

Reliability of the counselor survey instrument using Spearman-Brown formula was found to be .69.

The client survey schedule and the case review schedule are still undergoing preliminary testing. In particular, the case review schedule is being checked against the San Diego Case Review schedule since in recent months a lot of use has been made of it by various VR agencies.

In regard to the client sample of 08 cases, several findings are presented in Table 1.

The highest percentage (40%) of 08 closures was attributed to refused services. Next highest group (16%) to be closed as 08 was considered to be too severely disabled for the purpose of rehabilitation. Unable to locate category as reason was 13% and failure to cooperate was 12% of the total cases. It is worth noting that the next highest group (10%) of closure did not have any vocational handicap and another 5% of the group did not have significant disabling condition.

Next, we examined the referral sources of the 08 cases and compared these with the cases which were accepted for services (12). Table 2 shows this comparison.

It is evident from the data that lower 08 closures come from sources such as individuals (a difference of 7 percentage points between status 08 and 12) and educational institutions (a difference of 4 percentage points). On the other hand, referrals from welfare agencies appear to have higher 08 closure (a difference of 10 percentage points).

One speculation could be made that the welfare benefits could serve as disincentives to take part in rehabilitation. Another reason to propose such a hypothesis is the fact that about 80% of SSDI applicants were closed as 08 while only 37% of Non-SSDI applicants were closed in the 08 category.

TABLE 1
Reasons for Closure as 08

Reason	%
Unable to locate	13
Handicap too severe	16
Refused services	40
Death	1
Institutionalized	1
Transfer to other agency	1
Failure to cooperate	12
No disabling condition	5
No vocational handicap	10
Other	1
Total	100

TABLE 2

Comparison of the Referral Sources for Status 08 Cases and Status 12 Cases

Referral Source	Percentage	
	Status 08	Status 12
Educational Institutions	25	29
Hospital—Health Agencies	14	13
Welfare Agencies	24	14
Public-Private Agencies	15	15
Individuals	21	28

APPLICABILITY: The actual findings should be useful to states and to the federal government as they continue their review and interest in clients closed and not accepted for service. Also, the protocol developed should be useful to states in conducting their own studies on an on-going basis. Evaluators will be able to implement the protocol without having to construct their own study, thus resulting in time-saving for states' evaluation units.

187 National Study of Trends and Characteristics of Closed VR Cases as a Function of National Priority on the Severely Disabled

Principal Investigator: Ranjit K. Majumder, Ph.D.

Status: Continuing

Dates: May 1978-April 1981

Cost: Annual $32,392 — Projected Total $110,000
RT Annual $24,649 — RT % of Annual Total 76%

Annual Report Reference: #15, Page 223, R-39

OBJECTIVES: This study deviates from the traditional hypothesis testing model since it is concerned with analyzing currently available data, based on exploratory objectives. The study has two broad objectives:

1. Determine trends and patterns in program change as a result of the priority to serve the severely handicapped;
2. Compare the current method of developing performance levels (using state means) to a random sampling procedure (using all cases). This comparison will be made for selected standards that make use of RSA-300 data.

The first objective stated above has sub-objectives aimed at differentiating between client characteristics of severely and nonseverely handicapped, by severity of disability, on the following:

a. Referral patterns
b. Use of extended evaluation
c. Patterns of ineligibility
d. Case service expenditures
e. Trends in time to rehabilitation
f. Patterns of services rendered to clients
g. Demographic characteristics of clients
h. Referral and Closure income
i. Trends in closures
j. Trends in competitive and noncompetitive employment closure
k. Changes in ratio of rehab in terms of case service costs, client-counselor ratio, facility-served client ratio, and program priorities since 1974 Act.

Also in this study profiles will be developed using Profile Analysis Technique (PAT) that depict trends in programmatically useful charts.

The sub-objectives under objective 2 should permit answering a series of programmatic questions regarding trends such as:

a. **Intake:** Following the 1973 VR Act, are proportionately more severely handicapped than non-severely handicapped: (a) referred to VR? (b) accepted by VR?

b. **Intervention:** Following the 1973 VR Act, do the severely handicapped, compared to nonseverely handicapped: (a) spend more time in the VR system? (b) receive more training services? (c) receive more physical and mental restoration service? (d) receive more maintenance services? Is more money being spent on the severely disabled than nonseverely disabled?

c. **Output:** Following the 1973 VR Act, do the severely handicapped show an increase in competitive placements than the nonseverely handicapped?

The answer to these questions can then be compared to such priorities as shown in state plans and PFPs.

METHODOLOGY:

1. **Population and Sample:** National data for the fiscal years of 1971 through 1976 will constitute the population. Principal source of data will be that contained on the RSA-300 form. A 5% stratified random sample (based upon the states) will be drawn for each of the six years from the client data set. The sample size for each year is being estimated at 50,000.

   The study plans to investigate the program change and associated trends and characteristics occuring primarily at the national level, and in some areas, at the state level. In addition to the RSA-300 data source, other sources of information (for example, Annual State VR Reports; Statistical Reports and Financial Plans published by the RSA, etc.) will be utilized insofar as data on rehab manpower, funding level, rehab facility and program priorities, etc. are concerned.

2. **Procedures:** Drawing sample from each of the six years data and analyzing data using the following variables: severely versus nonseverely handicapped for designatable categories; primary disability; age; education; referral source; extended evaluation use; ineligibles (08 closures); successful rehabilitation (26); unsuccessful closure (28 and 30); closure income and referral income; placement (i) in competitive employment, (ii) in sheltered workshops, (iii) as self-employed, (iv) in BEP, (v) as unpaid family worker, and (vi) as student; case service costs; time to closure; facility cost; and SSDI cost.

   As the data are being analyzed for each year, as stated above, the data will also be analyzed for appropriate standards to determine performance level based on sampling national data instead of the current mean of the state means approach.

   A series of ANOVAs will be conducted using the appropriate independent variables for each continuous dependent variable. Chi Square analysis will be used when the measures are nominal in nature. Also, insofar as it is possible, the data will be analyzed in light of the changes over time as a result of the emphasis on the severely handicapped. Since that emphasis started in 1973, prior years' data provide an excellent comparative basis for severely disabled categories that are without qualifications.

   Stepwise regression and time series analysis will be conducted using such variables as cost of services, time in rehabilitation, income at referral or closure, level of education, age, etc. A data validity check will be conducted by comparing case records to R-300 data using a 1% subsample from the original sample drawn.

FINDINGS TO DATE: Traditionally, VR has been operating on the efficiency side (versus equity), partly because of pressure to produce an ever growing number of rehabilitations, and partly because of perennial tight budgets that the State Rehabilitation Agencies have to work with. But with no additional funding, this expectation, of course, could not be reasonably met.

The Social Security Administration 1972 Survey has estimated that 7.7 million persons between the ages 20-64 are unable to work due to disability. Assuming that this has not drastically changed in the last 7 years, we can estimate the average per capita annual expenditures on VR for the disabled and severely disabled.

Rehabilitation is an expensive process, and particularly for the severely disabled. It may be one thing to raise our expectations of VR (a historical perspective would clearly show the tremendous growth VR has experienced in program philosophy, character, and clientele) but it is another to adequately provide the resources to fulfill such expectations.

Most handicapped individuals served by VR agencies do not "apply" but are "referred" by other agencies that sense the individuals can profit from VR services. Even after referral, motivating the handicapped person to accept VR services has been one of the difficult tasks the agency faces. It is not easy for an individual whose income comes from either Social Security or welfare, etc., to risk such income security while receiving VR services, even though he is assured that he will not lose such benefits in the event of unsuccessful rehabilitation.

Furthermore, "severity of disability" is not the sole determining factor in the eligibility of a handicapped individual for VR services. An equally important factor is the extent to which disability constituted a "handicap" to employment. Disability and handicap are two different concepts and must not be confused. An individual may have a severe impairment but little or no handicap to employment. This is something not very well understood by many people.

Basic eligibility for VR services is contained in the definition of "handicapped individual" stated in the 1965 Amendments to the VR act (Section II (a)) which reads:

> ". . .any individual who is under a physical or mental disability which constitutes a substantial handicap to employment, but which is of such a nature that VR services may reasonably be expected to render him fit to engage in a gainful occupation . . ."

"Gainful occupation" includes employment in the competitive labor market; practice of a profession; self-employment; home-making; farm or family work (including work for which payment is in kind rather than in case); sheltered employment; and home industries or other gainful homebound work.

The Rehabilitation Act of 1973 defines "handicapped individual" as "any individual who (a) has a physical or mental disability which for such individual constitutes or results in a substantial handicap to employment and (b) can reasonably be expected to benefit in terms of employability from VR services provided pursuant to Titles I and III of the Act."

The definition of "handicapped individual" in the 1965 Amendments to the VR Act and the Rehabilitation Act of 1973 are similar. But the 1973 Act placed emphasis on serving the severely handicapped individuals and therefore defined the term "severe handicap" as:

> "The disability which requires multiple services over an extended period of time and results from amputation, blindness, cancer, cerebral palsy, cystic fibrosis, deafness, heart disease, hemiplegia, mental retardation, mental illness, multiple sclerosis, muscular dystrophy, neurological disorders (including stroke and epilepsy), paraplegia, quadriplegia and other spinal cord conditions, and any other disability specified by the Secretary in regulations he shall prescribe."

The language used in the field and in the political arena to describe the target population of VR is full of ambiguities. The term "impairment", "disability", and "handicap" are synonymously used and they can mean what one wants them to mean. To decide who are "severely handicapped" or "most severely handicapped" becomes a matter of judgement. The imprecise nature of the concept causes difficulty for the policy-writers as well as those enforcing such policies. To make matters more confusing, different public programs for the disabled have different definitions of the same term. Diagnostic labels are also used sometimes as proxies for disability or handicap. But there is no necessary continuity between the label and the nature of the problem which would permit one to analytically and unequivocally describe one person with a given extent of impairment as "severely disabled" or not.

The inadequacies and/or ambiguities in the current definition of "severely handicapped individual" as stated in the Rehabilitation Act of 1973 have caused much confusion and difficulty for the providers of rehabilitation services.

APPLICABILITY: Knowledge about how the program changes occur over time could provide managers and administrators at the state and federal level with insights that would affect planning and evaluation efforts. Also, state evaluation personnel could use these data for comparison of their

state's efforts in conjunction with continuing statewide studies that go beyond the standards in their depth. Findings from the study will assist the leaders of rehabilitation: (a) in understanding what is involved by way of time, money and manpower to implement a priority program; and (b) to take appropriate measures (if needed) to correct the direction of the program in order to attain the goal. If the current method of calculating performance standards is verified, no change in this area would be necessary.

However, if the comparison reveals differences in levels based on computation method, then this would call for a policy decision on the part of RSA as to how those performance levels should be calculated.

Additionally, data about the nature of change over time in the rehabilitation program should provide administrators with more accurate data for planning and projection purposes. This could promote data-based decision-making by: Administrators (CSAVR), RSA Central Office, and legislative sub-committees.

188 Role and Impact of Consumer, Provider/Advocacy and Advocacy Groups on Vocational Rehabilitation Policy—The National Experience

Principal Investigator:	**Antonio Jones, M.A.**	
Status:	**Continuing**	
Dates:	**May 1978-April 1980**	
Cost:	**Annual $42,041** **RT Annual $19,288**	**Projected Total $45,872** **RT % of Annual Total 46%**
Annual Report Reference:	**#15, Page 242, R-40**	

OBJECTIVES: The purpose of this research is to analyze the Federal Vocational Rehabilitation policy in relation to consumer, provider/advocacy and advocacy group input into the policy development. The following objectives are central to this research.

1. To determine how VR has evolved in the statutes from 1920 to present.
2. To determine what policy positions have been advanced by each of the three types of groups.
3. To determine the relationship between the group input and policy output.
4. To determine the nature in size and membership of the various groups.

METHODOLOGY: The initial rehabilitation act and all subsequent amendments will be analyzed in terms of the six focal points of the study (change in clientele groups, eligibility, allowable services, allowable employment objectives, funding, civil rights and other major changes).* To organize the statutory data, we will use the "Statutory Analysis Data Retrieval Form." In addition, a "Supplemental Data Retrieval Form" for sfatutory analysis will be used for statutes found in the VR acts that are not administered by Rehabilitation Services Administration. An example is Section 503 of the Rehabilitation Act of 1973, in which the Department of Labor serves as implementing agency.

To organize group positions, we will use a "Group Input Data Retrieval Form." This form will allow coding for type of input, policy position, and group opposition or support.

To determine the role and impact of consumer, provider/advocacy and advocacy groups upon policy formation in Vocational Rehabilitation, we propose to use the group approach, i.e., analyze the VR statutes in relation to group impact upon their development.

Policy Boundary: Earlier we discussed several definitions of public policy. We believe the following units of policy meet the Kerr definition.

Unit of Policy Analysis: U.S. Statutes mandating the Vocational Rehabilitation program. At the present time, the citation is 29 USCA 701, et.seq. The approach will be incremental, i.e., the research will treat each act and amendment as a separate unit of analysis, comparing the input (by the groups) with the output (statutes), using the correlation analysis indicated in the Analysis of Data Section. In addition to the individual (i.e., incremental) consideration of the data, a time series longitudinal analysis of the input and output will be employed to map the direction of policy change over time.

Group Input Boundary: The group input of this study will be taken from the hearings of the Senate and House Subcommittees charged with handling the VR Act during any specified year.

Unit of Group Input Analysis: Subcommittee Hearings will be analyzed with regard to the policy positions taken by representatives of the various groups. The policy positions may be in the form of oral (recorded) or written testimony, responses to questions by the Congressmen, and departmental reports and communication.

Analysis of Data: The analysis of the positions taken by the groups at this stage of policy formation will be analyzed in relation to (1) success, (2) partial success, (3) coalitions, (4) oppositions, (5) common positions, (6) periods of increase in number of certain types of groups, and (7) changing positions by the same group. Such analysis will be aimed at uncovering trends in the statutory evolution of VR policy. We anticipate policy positions advanced by groups of all three types (consumer, provider/advocacy, and advocacy) to be advanced on several occasions prior to success. The import of specific groups may be indicated by the degree to which coalition formations including those groups prove to be successful. Positions advanced by specific groups (whether in opposition or in support) should prove to be partially successful until dominant group-types coalesce on the issue. We expect, in turn, that the dominance of one group-type over the others would be a function of the statutory content of VR policy at the latest stage of development.

*The authors recognize that there will be various changes made in the law that do not merit a specific category, but are significant in terms of group impact on policy.

FINDINGS TO DATE: Preliminary findings last year indicate:

1. **Multiple policy positions** are espoused by the various groups making input. Many of these positions are very specific to the goals of the particular organization, e.g., a professional association wanted policy provisions to assume that VR agencies perform certain diagnostic tasks that were central to their professions. Other groups gave general support to the continuance of VR as a program.
2. Representation of each type of group was about split between consumer and provider/advocacy with only a very small number of advocacy groups (the authors realize possible confusion of the terminology of group types) they are considering alternatives to alleviate this problem.
3. Striking **success** by all types of groups is indicated. Also, there appears to be very little conflict between group types.
4. A summary of the 1978 Amendments to the Rehabilitation Act is contained in a publication called "Section Analysis of the Rehabilitation Comprehensive Services, and Developmental Disabilities Amendments of 1978," Research and Training: Institute. WV (1979).

APPLICABILITY: First, the research focuses upon VR policy determination including consumer and advocacy group input. Second, the statutory analysis will provide longitudinal data that will be useful in future policy and program evaluation research.

This study will attempt to measure a very important part of consumer input into the policy making process. Even though it is at the macro level, it will hopfully provide insights into the past and current role of consumer and advocacy groups in the policy making process.

The research project findings will be utilized by policy analysts, program evaluators, general management staff. Also, the findings will serve as the basis for further VR research at both intra-policy and inter-policy levels.

189 Job Obtaining Behavior Strategy (JOBS): The Use of Group Counseling and Intensive Behavioral Instruction for Vocational Placement of Rehabilitation Clients

Principal Investigator: Michael D. Wesolowski, Ph.D.

Status: Continuing

Dates: March 1978-March 1981

Cost: Annual $38,340 — Projected Total $114,000
RT Annual $28,172 — RT % of Annual Total 73%

Annual Report Reference: #15, Page 296, R-41

OBJECTIVES:

1. The purpose of this study is to develop JOBS groups in selected rehabilitation centers and field offices that will cooperate with the Research and Training Center with regard to this project.
2. To collect data to ascertain the proportion of VR clients who obtain employment through the JOBS groups, and these data are to be compared to the proportion of VR clients who obtain employment via existing methods of procuring jobs.
3. To collect data regarding the differences in wages, job satisfaction, and job retention between JOBS groups and other groups. Also, data will be collected regarding a client's expanding social support network as a result of the JOBS program.
4. After initial rehabilitation of the JOBS project, an attempt will be made to train rehabilitation workers and clients of other rehabilitation centers and rehabilitation field operations in the JOBS program.

METHODOLOGY: A group of 8 to 12 job-ready (status 20) clients meet with a placement specialist for 4 hours a day, 5 days a week. During this time, the clients contact friends, relatives, and former employers by telephone, look through help-wanted ads in the yellow pages of the phone book and exchange job information within the group. Clients are expected to find 10 job leads a day and arrange for 2 employment interviews a day. The interviews are arranged for a time outside the group session. Also, in the group sessions, clients compose resumes, obtain letters of recommendation, role-play interviews, discuss employment objectives, and provide each other with moral support.

FINDINGS TO DATE: The JOBS project has been established in Washington, DC, and Morgantown, WV. The Washington, DC office has been operating since November, 1978, and the JOBS group has about 67% rate of placement. No data are yet available regarding the rate of placement specialists who are not using the JOBS method in Washington, DC. Also, no data are available regarding the Morgantown, WV project since it is just beginning. The most significant finding to date is that there is a high positive correlation (.9) between attendance in the JOBS groups and getting a job. The JOBS program has served 38 clients. Within 5 days, 7 clients or 18.4% had obtained jobs while 13 clients or 34.2% had dropped out of the program. After 13 days, 15 clients or 39.4% had obtained employment while 15 clients or 39.4% had dropped out. After 29 days, 23 clients or 60.5% had gotten jobs. Five persons did not retain employment beyond 74 days after they had entered the program.

The JOBS program inherently contains a measure of job readiness. Those who drop out do so within the first few days--those who remain almost certainly get jobs. In examining the amounts of cash benefits of clients who obtained employment as opposed to those who dropped out, it was found that the former received an average of $84.28/month while the latter got an average of $218.85/month. The people who obtained a job but didn't keep it received an average of $178/month. These benefits as well as non-cash benefits such as medicade and food stamps would be eliminated if a job was obtained. The anticipated loss of these benefits certainly serves as a disincentive to vocational rehabilitation.

APPLICABILITY: Although there has been much discussion about the placement process in rehabilitation, the placement process in the rehabilitation service delivery system has been professionally the least implemented area among the various services available from team members for the severely disabled individual. Given impetus from the Vocational Rehabilitation Act of 1973 and especially Section 503 on Affirmative Action, there has been renewed interest and emphasis on the placement process. Within the placement process, the teaching of job seeking skills to clients is important and often neglected. The focus of this project is to teach rehabilitation clients to assume an active role in job seeking as well as studying variables related to client placement. Further, the study will show the best method of establishing such a program in a state agency.

190 Labor Market Participation of Vocational Rehabilitation Clients (Status 26)

Principal Investigator: Sita Misra, M.A.

Status: New

Dates: May 1979-April 1982

Cost: Annual $38,058 — Projected Total $72,000
RT Annual $24,244 — RT % of Annual Total 64%

Annual Report Reference: #15, Page 377, R-42

OBJECTIVES: The general objective of the study is to uncover the complex of economic, social, and attitudinal factors that are associated with successful adaptation by VR clients to the labor market.

The study will be conducted in two phases and they are explained below:

Phase I: Objectives

1. To compare the labor market and employment experience of clients with that of the general population in the labor force who are in similar employment.
2. To estimate the effect of disability on the labor force participation of VR clients.
3. To examine the impact of disability on employment and earnings of VR clients.
4. To determine the occupational and industry status of VR clients.
5. To determine the extent to which the elements of the work career before disablement affect work adjustment of the VR clients.
6. To summarize work histories of VR clients using mobility as a measure.

Phase II: Objectives

1. To examine employer attitudes, policies and practices.
2. To assess the extent to which the economic disincentives in the public assistance programs inhibit labor market activity of VR clients.
3. To determine the effects of:
   a. Tax Reform Act of 1976—Title II (Discriminatory Taxes)—Architectural and Transportation Barrier Removal—expenses up to $25,000 per year deductible by businesses; and
   b. Tax Reduction Simplification Act (P.L. 95-30)—Tax Credit—60% of the first $4,200 of earned wages of a new employee (handicapped individual)

   on the labor market activity of the VR Clients. And if possible,
4. To examine the influence (adverse or favorable) of labor unions' attitudes and policies toward the employment of VR clients.

METHODOLOGY:

Samples:

Phase I: A stratified sample of 2,000 VR clients, per year, who were successfully closed (status 26) and placed in competitive employment by the State (one of the states in Region III will be chosen

for the study) VR Agency during two select years will be used. The clients will be distributed across six disability categories.

The data to be used will come from three sources.

1. The R-300 Form, the VR Case Service Report, which is used for keeping the records of every client as he/she moves through the VR system from intake to closure.
2. A mail survey to be conducted. A detailed questionnaire will be prepared and mailed to the clients. The questionnaire will be pretested.
3. Statistical reports published by the State and National Bureaus of Labor Statistics for the following labor force statistics in the case of general population (nondisabled) of the State:

   Total population and labor force for the state
   Unemployment rates for the state
   Total annual employment (by sex), by industry: manufacturing, nonmanufacturing, and agriculture
   Labor force, employment and unemployment rate for Small Labor Areas; and Standard Metropolitan Statistical Areas (SMSAs)
   Annual average wages: for the state as a whole; and for counties
   Average weekly earnings by industry
   Average weekly hours worked by industry
   Per capita income for the state

The reason for choosing two years--one of low unemployment and the other of high unemployment--is to facilitate examination of the effects, if any, of the state unemployment level on the labor force participation of the VR clients.

Variables and Measuring Instruments:

Phase I: The following variables will be used and the measuring instrument will be the questionnaire.

Age
Education and Troining
Marital and familial characteristics
Disability (health and physical condition)
Financial characteristics
Employment characteristics
Attitudinal variables
Economic Environment variables
Labor Force participation
Unemployment
Mobility

The data retrieved from the R-300 will be analyzed, and compared to the corresponding labor statistics for the general population (nondisabled) of the State.

Phase II: Some of the variables to be used in this phase are:

Employer attitudes on hiring the handicapped (positive or negative)
Employers' employment policies and practices (equal opportunity employer or discriminatory)
Employers' reaction to the Tax Reform Act and Tax Reduction Simplification Act enacted to help the handicapped in their employment.

FINDINGS TO DATE: Data collection has been the major effort during the current year. Since the approval of this project in May 1979, officials of the State Rehabilitation Agencies within Region III have been contacted to determine the state to be chosen for the study. We are pleased by the enthusiastic responses of both Virginia and Maryland officials. For the only obvious reason that we needed to choose one state, we chose the State of Maryland for the study. Arrangements were made with them to provide us with names and addresses of rehabilitated clients who were successfully placed in competitive employment (status 26) during 1974 and 1975. Of course, due to the large number of clients in status 26, we have chosen a stratified sample of 2,000 clients per

year. The clients will be distributed across the six major disability categories: visual impairments; hearing impairments; orthopedic deformity except amputations; amputations of major and minor members; mental, psychoneurotic, and personality disorders; and other disabling conditions.

A questionnaire for the proposed mail survey has since been devised. A copy of it is appended to this report. Designing the questionnaire took considerable time. Keeping it reasonably short without sacrificing content was a formidable task. Also, the questionnaire was pretested for its reliability and validity. The questionnaire is being mailed out to all the clients whose names and addresses have now been provided by the Maryland Rehabilitation Agency.

APPLICABILITY: The findings of this study should provide a clearer and better understanding of the labor market experience of the severely disabled and the real problems they face in securing employment. Such an understanding would strengthen affirmative action efforts, particularly in the development of alternative employment procedures and also in functioning as consultant/educator to employers on behalf of disabled individuals.

191 National Civil Rights Policy for Handicapped Individuals and the Role of the Rehabilitation Counselor

Principal Investigator:	**Antonio Jones, M.A.**	
Status:	**New**	
Dates:	**May 1980-April 1981**	
Cost:	**Annual $23,064** **RT Annual $14,113**	**Projected Total $15,000** **RT % of Annual Total 61%**
Annual Report Reference:	**#15, Page 414, R-43**	

OBJECTIVES: The following objectives are central to this research project. They will be reflected in a survey questionnaire.

1. To determine the general awareness of civil rights/affirmative action by Vocational Rehabilitation counselors in the United States.
2. To determine the types of activities practiced by Vocational Rehabilitation counselors in civil rights and affirmative action for handicapped people.
3. To determine the role perceptions of Vocational Rehabilitation counselors with regard to affirmative action in their job function.
4. To determine the awareness and practices of Vocational Rehabilitation field services central office supervisor with regard to affirmative action activities of Vocational Rehabilitation counselors.
5. To determine role perceptions of Vocational Rehabilitation central field offices concerning Vocational Rehabilitation counselors.

METHODOLOGY: This project focuses upon two populations in State Vocational Rehabilitation agencies. The first population of interest is all rehabilitation counselors employed by the State/Federal Vocational Rehabilitation programs in the United States. The second population is the field operations supervisor, i.e., the person who is responsible for all counselors in each agency in the United States. In order to determine what rehabilitation counselors and supervisors (a) generally know about civil rights/affirmative action* (b) have been doing in their jobs with regard to civil rights/affirmative action and (c) perceive as the rehabilitation counselor's role in civil rights/affirmative action, the survey questionnaire method will be used. A separate questionnaire will be sent to each counselor and supervisor.

In order to study the counselor a survey design will be implemented. A stratified simple random sample of the counselor population will be used. First, the ten (HEW) Rehabilitation Services Administration regions will be stratified, then a simple random sample of Rehabilitation counselors will be taken from each region. Counselor territory numbers will be selected in this random procedure. Contacts will then be made with the state agencies to obtain the names and office addresses of counselors chosen. This design will allow us to make generalizations about the civil rights/affirmative action oriented activities included in counselor functions and perceptions.

We will survey all 83 supervisors in the various agencies. A survey of the population will be inexpensive and more useful than a sample.

There are approximately 10,454 Vocational Rehabilitation counselors in the 83 agencies administering the Vocational Rehabilitation programs in the United States. The number of counselors per region and the region sample size are reflected in Table 4. It is hoped that these sample sizes will produce estimates of proportion with an error less than or equal to .02.

A questionnaire reflecting specific measurments of the practices and roles will be administered to each randomly chosen counselor. A follow-up questionnaire will be administered after a designated time period and a telephone follow-up will be used as a final attempt to stimulate responses.

In order to understand the perceived roles of the Vocational Rehabilitation counselors, supervisors of counselors must also be surveyed. We will identify the various state agencies in the regions and within each state agency, the field operations supervisor, i.e., the supervisor of all the counselors in the state agency. Three types of agencies will be included in the survey; they are Combined, General and Blind. The distribution of these types of agencies is illustrated in Table 5.

*Civil rights/affirmative action refers to Title V, Rehabilitation Act of 1973, as amended P.L. 93-112. Title V prohibits discrimination in employment and in receipt of services on the basis of physical or mental handicap in the federal government, by federal contract recipients in excess of $2,500, and by Federal grant recipients. Affirmative action refers to a program or plan required by Federal agencies and contract recipients to hire, promote and eliminate barriers in employment. See Table 1 in the Statement of the problem section for a breakdown of Title V as to who is covered and the administering agency.

FINDINGS TO DATE: Survey in progress. Findings will be reported in Spring, 1981.

APPLICABILITY: In the implementation of rehabilitation policy by VR agencies, certain external factors must be considered. These external factors might be viewed as the policy environment of VR. To be sure, there are several policies operating in this environment which may either facilitate the implementation of VR policy, or may cause problems for VR implementation. What we are trying to do here is measure the influence of a specific rehabilitation environmental policy, i.e., Title V of the Rehabilitation Act of 1973, as amended, on the implementation of the VR program. We believe that VR cannot escape this influence of Title V. Trying to understand it may be helpful to both policymakers and VR program administrators.

192 Improving and Evaluating Job Skills Training

Principal Investigator:	**Richard T. Walls, Ph.D.**	
Status:	**New**	
Dates:	**May 1979-May 1982**	
Cost:	**Annual $23,641** **RT Annual $17,332**	**Projected Total $62,000** **RT % of Annual Total 73%**
Annual Report Reference:	**#15, Page 432, R-44**	

OBJECTIVES:

1. **Phase 1** - To review and consolidate established principles of learning and teaching that may be applicable to VR client training.
2. **Phase 1** - To investigate the relationships of such variables to VR client training to determine which teaching procedures result in fastest client learning and fewest errors.
3. **Phase 2** - To prepare a straightforward and easy to follow guide on "How to Train Clients."
4. **Phase 2** - To prepare a straightforward and easy to follow guide on "How to Evaluate Client Training."

METHODOLOGY:

Subjects. The subjects for Phase 1 will be approximately 200 VR clients of varying age, sex, and disabling condition. These clients will be paid volunteers from rehabilitation facilities such as the

West Virginia Rehabilitation Center (Institute, WV), Vocational Rehabilitation Center (Pittsburgh, PA), or selected sheltered workshops.

Design. At least four experiments will be conducted in Phase 1. One comparing whole versus part methods including forward and backward chaining; one comparing tactile, auditory, and visual prompting; one comparing pre-response and response-contingent prompting; and one which compares contemporary training procedures in a rehabilitation facility with selected standard teaching procedures. The dependent variables will be time, trials, and errors.

FINDINGS TO DATE:

Experiment 1 - Abstract

Training methods naturally employed by trainers were analyzed and compared to systematic structured training procedures. Trainers were observed teaching retarded subjects how to assemble a bicycle brake, roller skate, carburetor, and lawn mower engine. Trainers first taught using their own (personal) method, which was recorded in terms of types of prompts given, time of prompts (before or after subject responses), and type of task sequencing (whole task or chaining methods). Trainers were then required to teach by using either a Structured Whole Method (whole task presentation with prompts given for error correction) or Backward Chaining (last parts taught first using prompts to cue subject responding). Three trainers' personal methods consisted of whole task presentation, one trainer used forward chaining, and two trainers used a combination of whole and chaining. The most effective procedure was the Backward Chaining Method, followed by the forward chaining procedure used spontaneously by one trainer, and the combination of whole and chaining methods. The least effective procedure was the Structured Whole Method. Results indicated that the effectiveness of training procedures was due to both the timing of prompts and type of task sequencing.

Experiment 2 — Abstract

The effects of training using tactile (physical guidance), visual (modeling), auditory (verbal instructions) prompting, and a combination of all three methods were compared by teaching vocational rehabilitation clients the construction of four assembly tasks. Clients learned to assemble a movie projector, a carburetor, a bicycle brake, and a lawn mower engine on four successive days by the four prompting methods in a counterbalanced design. Using auditory prompts alone resulted in significantly more time to criterion and total errors than the other three methods. Tactile, visual, and combination prompting methods were not significantly different. Retention data indicated no difference among the four methods, but in a relearning phase, the auditory prompting method again produced more errors to acquisiton.

Experiment 3 - Abstract

The effects of training by whole task, forward chaining, and backward chaining methods were examined in teaching vocational rehabilitation clients the construction of three assembly tasks. Clients learned to assemble a bicycle brake, a meat grinder, and carburetor on three successive days by the three training methods in a counterbalanced design. The percent of responses that were errors was, on the average, more than twice as great for subjects in the whole task method as for subjects in either chaining method (which did not differ). Total time to criterion did not differ among chaining and whole methods. Slower learning subjects benefited substantially from the systematic chaining procedures.

Experiment 4 - Abstract

The effects of training using visual modeling prompts as preresponse and as error-correction prompting and a combination of both procedures were examined by teaching vocational rehabilitation clients the construction of three assembly tasks. Clients learned to assemble a carburetor, a bicycle brake, and a lawn mower engine on 3 consecutive days. On the first 2 days, all clients learned either two tasks by preresponse prompting, or two tasks by error-correction prompting, or one task by each prompting method. All clients learned a transfer task on the third day by error-correction prompting. Preresponse prompting resulted in fewer total errors and more trials on tasks 1 and 2. There were no statistical differences in training time between the two methods, although there was a trend toward less time for preresponse prompting. The combination group demonstrated superior performance on total errors and number of trails on the transfer task. Data for retention and relearning indicated no significant differences.

Experiment 5 - Abstract

Several successful training techniques for teaching complex behaviors to the retarded have included chaining, whole task, prompts, and consequences. However, little has been learned in terms of how these different instructional methods interact with each other – that is, how the use of guidance procedures affect the efficiency of chaining and whole task. The present study compared the efficiency between two pairs of training methods: (1) Backward Chaining-Pre Guidance (working in a backward order and using prompts) versus Backward Chaining-Post Guidance (working in a backward order and using feedback only); and (2) Whole-Pre Guidance (working in a forward order from start to finish and using prompts) versus Whole-Post Guidance (working in a forward order from start to finish and using feedback only). Twelve moderately and severely retarded adults were taught to assemble four nine-part assemblies – a carburetor, bicycle brake, dishwasher pump, and lawn mower engine. Results indicated that pre-guidance procedures were superior to post-guidance in terms of total training time and total errors. This trend favoring pre-guidance was evident for both backward chaining and whole task, and with the moderately and severely retarded subjects as well.

APPLICABILITY: Preparation of a clear, concise, field usable distillation of what is known (and will be discovered) about factors influencing the acquisition, retention, and transfer of skills could have a distinct effect in improving client training practices. Preparation of a clear, concise, field usable guide to evaluation of client training services could allow trainers in and out of VR and other VR personnel to determine what is wrong and right with the training program. If we can significantly improve the efficiency and/or effectiveness of the way we train persons with disabilities, we will have made inroads to improved VR program and practice.

193 Study of the Impact of an Interactive Data Analysis System on State Agency Program Evaluation Functioning

Principal Investigator: Don E. McLaughlin

Status: New

Dates: May 1979-April 1982

Cost: Annual $47,951 — Projected Total $150,000
RT Annual $45,140 — RT % of Annual Total 95%

Annual Report Reference: #15, Page 488, R-47

OBJECTIVES: The objective of this proposed project is two-fold. The first major objective is the development of a computer-based analysis system specifically designed to perform program evaluation functions for state VR agencies. The second major objective is to experimentally investigate the impact of this data analysis system.

The data analysis system itself will, in general, consist of a collection of VR oriented program modules each under the control of an overall main program. This main "driver" program will be responsible for conversing with the program evaluator, determining his data analysis needs, and executing the appropriate set of program modules to satisfy his request. The program modules, however, will actually perform the data management and analysis functions as specified by the evaluator. Generally, these analysis modules can be classified under two broad headings depending on the type of output they produce—tabular or graphic.

A. **Tabular analysis modules.** These program modules will be composed of a set of interrelated programs which generate output in a tabular format similar to that produced by most standard data analysis packages.

B. **Graphic analysis modules.** One axiom of information representation is that it should be displayed in the simplest and most concise manner possible without sacrificing the content of display. Probably the most effective means of meeting this criterion is through the use of graphic display. Although manual techniques for graphic production are typically costly, appropriately equipped computers can graphically represent information at minimal costs. Thus, the second set of system modules will be designed to produce the results of data analysis in graphic form.

METHODOLOGY: This project will consist of two major phases. The first phase will be the design and implementation of the interactive data analysis system for use in VR program evaluation. The second major phase will consist of an experimental assessment of the impact of this system on the functioning of the state agency program evaluation units.

Phase I

The system design phase of this project will be composed of two basic steps. The first step covers a questionnaire development and implementation to assess the computer-based program evaluation capabilities and needs of rehabilitation agencies across the country. Through an analysis of the responses to this questionnaire, general specifications will be developed delineating a model of the types of rehabilitation-program evaluation computer support systems that would most facilitate, in principle, the largest number of agencies.

The second step will be the design and implementation of the basic interactive data analysis system. The guidelines for this design will come from two sources—the information obtained from the agencies and the Research and Training Center's previous work with the RSA-300, for which software is already partially developed. This will provide the foundation on which to build the computer support system.

Phase II

As stated previously, the second major phase of this project will consist of an experimental determination of the impact of this system on program evaluation functioning. The subjects for this study will be six state agency program evaluation units from nearby states. The program evaluation units will be selected on a voluntary basis and the requirement for their participation is that they will periodically complete and return questionnaires assessing the dependent variables.

The dependent measure will consist of a questionnaire specifically designed for this study. It will be designed to assess several factors associated with program evaluation functioning. For example, the participating agencies will be asked to provide information on such things as the mean turnaround time required for the completion of a data analysis request, the mean time required from the time that an information need arises and the time it is satisfied, the number of new evaluation studies initiated, the evaluator's satisfaction with their computer supports, etc. The questionnaire will also assess changes in the program evaluation unit staff's willingness to interact directly with a computer system.

The study will be implemented as a multiple baseline design across agencies. That is, all of the program evaluation units will be asked to complete and return the questionnaires on a monthly basis for the duration of the study. The first six months of this phase of the study will be a baseline period during which none of the program evaluation units will have access to the data analysis system. They will, however, return the completed questionnaires during this time period. At the end of the six month baseline two agencies will be allowed access to the system via a terminal at or near their installation. Thereafter, at three month intervals, two additional agencies will be brought on line with the system. Thus, at the beginning of the twelfth month of the study the last two agencies will be given access to it. This observation period will, then, continue for an additional three months. Therefore, barring any unforeseen circumstances, the experimental phase of the project will last for a total of fifteen months.

The results of this study will be analyzed by plotting the agencies' responses to the questionnaire item in relation to their access to the system. Thus, in this manner, each agency will serve as its own baseline in determining the impact of this computer system on its program evaluation functioning.

FINDINGS TO DATE: The project efforts, to date, have primarily been in two major areas. The first is the installation and familiarization of the computer system. While the procurement process for the R and T center computer system proved to be considerably longer than originally expected, it was delivered and installed during the later half of this project year. The physical configuration of this computer system is composed of a PDP 11/60 central processing unit with 256 K bytes of MOS memory, two RK07 28 Mega byte disk storage units, one 800/1600 bit per inch magnetic tape transport, one hardcopy terminal operator's console, two alphanumeric CRT terminals, one graphic CRT terminal, one Hewlett-Packard four-color incremental plotter, and one Printronix 300 line per minute printer plotter. This hardware configuration is shown graphically in Figure 1.

In addition to this arrangement of computer hardware, the computer system also contains a vast array of software. This software will provide the tools necessary for the project to design and implement the system prescribed by this project. This includes such programs as operating system utilities for the use of system manager and the user and several high-level languages such as Basic, Basic-Plus-Two, and Fortran IV. This software package also contains a data-base query-information retrieval language called Datarieve. Due to the complexity and volume of systems and applications development software available on the R and T Center computer system, much of the available time during this project year has been devoted to the familiarization of the computer system by the project staff. The primary vehicle for this training has been through in-house workshops conducted by members of the R and T Center staff. That is, each week a member of the center staff would be assigned to select a particular aspect of the computer system software and become as knowledgeable as possible in this area by studying the software documentation and by practice in using the system itself. Then, after becoming comfortable with it, this staff member would then conduct a training session of approximately one hour's duration to acquaint the remainder of the staff with the system. Also, many of the system's programs contain a "HELP" facility which allows the user to obtain online information regarding the use of that particular program. This approach appears to have been particularly effective in familiarizing the project staff with the use and capabilities of the Center's computer system. It is believed, however, that due to the scope and complexity of the area, it will be several more months before the project staff become thoroughly familiar with all aspects of the system's capabilities. This should not inhibit in any way the future progress of the project, however.

Recently, work has begun on the second major area of activity alluded to earlier. That is, the development of the overall design philosophy for the data analysis system to be developed. While this activity is in a preliminary phase, certain design considerations have been established. Some of these are listed below:

1. The use of the program evaluator's data system will be through an interactive or conversational mode as opposed to a batch orientation. This should provide the evaluator with quicker turnaround for analysis requests and instantaneous error checking and correction.

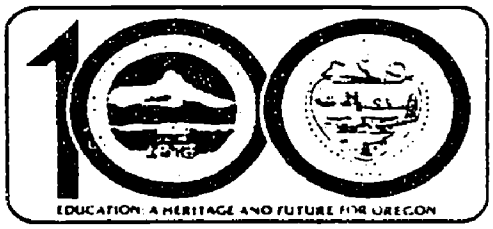
2. All dialogue between the user and the evaluator will be expressed, to the extent possible, in the terminology of the program evaluation and specifically that of vocational rehabilitation. This will allow the evaluator to define a problem in his own language rather than having to reconceptualize it for the benefit of the computer.

3. The data analysis system will separate data definitions and format specifications from the information requests. That is, while the user may, through a dialogue with the system, define his data file, it will not be necessary to do so each time that data base is used since that system will be capable of storing at the user's request the data definitions for subsequent use. Furthermore, certain standard file formats, such as the R300, will be prestored and available to the user; thus, eliminating the need for the evaluator to go through the data base definition process altogether in some cases.

4. The data analysis system will be developed in a modular fashion. In this manner, the inclusion, exclusion, or modification of particular modules should not substantially affect the performance of other modules in the system. This will also allow the system development to procede utilizing "top down" structural programming. This approach should considerably facilitate the speed and accuracy with which the system software is developed. (Davis, 1977)

While the items listed above provide some general goals around which the system will be designed, mechanisms must be found for implementing these goals. Item number three, for example, is concerned with freeing the evaluator of most of the responsibility for describing the record layouts and data elements for a file of interest. To accomplish this, it will be necessary for the program to use stored data format descriptions and still maintain the flexibility required to tailor the analyses to the evaluator's requests. Work is currently being initiated to test various approaches to this and other design objectives. This, then, will provide a means by which the system may be optimized in terms of both efficiency and flexibility.

APPLICABILITY: The goal of this project is to determine the data analytic needs of program evaluation in vocational rehabilitation and development of computer support software to meet these needs. Results of this project should aid program evaluators and vocational rehabilitation managers in assessing program performance and making decisions which might facilitate the vocational rehabilitation process.



University of Oregon (RT-16)
Mental Retardation Rehabilitation Research and Training Center

CORE AREAS

Program Related Assessment

The development of client assessment strategies and specific instruments that measure the behaviors of mentally retarded adults that are critical determinants of their potential for community adjustment.

Professional Growth and Development

Activities aimed at improving understanding of the major roles and functional demands of supervisory and management personnel in rehabilitation agencies; e.g., staff development specialists, rehabilitation educators, and first-line supervisors of rehabilitation counselors.

UNIVERSITY OF OREGON

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COMPLETED

CONTINUING

NEW

194 Predicting Rate of Acquisition and Production of Complex Industrial Tasks by Institutionalized Moderately and Severely Retarded Adults

Principal Investigator: Larry Irvin, Ph.D.

Status: Completed

Dates: July 1974-July 1980

Cost: Annual $10,998 — Projected Total $185,000
RT Annual $10,998 — RT % of Annual Total 100%

Annual Report Reference: #14, Page 60, R-31
#15, At Press, R-31

OBJECTIVES: To revise the Trainee Performance Sample in order to:

1. increase the range of appropriate examinees to include individuals classified as low-moderate mentally retarded, as well severely/profoundly retarded;
2. establish content/construct validity—that is, to sample within the test in a systematic fashion, type of task and type of instruction dimensions; and
3. examine thoroughly the reliability and concurrent validity of the revised scale;
4. establish the criterion-related validity of the TPS for illustrating subsequent training needs of examinees.

METHODOLOGY: A content grid was developed to guide TPS revision. The three components of the grid were type of instruction, task attributes, and number of objects involved in the task. Three different types of item instructions—model/match-to-sample, physical prompts, and verbal directions—were systematically integrated into revised TPS items. These instructional strategies are the three types of training procedures commonly employed in vocational training for severely retarded adults. The task attributes—minimal difference, coordinated two-hand movement, if-then rule, sequencing, conjunctive stimulus control—evolved out of contemporary thinking regarding task analyses of vocational tasks. These seem to serve well as difficulty descriptors for vocational tasks. The third dimension of interest in TPS revision was number of objects within each task. This component has less of a theoretical rationale; rather, it serves to guarantee a variety in types of test items, e.g., physical manipulation without objects as well as more difficult tasks with one or two objects. Via use of the grid as a blueprint for item generation or revision, a total of 30 revised or newly developed items were field tested.

One hundred forty-nine adults classified as profoundly retarded, severely retarded, or low moderately retarded were identified as project participants in May 1978. Selection for participation was based on facility willingness to participate. All 10 facilities that were initially contacted agreed to be involved; eight were community-based work facilities and two were institutions—one state and one private. Fifty-four percent of the individual participants were enrolled in community work activity centers and 46% in residential institutions. A sample of 26 community-based participants was retested two weeks after the original test.

Concurrent validity of the revised TPS was also ascertained. A Supervisor's Checklist was developed with items relevant for severely/profoundly retarded workers. Four major categories of work behaviors commonly correlated with vocational success were used as guides to item development: stability of worker's performance, ability to follow instructions, social/cooperation and peer relation skills, and coordination and physical dexterity skills. Each item was a behavioral statement such as, "Responds to simple verbal directions without requiring further assistance." or "Performs tasks which require the use of a hand tool, such as a screwdriver, with minimal assistance." Each statement was followed by a 3-point rating scale, most of which involved frequency ratings ("usually or always," "sometimes," "seldom or never"). Supervisors' ratings of retarded workers on the Supervisor Checklist were then correlated with revised TPS scores.

In addition to applications with institution- and community-based individuals, it was important to examine the utility of TPS with younger (adolescent) severely/profoundly retarded persons to determine whether as age (and relevant experience) decrease, TPS remains sensitive to vocational skill differences among retarded individuals. Accordingly, a large secondary-level educational service district in the Eastern U.S. (services to 19 school districts) was selected on the

basis of widely available and willing participation of severely and profoundly retarded adolescents. Students' classification as severely or profoundly retarded by the school district was on the basis of IQ/SQ, adaptive behavior, and institution referral records. Ages of these participants ranged from 12 to 22, with mean, median, and mode between 17.0 and 17.5. TPS tests were administered by qualified psychological services professionals within the education service district to project participants.

Finally, a subset of 75 of the 149 standardization examinees was identified as participants for a criterion-validation investigation of the TPS. This study involved training the examinees to successfully complete two prototype vocational tasks—sorting solderless wire terminals by shape and assembling a 6-part cable connector—and then correlating training time, trials and errors with TPS scores. Standardized training and scoring procedures, derived from contemporary training technology, involved step-by-step verbal instructions, models, and physical prompts from trainers, and repeated practice on steps where trainees made errors. In this way, the criterion-related validity of the TPS could be examined for illustrating subsequent training time and resources required by examinees.

FINDINGS TO DATE: Results indicated adequate psychometric characteristics for the revised TPS. Mean difficulty level was 59% correct for the total sample of 149 examinees. The standard deviation was 15.6. Item to total test correlations were also computed for each item. These Pearson r's ranged from .20 to .78, with 21 items having such item validity indices in the .50 to .69 range. Coefficient Alpha internal consistency reliability for the 30-item revised TPS was r_{cc} = .95. Test-retest reliability was r=.92 for N=26.

Data-based measures of appropriate TPS content/construct validity also emerged from 1977-78 project activities. One index was the disparity between scores of institutionalized and community-based examinees. Experiences related to TPS tasks are clearly more readily available in community workshop/activity center settings than in typical institutional prevocational training programs. The revised TPS appears quite sensitive to these experience-related effects; the mean total revised TPS score for 81 institution residents was 71% correct, while that for 68 institution residents was 45%.

The second major data-based outcome related to content/construct validity involved the potential utility of subscales within the revised TPS. As would be predicted, the 10 items which were presented with verbal instructions only were more difficult for all TPS examinees than were the 20 items presented with verbal plus modeled and/or physically prompted cues. The average percent correct was 56% on verbal only, 60% on verbal plus modeled, and 61% on verbal plus modeled and physical prompts. As with total TPS scores, community-based examinees scored substantially higher than institution residents on each "subscale."

The results of the concurrent validity study indicated that the relationship between all institution residents' revised TPS scores and Supervisor Checklist scores was r=.60 (N=68), while that for all community-based participants combined was r = .64 (N = 81), indicating moderately high agreement between TPS scores and supervisors' perceptions of retarded workers' skills/performance.

Additionally, on all important dimensions—difficulty, variability, and reliability—the revised TPS appears psychometrically adequate when used with severely/profoundly/retarded (SPMR) adolescents. Total scale average difficulty level was 38% correct. When considered in the context of previously described data regarding TPS difficulty ($\bar{x}$=71% correct for 81 SPMR community residents, and $\bar{x}$=45% correct for 68 SPMR institution residents), the difficulty of TPS for SPMR adolescents is as predicted, i.e., most difficult for those who would be expected to be lowest functioning because they are younger and less "vocationally" experienced.

The relative difficulty of TPS subscales, "verbal instructions" only vs. "verbal plus modeled instructions," is also as predicted. That is, items with verbal instructions only were most difficult ($\bar{x}$=30% correct), items with verbal and modeled instructions were next most difficult ($\bar{x}$=39%), and items with verbal plus modeled and prompted instructions were "easiest" ($\bar{x}$=55% correct).

The Coefficient Alpha internal consistency reliability estimate for the revised TPS with the Pennsylvania adolescent sample was r_{cc}=.92. For the three subscales, Coefficient Alpha internal consistency reliability estimates were: verbal instructions only—r_{cc} =.76; verbal plus modeled instructions—r_{cc}=.86; verbal plus modeled and physically prompted instructions—r_{cc}=.81.

The major results of the TPS criterion-related validity study confirmed that the TPS is a valid predictor of subsequent vocational training performance of examinees. Validity coefficients were moderately high (r's ranged from -.57 to -.68) between TPS total scores and subsequent performance by examinees on the two different training tasks. The negative correlations are appropriate in that as TPS scores were higher, subsequent training required fewer trials, errors and time.

Essentially, these results suggest that TPS scores can be used as indicators of likely training resources required by individual examinees. That is, the higher the TPS score, the easier it will be to train examinees with less one-to-one trainer time, and the more likely it is that verbal instructions, as well as modeling and prompting, will work effectively as training tools. Conversely, low scorers on the TPS will clearly require maximal one-to-one trainer attention, repeated training trials and modeled and physically prompted instructions and corrections.

APPLICABILITY: The utility of the type of vocational assessment information provided by the TPS is high for placement and instructional design decisions regarding severely retarded adults. High scorers on the TPS are good candidates for commonly available sheltered workshop and activity center settings. Low scorers, on the other hand, cannot be expected to achieve habilitative vocational skills outside of a training environment where maximal assistance is always available. Acquiring and using such information prior to placement would enable an habilitation specialist to enhance the likelihood of **appropriate** vocational training for all severely retarded individuals.

The need and demand for such an instrument as the TPS is clear. Recent efforts toward deinstitutionalization and normalization of severely retarded adults have created an increased need for assessment instruments to assist in placement and programming. An instrument such as the TPS is especially appropriate because of its focus on assessment of approximate rate of acquisition and necessary levels of client training.

The findings of this project should yield three major implications for practice changes. First, they will provide vocational trainers with a behavioral assessment of performance on specific task criteria rather than a global assessment of work abilities. Second, they will produce a validated set of predictor variables which could increase the accuracy of significant managerial decisions. And third, they will stimulate vocational opportunities for a population not previously considered as potential candidates for sheltered workshops.

195 Validity Study on an In-Service Training Impact Instrument

Principal Investigators:	**Philip Browning, Ph.D.** **Barbara Ayers, Ph.D.**	
Status:	**Completed**	
Dates:	**March 1975-December 1979**	
Cost:	**Annual $17,477** **RT Annual $17,477**	**Projected Total $165,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#14, Page 144, R-35** **#15, At Press, R-35**	

OBJECTIVES: The purpose of this study was to investigate the validity of a follow-up instrument designed to measure the effects of training. Specifically, the two major research questions were:

1. Do training participants' change responses to the TEK follow-up instrument correspond with the documentation of those responses via personal interview?
2. Do training participants' change responses to the TEK follow-up instrument (as well as the same instrument administered via personal interview) correspond with their supervisors' ratings of trainee change?

METHODOLOGY: The instrument examined in this study is a component of the **Training Evaluation Kit** (TEK) developed at the University of Oregon. The Follow-up Evaluation Booklet (FEB) is primarily a YES/NO self-report form with question items subsumed under the headings of Professional Development and Professional Practice. These items pertain to job-related behavior changes attributable to training.

The subjects for this study consisted, in part, of 63 trainees of four short-term in-service training programs designed for rehabilitaton practitioners. Additional subjects were 22 supervisors who were directly responsible for these persons.

Three steps were implemented for data collection. First, the participants who attended the four workshops received FEB via mail three to six months after training. The purpose was for them to indicate job-related behavior changes which they attributed to their training experience. Second, the participants who completed and returned FEB were interviewed via telephone. The purpose was to verbally administer the same instrument in order to address agreement of response over time **and** to elicit documentation of all YES responses to determine if there was substantial evidence to warrant their change response(s). Finally, the supervisors of the in-service training participants received a comparable FEB instrument via mail. The purpose was to elicit their independent judgment of trainee change (i.e., their supervisees) with respect to the same YES/NO job-related change items.

FINDINGS TO DATE: Correlations between trainee responses to the FEB via mail and the FEB via phone interview were significant at $p \leq .001$ for Professional Development items, Professional Practice items, and Total Test items. Percent of agreement analyses yielded values of 84, 71, and 78, respectively for these three sets of items. In addition, trainees were able to substantially document YES responses during the interview with concrete examples of behavior change(s).

Correlations between trainee responses to FEB via **mail** and supervisors' judgment of change in their supervisees were significant at $p \leq .01$ for Professional Development items, non-significant for Professional Practice items, and significant at $p \leq .05$ for Total Test items. Percent of agreement analyses yielded values of 76, 63, and 70, respectively for these three sets of items. Finally, correlations between trainees' responses to FEB via **phone interview** and the supervisors' judgment of change in their supervisees were significant at $p \leq .01$ for Professional Development items, Professional Practice items, and Total Test items. Percent of agreement analyses yielded values of 81, 68, and 74, respectively for these three sets of items.

APPLICABILITY: For the past seven years, the training staff of the University of Oregon Rehabilitation Research and Training Center have been involved in the evaluation of short-term training. The result of this effort is the development of Training Evaluation Kit (TEK). TEK is designed to obtain information on both training process and impact. The process areas of concern are training objectives, methods, and immediate outcome. This evaluative information is used for decision-making directed toward program improvement. The areas delineated for training impact are professional development, professional practice, and information dissemination and utilization. This evaluative information is used to determine accountable change due to training.

This study was intended to further examine the psychometric properties of the TEK Follow-Up instrument which is designed to measure the long-range effects of short-term training. The results lend further support for its usage.

196 Pilot Study on Overdependence in Mildly Retarded Adolescents: A Structural Family Therapy Analysis

Principal Investigators: Philip Browning, Ph.D.
Beth Hunt, Ph.D.

Status: Completed

Dates: October 1977-February 1980

Cost: Annual $12,198 — Projected Total $12,198
RT Annual $12,198 — RT % of Annual Total 100%

Annual Report Reference: #14, Page 104, R-45
#15, At Press, R-45

OBJECTIVES: The purpose of this study was to investigate the relationship between parents and their adolescents in families of independent and overly dependent mildly retarded adolescents. Specifically, the objectives of the study were:

1. To determine if a set of identified behavior variables comprise any family interaction patterns (the relationship between adolescent and parent) with overdependence and independence in

mildly retarded adolescents; and

2. To determine if a set of identified behavior variables comprise overdependence and independence in mildly retarded adolescents or their respective parents.

METHODOLOGY: Three independent and three dependent subjects were chosen for this study from a pool of 49 mentally retarded adolescents (ages 16-21) living with their family of origin. They were selected on the basis of concurring with all five criteria measures related to whether the subjects were dependent or independent: (1) counselor/teacher judgment based on a set of dependent/independent criteria; (2) extreme scores (high-low) resulting from the Highlands Dependency Questionnaire, which was administered to the mother; and (3) the independent judgment of each of three family clinicians using a 4 point Likert scale.

Each subject and his/her mother wos asked to engage in a 20 minute Family Problem Solving Task which consisted of agreeing upon planning an outing (what, where, when, how long, and what preparation?). Each 20 minute Family Task was videotaped. These videotapes were then subjected to an interactional coding system.

The Marital Interaction Coding System (MICS), which has been adapted for use with adolescents and their family members, is designed to sequentially code all verbal and non-verbal behaviors in a problem-solving setting. The system is comprised of 28 behaviors which, based on prior research, can be clustered into the following five behavioral domains: (1) Problem-Solving; (2) Positive Verbal; (3) Positive Non-Verbal; (4) Negative Verbal; and (5) Negative Non-Verbal.

FINDINGS TO DATE: Both research questions, one and two, were addressed by subjecting the data to a frequency/percentage analysis across the behavioral domains derived from 28 specific coded behaviors: (1) Problem Solving; (2) Positive Verbal; (3) Positive Non-Verbal; (4) Negative Verbal; and (5) Negative Non-Verbal. The following reflects the results of this analysis.

The results indicated that for each of the two research questions it was possible to differentiate behavioral patterns. In all cases, these differences were reflected in the rate of occurrence of behaviors rather than types of behavior, since the independent ond dependent adolescents and their respective mothers were assessed on the same behavioral domains.

One pronounced behavioral characteristic of the independent versus dependent adolescents was that they participated more actively in the problem-solving task. In addition, they did virtually the same rate of problem-solving as did their mothers. One could interpret this balanced reciprocal exchange as indicating equality between one adult and one emerging adult. By contrast, dependent adolescents did less problem-solving than did their mothers in their interaction. In essence, they choose to be or were put in the position of being more passive while their mothers "took over" the problem-solving activity.

Another behavioral feature of the independent adolescents was that they had a greater rate of both positive and negative verbal behaviors when compared to the dependent adolescents. In addition, their rate of verbal behavior was greater than their mothers' By contrast, the dependent adolescents' rate of verbal behavior was less than their mothers'.

APPLICABILITY: An interpretation of the findings within a family systems model would suggest that certain transactional patterns between mothers and adolescents are repeated time after time. These transactional patterns become the accepted, actually preferred mother-adolescent interaction patterns. In fact, the interaction patterns reoccur so often that they are considered to be the "way of being" for the individuals involved. For example, mothers of dependent mildly retarded adolescents repeatedly take over the problem-solving while the mildly retarded adolescents assume the more passive, non-assertive role.

It is the author's premise that dependence is, at least in part, related to family behavior patterns. Therefore, it seems reasonable to suggest that families can constructively foster greater self-reliance in their mildly retarded adolescents. That is, since the family contributes to the dependence of its mentally retarded member, that same family should be able to encourage its mentally retarded member's independence.

One particularly productive approach to treating dependence in families of the retarded may be structural family counseling. The model of structural family theory makes the following assumptions: (1) certain types of family organization are closely related to the development and maintenance of problems of family members; and (2) family members' problems (e.g., over-

dependent adolescent) play a major role in maintaining family patterns. In regard to the second assumption, the role of maintaining family patterns becomes in and of itself an important source of reinforcement for the primary client's problems.

Traditionally, the presenting problem has been viewed as the **client's** problem, and only the client was treated. Within the system's approach of structural family counseling, it is assumed that the problem is maintained within the family context. Therefore, the **entire family** is seen in counseling sessions. The change in focus from the problematic client to the problematic family has implications regarding both the nature of the problem and therapeutic intervention.

Of course, the qualities of independence and dependence are not restricted to family interactions. A person carries his preferred transactional behavior pattern into other settings and other relationships, e.g., classroom, work, counselor-client sessions, etc. In those settings, it is important for the teacher/work supervisor/counselor to be cognizant of the student/employee/clients' preferred transactional behavior. Such awareness may minimize their participation in the person's dysfunctional transactional behaviors such as dependency.

197 Utilization of the Social and Prevocational Information Battery (SPIB)

Principal Investigator: Larry Irvin, Ph.D.
Status: Completed
Dates: March 1978-June 1979
Cost: Annual $6,661 — Projected Total $23,000
RT Annual $6,661 — RT % of Annual Total 100%
Annual Report Reference: #14, Page 43, R-49

OBJECTIVES:

1. To ascertain ways in which SPIB is being utilized by a representative sample of users across the country with respect to:
    a. student/client diagnosis and classification;
    b. individual program planning;
    c. program monitoring; and
    d. program evaluation.
2. To update and improve the SPIB test materials.
3. To provide the basis for the content of a campus workshop on SPIB utilization.

METHODOLOGY: **Sample selection.** CTB/McGraw-Hill records of SPIB distribution and sales from September, 1975, to October, 1977, indicated that SPIB was being purchased by school districts and a variety of other educational and rehabilitation agencies nationwide. These records also showed that the smallest purchase order by a single SPIB user was 20 tests and the largest was 10,000.

Further examination of the distribution and sales data resulted in the identification of two broad dimensions that could be used to describe the SPIB-purchaser population. First, by the 10 federal regions that described their geographical location. Secondly, according to the size of their SPIB test booklet purchase orders: 20-40, 60-80, 100-200, and more than 200 test booklets.

After classification by geographical region and purchase order size, a stratified random selection of one-third of all SPIB purchasers was completed. Via this process, 204 school districts and rehabilitation/education agencies that had purchased SPIB were identified as potential participants. Ten other locations of special interest because of large purchase orders were later added, increasing the sample to 214 sites.

Telephone calls were made to each potential site. If a potential site chose not to participate, replacement procedures were effected to locate another equivalent site. Successful location of sites was followed by letters to further explain the project objectives and to request a listing from the contact person of all people who had actually administered SPIB.

Questionnaire development and distribution. A questionnaire on SPIB utilization was developed to solicit a variety of information from SPIB users. Questions were formatted to require only checkmarks in response, and to provide space for additional comments.

Questionnaires were mailed to each of the 686 individuals who had been identified as SPIB users in the 214 locations sampled. Recipients were asked to fill out the questionnaire and return it in a stamped, addressed envelope provided along with the questionnaire.

Data analyses. Using the sampling stratification categories, data were classified and analyzed by respondents' geographical region, by test booklet purchase order size, and by job title of respondent.

In summary, the sampling process produced 285 completed questionnaires from 95 locations scattered throughout the 10 regions of the country. Of the 686 potential participants, 227 were determined to be inappropriate recipients of the questionnaire for two reasons. First, though some had purchased SPIB, they had not used it. Secondly, some had not heard of SPIB, though their employment location had purchased some SPIB materials. As a result, the return rate from appropriate questionnaire recipients was 62%. Approximately 55% of the **locations** where SPIB actually had been used were represented by the 285 returns. The return rate varied from 35% to 75% by region. Of the 40 sub-sample groups identified by region (10) **and** purchase size (4 levels), only 2 were unrepresented after all questionnaire returns. In one case there were 3 potential participants and no returns, and in the other there was 1 potential respondent who did not complete a questionnaire.

FINDINGS TO DATE: **Student groups assessed with SPIB.** Analysis of responses to the first three items of the questionnaire revealed that SPIB has been administered to a variety of student groups, differentiable by grade level, handicapping condition, and ethnicity. With respect to grade level, SPIB has been administered more often to students in grades nine and above than to those in grades eight and below. This is not surprising because SPIB was developed to be administered primarily to mildly retarded (EMR) secondary level students in work-study programs.

Most of the respondents (94.9%) said that SPIB had been administered to mildly retarded (EMR) students, and 37.7% indicated that learning disabled students were often assessed. About 20% of the respondents indicated that SPIB had been used with moderately retarded (TMR) or emotionally handicapped students. (An experimental version of SPIB for moderately retarded or TMR students was developed in 1977. Named "SPIB - Form T," it will be published by CTB/McGraw-Hill in 1979.)

Four other handicapped student groups have also been tested occasionally with SPIB. In order of descending frequency, these groups were physically handicapped students tested by 53.2% of the respondents, cerebral palsied students (43.4%), deaf students (18.4%), and visually impaired students (6.6%).

Program planning at the individual group level. Although more than one-half of the respondents (56.1%) answered that the **SPIB User's Guide** had been used in general program planning and development, an even higher proportion (67.1%) reported that SPIB materials had been used satisfactorily to help develop Individual Educational Programs (IEPs) for students. For example, SPIB was widely accepted for IEP-related uses in several ways: as an aid for gaining parent participation in the development of programs (70.0% of the respondents so responding); in justifying placements or documenting student needs (61.6%); in identifying student's academic goals (85.3%); in writing short-term objectives (87.4%); and in helping to select, develop, or modify materials to meet IEP objectives (60.2%). SPIB test results or content definitions were not typically used to help revise IEPs **between** annual IEP meetings. Further, only 47.8% of the respondents answered that SPIB information had been used in making **annual** revisions or evaluations of student's IEPs. In concluding the questionnaire about IEPs, many respondents suggested that additional materials, such as curriculum guides, would make SPIB an even more useful tool in helping to complete the IEP development and implementation process.

Selecting and development materials in SPIB domains. Close to half of the respondents answered that SPIB test results or content definitions had been used to select (48.0%) or develop (49.8%) curriculum materials for programs. When asked in what specific areas materials had been developed, respondents noted relatively high activity in all SPIB domains. Materials were most often developed in the areas of Banking, Job Related Behavior, Budgeting, and Job Search Skills, and least often developed in the areas of Health Care and Home Management.

Most of the total respondent group noted that their interpretations of SPIB results for program evaluation had been very or moderately useful (29.3% and 62.1%, respectively). Only 8.6% said

their applications of SPIB for program evaluation had been slightly useful.

Technical concerns in SPIB utilization. The percentages of respondents who reported finding ambiguous test items or items too difficult for students because of vocabulary, syntax, content, or concepts is low, ranging from 22% to 35%. In very few cases was the same item identified by three or more people to be problematic. Overall, SPIB's answer formatting was considered to be appropriate; there were few people, less than 10%, who were in favor of changing the present "True-False" format to "Right-Wrong." In general, SPIB tests do not typically take longer than 20 minutes to administer, and most respondents felt that oral administration of the test was appropriate. In each of these areas, then, the finding has been that most respondents have found SPIB to be quite appropriate and satisfactory for the student groups they normally test.

Close to half of the respondents (43.7%) reported similarity between the reference group performance norms presented in the **SPIB User's Guide** and the performance of their own students. About 10.3% found the **User's Guide** norms to be **lower** than their own students' performance. 28.1% found these norms to be **higher** than their students' performance, and 17.9% reported that the **User's Guide** norms had not been considered

Future needs with SPIB. One of the final questions presented in the SPIB Utilization Questionnaire asked about the desirability of developing a **SPIB User's Information System** and about the types of information SPIB users would like to have available. Respondents rated all of the following six possible sources of information as "very" or "moderately" useful: (1) SPIB-related curricula developed by other schools and/or districts; (2) commercially available SPIB-related curricula identified by other SPIB users; (3) SPIB norms made available from other similar size school districts; (4) IEP development procedures in SPIB domains; (5) additional needs assessment procedures for SPIB; and (6) program or student evaluation procedures in SPIB domains.

APPLICABILITY: Rehabilitation policy setters have long believed that vocational objectives for mentally retarded clients cannot be accomplished in the absence of social and community adjustment. SPIB diagnostic results provide rehabilitation service providers with specific and appropriate information for developing client objectives in social and prevocational domains.

198 Sociological Look at Retarded Persons' Perceptions of the World of Work

Principal Investigators:	**Philip Browning, Ph.D.** **Ray Nelson**	
Status:	**Completed**	
Dates:	**March 1978-February 1980**	
Cost:	**Annual $8,515** **RT Annual $8,515**	**Projected Total $15,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#14, Page 275, R-51** **#15, At Press, R-51**	

OBJECTIVES: The purpose of this study is to conduct a sociological inquiry into the world of competitive employment from the perspective of mentally retarded persons. Specifically, sociological qualitative methodology will be employed to implement the following objectives:

1. to investigate the potential influence of four areas upon mentally retarded persons' perceptions of the world of work. The four areas or factors which may influence retarded persons' perceptions are family interaction, peer interaction, job interaction, and social/leisure interaction; and
2. to search for theoretical assumptions and paradigms which will enable us to better understand the impact of being a retarded worker in this society.

METHODOLOGY: Thirty-three mildly retarded persons were selected from a pool of over 250 such persons who participated in a job search skills program funded by CETA and the Oregon Association for Retarded Citizens. Twenty-eight subjects comprised the final sample.

Each subject was interviewed on five separate occasions. The interviews were conducted using five in-depth focused interview schedules related to the content areas of (1) Basic Information; (2) Work; (3) Family; (4) Social and Leisure Interaction; and (5) Peers and Daily Interaction.

FINDINGS TO DATE: A total of 140 taped interviews (46 ½ hours of listening time) were conducted with 28 mildly retarded adolescents over an eight-month period. Extensive "field notes" were taken throughout this process to supplement the data bank. The data was subjected to both quantitative and qualitative analysis. The following narrative reflects a sample of the findings.

Generally the subjects perceived their work as do most persons on the lower end of the occupational structure. A job, any job, is in some small measure a badge of independence, a symbol of a normal adult existence. Although many of the subjects (36%) had been laid off or fired they could handle any job they were given. The subjects had a fairly unrealistic expectation of what they could expect from a job, however. Many men resented close supervision and looked forward to a time when "they could be boss." More women than men enjoyed their work and were contented with it. The other major response of the women who worked or were planning to work was that they saw a job as a chance to get out of the house and meet people, and also as a transition to marriage. Both men and women did not cope well with stress situations. If a co-worker was bothering the subject, he or she would often walk off a job rather than cope with the situation. Also, many of the subjects had been fired for social reasons; showing up late, taking unannounced breaks, or yelling at supervisors or co-workers.

Families tended to either have very positive or very negative influences on the subjects. The subjects with very positive family influences tended to have very stable family backgrounds where one or both parents work full-time. The parents provide positive work-oriented role models that develop in the subject's good social job skills (i.e., being on time, dressing neatly, and working steadily). This family type was more involved in the subject's general welfare and will act as a benefactor (vis a vis Edgerton). The subjects with very negative family influences tended to come from rural poor backgrounds and from very large families in which neither parent has full-time employment. Subjects from these background tended to be employed less often and for a shorter amount of time.

The peers of the subjects were usually from two categories: family and friends met at school. The family was the most important source of the subject's peer interaction. Often the subject moves from the role of son/daughter to wife/husband without significant social contact in between. Few of the subjects had continuing friendships from their school days.

In the area of social and leisure interaction, the subjects were generally very passive. Television was by far the most popular form of entertainment. Some subjects watch a baseball game or go bowling, but most stay very close to home. There were two exceptions to this. A few of the younger men like to "hang out," drink beer, ride around in cars, and sometimes smoke marijuana. Also some of the younger women enjoy professional wrestling, both on television and live shows.

The following select statements pertain to the general findings derived from the job-related interview schedule. The subjects described many reasons why they had difficulty finding jobs. Transportation and insufficient experience and training were most often mentioned. Few of the subjects drove and even fewer own an automobile. Bus service was available, however, many subjects complained about complicated bus schedules and the necessity to reach outlying areas. Subjects also stated that they felt they did not have the experience or training for jobs they would apply for. Fewer subjects stated they could not read or had great difficulty reading job postings and newspapers. A few subjects stated that speaking on the phone or understanding persons gave them great difficulty in finding work. Two subjects gave medical reasons as the biggest problem in finding work and one subject complained that the area had no jobs in which he was interested. Generally, the subjects felt they were paid well enough for the work they did. Many at the same time complained that they had financial problems and did not make enough money at their job. More men than women expressed that they were not being paid well enough for the work they were performing. Generally, the subjects' perceptions of co-workers was one of peers who accepted them on the job. The subjects' perceptions of co-workers would vary with their perception of the job as a whole. That is to say, if the job was going well or if it was one they liked, the tendency was to view their co-worker in a favorable light.

APPLICABILITY: Such knowledge has the possibility of enhancing our methods for improving the work role for retarded people so that they may participate more fully as productive members of the community. This type of consumer-based information has definite implications for pinpointing previously unforeseen problems as they pertain to retarded workers. This increased understanding of their perception of the work world has the potential of facilitating and increasing our communication with an understanding of retarded people.

199 Utilization of Community Services by the Staff and Consumers (Residents) of Group Homes for the Mentally Retarded

Principal Investigators: Philip Browning, Ph.D.
David Bostwick, Ph.D.

Status: Completed

Dates: March 1979-February 1980

Cost: Annual $11,248 — Projected Total $11,248
RT Annual $11,248 — RT % of Annual Total 100%

Annual Report Reference: #14, Page 298, R-54
#15, At Press, R-54

OBJECTIVES: The purpose of this investigation was to assess the utilization of community services by mentally retarded people living in small community residential facilities, and to obtain the perceptions of facility staff and residents regarding their satisfaction with the services available to them. In order to most effectively meet these objectives, the following research questions were delineated:

1. What is actually available to mentally retarded persons living in community residential facilities in the way of community services?
2. How often are community services actually being utilized by residents of community residential facilities?
3. How adequate are currently available support services in meeting the needs of persons living in community residential facilities, as perceived by residential facility staff?

METHODOLOGY: The sequential steps used in developing the **Community Services Utilization Questionnaire** were: (1) literature review; (2) interviews with residential facility staff; (3) task force; (4) initial instrument; and (5) field testing and revision. The final questionnaire addressed Health Services, Educational Services, Vocational Services, and General Support Services. Items were generated to include specific services within each of the four domains, frequency and patterns of service usage, and perceptions of service appropriateness.

The project utilized a previously identified nationwide sample of community residential facilities (CRFs). Specifically, that sample consisted of over 5,000 names and addresses nominated by (1) all State Mental Retardation Coordinators; (2) all superintendents of public and private residential institutions; (3) State Developmental Disabilities Councils; (4) State Associations for Retarded Citizens; (5) mental health/mental retardation agencies; (6) regional centers in states where they exist; (7) agencies identified as licensing such facilities; and (8) all individuals or agencies identified by earlier contacts as potential sources of information. These nominators were reduced to a total of 3,582 CRFs after all duplications were removed.

Each of the facilities was surveyed in order to determine if they met the following definition of CRFs which was used for this study:

> For the purpose of this project a community residence is a facility for the developmentally disabled which operates 24 hours a day to provide services to a small group of mentally retarded and/or otherwise developmentally disabled persons who are presently or potentially capable of functioning in the community with some degree of independence. These living facilities may also be known as group homes, hostels, boarding houses, and halfway houses. However, this definition does not include foster family placement typically serving five or fewer developmentally disabled individuals. Nor does it include nursing home services or other forms of care which are primarily directed toward meeting the health, health related, and/or medical needs of the resident.

Of the 3,582 facilities, 611 respondents indicated that their facility did fit the definition. The 611 CRFs from this previously identified nationwide sample were updated and added to with the aid of the 1978 National Association of Private Residential Facilities for the Mentally Retarded directory. Thus, the final sample for this study on the utilization of support services included 810 CRFs.

FINDINGS TO DATE: The Community Services Utilization Questionnaire was mailed to 810 CRFs throughout the United States. Ninety-one of these questionnaires were returned as undeliverable, while 241 were completed and returned (return rate of 34%). Of these questionnaires returned, however, 112 were completed by facilities not meeting the definition of a CRF adopted for this study, or were inappropriately filled out, and thus were dropped. The remaining 129 questionnaires represent the data pool for this project. These 129 CRFs reportedly serve a total of 1,944 residents. Of 122 facilities reporting the number of residents served by level of mental retardation, 1,344 persons (77%) were classified as mildly or moderately retarded, with 410 (23%) persons described as severely or profoundly retarded. An in-depth analysis conducted regarding the nature of supportive services which are available to these CRFs.

A series of questions in **Part A** of the CSUQ provided descriptive information about the facilities surveyed and about the residents of each facility. With respect to location, 83 of the group homes (N=125 respondents) were situated in cities of more than 15,000 people, 32 were in towns of 1,000 to 15,000 people, and 10 facilities were reported to be in towns of less than 1,000 people.

In terms of facility's surrounding neighborhood, 110 were reported (N=127 respondents) to be in predominately residential areas, while 10 were considered to be in a farm or open country. Only four of the facilities were reported to be located in commercial zones, one in an industrial zone and two operated on institutional grounds.

Of the 129 facilities included for study, 55 met the criteria for a small facility (3 to 10 residents), 43 for a medium-sized facility (11-20 residents) and 31 met the criteria for a large facility (21 to 40 residents). A total of 1,944 mentally retarded persons older than 18 years are currently being served by these facilities. Although the small group homes are the most common among those studies, 45% of all the residents are living in large residences. Only 22% of the people are presently living in the small homes.

Facility staff completing **Part B** of the **Community Services Utilization Questionnaire** were presented four lists of community services believed to reflect the basic array of services that may be needed at one time or another by many mentally retarded persons.

Information pertaining to the first research question was obtained by asking respondents to indicate whether the services shown in each of four domains are needed and whether the services are available for use. The four service domains along with the percentage and total number of respondents who reported on the need for each service and its availability are too extensive to report here.

Data reflecting the utilization of community services by group home residents were obtained by asking questionnaire respondents to indicate how often the services shown in each of the four domains are actually used. The data, which are too extensive to report here, are provided in terms of percentages and total number of respondents reporting that the services are used daily-weekly, monthly, less often, or never.

Staff perceptions of service adequacy were solicited by asking respondents to recommend four improvements to each of the four service domains. In all, 861 recommendations were received. Of the 861 comments, 237 pertained to Health Services, 182 related to Educational Services, 254 pertained to Vocational Services, and 188 recommendations were made for improvements in General Support Services.

After similar statements were combined and irrelevant statements eliminated, seven major clusters of statements were generated under Health Services, four under Educational Services, five under Vocational Services, and six under General Support Services. In order to qualify as a major cluster at least 10% of the statements within each domain had to reflect a similar recommendation.

When the four highest rated clusters are examined for content similarity, it becomes apparent that a major request of facility staff is for expanded service provision. Of the four clusters, three specifically focus on the need for additional services. When all of the submitted recommendations are analyzed for similarity, two groups of statements emerge as priority issues. Again, statements which comprise the largest of the two groups focus on the need for more services.

APPLICABILITY: Large numbers of retarded persons have been returned to the community from institutions in recent years. In order to maximize the successful transfer of these individuals to community-based residential facilities and to insure their adjustment to community life, support services must be found within the community itself. Results of this project provide habilitation personnel with a more complete view of community-based support services available for use by retarded persons. The results also have the potential for utilization in either a training or research capacity. Significant findings could be translated into a training module which could be presented in a variety of training settings. Research personnel could also find the results of this study useful in identifying and focusing future research activities in the area of community service utilization.

200 Supervision in Vocational Rehabilitation

Principal Investigator: William English, Ph.D.

Status: Continuing

Dates: May 1976-February 1981

Cost: Annual $25,104 — Projected Total $325,000
RT Annual $25,104 — RT % of Annual Total 100%

Annual Report Reference: #14, Page 163, R-40
#15, At Press, R-40

OBJECTIVES:

1. To describe the supervisory process in vocational rehabilitation.
2. To implement, through an original research utilization project, the findings of the proceeding descriptive study of first-line supervision in vocational rehabilitation agencies.
3. To effect widespread dissemination and utilization of the implementation project in public vocational rehabilitation agencies in a multi-regional area.

METHODOLOGY:

1. **Literature review.** Books, periodicals, and manuscripts are being reviewed from a variety of sources to gather the best possible picture of a number of supervision issues, e.g., selection, training, theory, practice, and outcomes.
2. **Individual interviews.** On-site interviews are being conducted with vocational rehabilitation counselors, supervisors, managers, and administrators to supplement data collected via questionnaires and small group need assessment procedures. An interview schedule was developed as a stimulus tool for use in interviewing.
3. **Nominal group process exercises.** This on-site procedure consists of the identification of a need area, which is presented to a small group – usually 10-15 vocational rehabilitation personnel. A useful item in this research has been: "List 4 suggestions which, if implemented, would increase the effectiveness of first-line supervisors." The group is then directed by experienced facilitators through four steps: problem identification, listing of problems, clarification and revision of problems, and problem resolution.
4. **Questionnaires.** Survey questionnaire booklets consisting of questions concerned with supervisory selection practices, training, evaluation, and how supervisors assist counselors to rehabilitate retarded clients have been mailed to a stratified random sample of counselors, supervisors, managers, and administrators employed in more than 40 general vocational rehabilitation agencies.
5. **Data analysis.** Questionnaire data was analyzed through the use of the Statistical Packages for Social Sciences (SPSS) program, which yielded adjusted frequency percentages for each item and for each personnel group (Administrators, Supervisors, and Counselors). The adjusted percentage data was also subjected to tests of statistical significance using the Chi Square method to examine differences between personnel groups as they might be influenced by the following intervening demographic variables: (1) state agency size; (2) age; (3) years in the VR agency; and (4) level of academic degree.
6. **Training demonstration.** Based on findings from the state-of-the-art research study and input from an advising task force of agency administrators a training curriculum was designated and

demonstrated with first-line rehabilitation supervisors. This curriculum emphasizes personnel management and supervisor functioning in staff development. After the program was implemented with first-line supervisors it was modified for training with agency administrators and training of trainers.

FINDINGS TO DATE:

Supervisory Practices: Currently the most important influences on being selected as a rehabilitation counselor supervisor are a previous work record with a local agency manager and a successful existing relationship with those state agency administrators, managers, and supervisors responsible for making the selection decision. Agency professionals would like future selection procedures to be more objective, emphasizing the following criteria: (a) leadership ability, (b) personality characteristics, (c) case management skills, (d) previous work experience, and (e) educational training.

Professionals (administrators, supervisors, and counselors) believe that counselors need assistance in understanding and anticipating the position of first-line supervision and that such assistance should be provided within one year after the person joins the agency.

Two major problems that presently interfere with the state agency's supervisory selection procedures are lack of effective supervisory development programs and lack of validated objective selection criteria.

Rehabilitation professionals at all personnel levels want the agency to have almost complete internal control over supervisory selection, independent of civil service or other state departments. This theme is reflected in findings that indicate that the agency is not receptive to selecting supervisors from outside the agency, that supervisory candidates should have two- to three-years work experience as agency counselors, and that the agency wishes to develop its own criteria and procedures for selecting supervisors.

The most important supervisory role is that of counselor education/consultant. Supervisors currently spend most of their work time in administration and case consultation. These two supervisory roles would continue to receive primary emphasis under ideal working conditions, although supervisors would devote more time to case consultation and less time to administration.

Professionals believe that state rehabilitation agencies provide good/excellent physical facilities for supervisors to conduct individual and group consultation with case-service staff, and that supervisors are highly accessible to case-service counselors for consultation.

Approaches or methods of supervising counselors in rehabilitation case management are primarily limited to individual case review and field observation.

Professionals believe that supervisors' job responsibilities exceed their authority in almost all areas of administrative job functioning.

Rehabilitation professionals, especially administrators and counselors, believe first-line supervisors do a poor job in many functional areas of counselor consultation and counselor evaluation.

Professionals think that democratic leadership is the best choice for persons at all levels of rehabilitation agency leadership—supervisors, middle managers, and top-level administrators.

To be successful, professionals believe that it is very important for rehabilitation supervisors to display the following seven characteristics: personal honesty, leadership, efficiency, concern for others, concern for state regulations, flexibility, and decisiveness.

The five criteria ranked as most important in supervisors' "current" evaluations of counselor work performance are attainment of production goals, compliance with state agency policies, quality of case recording, quality of individual written rehabilitation plans (IWRPs), and subjective judgment. These criteria would apply under ideal agency conditions, but new emphasis would be given to counselors' own professional growth and less to subjective judgment and the attainment of production goals.

Supervisory Training: Professionals believe their agencies are not providing adequate resources for training rehabilitation counselor supervisors and approximately one-half are dissatisfied with the quality of supervisory training.

The largest obstacle to improving supervisory training is competing time demands between production and training.

Administrators, supervisors, and counselors believe training would improve supervisors job effectiveness.

Agency professionals believe that training for rehabilitation supervisors should begin when a person becomes a first-line supervisor or shortly after they reach civil service eligibility.

Basic management and human relations/communication are recommended as the two most important curriculum areas to be included in both long-term and short-term training programs for rehabilitation supervisors.

Professionals believe it is important that persons above and below the level of first-line supervisors should receive similar supervisory training experiences.

Recommended criteria for evaluating the effectiveness of short-term supervisory training are improved job efficiency, better staff communications, more satisfied clients, and improved staff morale.

Rehabilitation agency professionals are personally supportive of the development of new long-term academic education programs for supervisors, although they believe that agency support for such programs is contingent on outside funding. If new long-term supervisory education programs are developed, most professionals prefer that the programs have a very strong applied clinical training emphasis, that the programs be designed for current agency counselors or supervisors, and that full-time study in supervision lasts no more than a calendar year.

Supervisory training does contribute to improvement in supervisor performance, as perceived by a substantial proportion of supervisors and rehabilitation counselors.

A standardized program for training rehabilitation supervisors can be effectively expanded through training and implementation with other rehabilitation trainers.

Supervisory Evaluation: The present evaluation system is believed to be ineffective in decisions about supervisory merit increases, demotion, and termination. Factors considered as very likely to result in a supervisor's termination are supervisors ignoring agency policy procedures, acting highly inefficient, or being very vocal against agency regulations.

Middle managers are perceived as having the greatest influence on the development of supervisory evaluation criteria and the greatest responsibility for evaluating first-line supervisors.

Administrators, supervisors, and counselors rate the following nine evaluation criteria as being very important to supervisory evaluation, in current and ideal conditions: budget management, increasing counselors' successful closures, unit efficiency, planning, case consultation with staff, counselor evaluation, liaison activities, staff morale, and training/staff development.

Two major problems identified as obstacles to the improvement of the supervisory evaluation system are the lack of validated objective evaluation criteria and the lack of validated subjective evaluation criteria.

Supervision of Counselors' Work with Retarded Persons: Many administrators (38%), supervisors (39%), and counselors (46%) believe that the expected successful closure rate for retarded persons should be lower than the rate for other disability groups.

The process of supervising counselors' work with retarded persons is believed to be the same as the supervision process of counselors who work with other disability groups.

Administrators, supervisors, and counselors state that supervisors should receive special training to assist counselors who work with retarded persons. Areas of highest training priority are the etiology of mental retardation, job development/placement, community adjustment and community resources, general assessment, general counseling, behavior modification, and family adjustment counseling.

Generic Process Findings: Across 43 states studied, the typical rehabilitation counselor supervisor is a 39-year-old male with a bachelor's degree in psychology or sociology and a master's degree in rehabilitation counseling. He has worked more than 11 years in the rehabilitation field, over 9 years in a vocational rehabilitation agency, and 5 years as a rehabilitation counselor supervisor.

He supervises an average of seven counseling staff, and approximately three out of those seven have case loads comprised of 20 percent or more retarded clients.

Professionals are dissatisfied with the quality of their agencies' supervisory selection, training, and evaluation procedures but are optimistic that realistic improvements can be made.

Professionals are satisfied with the amount of time they spend verbally communicating with peers, paraprofessionals, clients, and clients' families. Approximately one-fourth, however, wish to increase their verbal communications with agency-related persons with whom they interact.

As discrete professional groups, rehabilitation administrators and supervisors tend to share more views with each other than they do with counselors. One major exception is supervisory practices, in which administrators and counselors express similar views that are more critical than supervisors' self-perception. Generally counselors are most critical about all aspects of supervision and least hopeful that supervision can be improved.

APPLICABILITY. This project holds four implications for policy, program and practice changes in vocational rehabilitation. First, it will influence the professional knowledge and skills of first-line supervisors. Second, it will provide administrative leaders with a data base for considering change in the state agencies' present system of first-line supervision. Third, study materials will be of assistance to specialists responsible for the selection, training and evaluation of supervisors. Fourth, it will help rehabilitation counselors to be better consumers of supervisory practices.

201 Evaluation and Training of the Severely/Profoundly Handicapped for Community Adjustment

Principal Investigator:	**Daniel Close, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1977-August 1982**	
Cost:	**Annual $102,695** **RT Annual $2,695**	**Projected Total $475,000** **RT % of Annual Total 3%**
Annual Report Reference:	**#14, Page 84, R-47** **#15, At Press, R-47**	

OBJECTIVES:

1. Determine the content of the preliminary form of assessment instrument in four domains of self-care, domestic, mobility, skills, and communication skills;
2. Task analyze the content identified in the four domains of self-care, domestic, mobility and communication skills into component parts to serve as a basis of item sampling;
3. Determine the level of complexity of the component parts of the task analyzed skills in the four domains to guide item sampling;
4. Develop an item sampling strategy;
5. Develop and evaluate a preliminary form of the assessment scale in the self-care and domestic domains;
6. Develop and evaluate preliminary forms of assessment scale in the mobility and communication skills domain;
7. Develop the final form of the assessment scales in all four domains;
8. Validate the final form of the assessment instrument for severely retarded adults;
9. Develop an assessment and training manual and an accompanying curriculum guide in the content area of self-care, domestic care, basic mobility, and communication skills for severely retarded adults; and
10. Evaluate the impact and utility of the assessment scale the assessment and training manual, and the accompanying curriculum materials.

METHODOLOGY: Project staff reviewed four behavior checklists to determine the content of the preliminary form of the instrument. These instruments included AAMD Adaptive Behavior Scale, Progress Assessment Chart, Independent Living Skills Assessment System, and the Camelot Behavioral Checklist.

The initial step in analyzing content of the scale was to reduce each task identified in Objective 1 into individual "core skills." These "core skills" are the individual steps necessary to teach or perform the task. Next project staff organized the content into larger groups of behavior called "functional limits." This was done because much training with severely retarded persons is accomplished with short sequences of skills rather than with individual "core skills." Finally, project staff grouped the content into still larger segments of 2-3 "functional units" labeled "extended clusters." "Extended clusters" were developed in an attempt to increase the ceiling of the assessment instrument.

Task complexity was determined by a three-stage process. The first step in the process was to produce detailed operational definitions of the dimensions of task complexity. These detailed operational definitions were used by knowledgeable raters to rate the complexity of task content on a two-point rating scale. Finally, the results were analyzed to determine a hierarchy of task complexity.

An item sampling strategy was developed to convert a representative sample of the content into actual test items. The item sampling procedure was designed to represent: (1) two levels of complexity (simple and complex) in both the manipulation and discrimination dimensions of all domains; (2) the core skills in relation to their proportion in the domains; and (3) different lengths of items in all domains, e.g., "core skills," "functional units," and "extended clusters."

A preliminary form of the assessment scale was then developed based on the outcomes of activities addressed in Objectives 1-4. This pilot version of the scale contains approximately 150 items that are fully task analyzed, and that are scripted into three presentation formats (verbal instructions, modeled instructions, and physically prompted instructions).

In order to determine the psychometric characteristics of the preliminary form of the self-care and domestic scales, project staff administered the scale of 75 severely retarded adolescents and adults who are involved in educational programs in the Northwest. Test administration occurred in the educational program settings where the participants live or attend school.

Based on the outcomes of the preliminary field test of the Self-Care and Domestic scales, necessary revisions in content and complexity analyses will be made in the remaining two domains of communication and mobility. In addition, any necessary modification of the item sampling strategy will be made. Pilot versions of scale components in the communication and mobility domains will then be constructed and administered to a sample which is the same as or similar to the group involved in the pilot of the self-care and domestic segments of the scale. Project staff will then develop the final form of the instrument on the basis of information provided by the evaluation of the preliminary forms of the assessment scale in all four domains.

Following development of the revised form of the instrument in four domains, a sample of 150 severely retarded adolescents and adults will be selected. The purpose of these activities is to produce full standardization and normative data on the tests in all four content domains. Project staff will modify or eliminate test items, and revise item formats on the basis of statistical analyses of standardization data. The result of these activities will be final forms of tests in all four content domains.

Project staff will individually train a sub-sample of 50 severely retarded individuals, who have been tested during the instrument standardization activities, on a sample of tasks from each of the four content domains. One-third of the tasks will be presented at the level of difficulty and with the training modality indicated by the outcomes of the diagnostic assessment. Another one-third of the tasks will be presented at the level of difficulty indicated by the assessment outcomes, but with a higher level (less informative) training modality than was indicated. The final one-third of the tasks will be presented with the indicated training modality, but at a higher difficulty level than was indicated by the outcomes of the diagnostic assessment. Training will be continued until criterion performance is achieved, or the number of unsuccessful trials reaches a point where it is safe to assume that further similar training will not facilitate criterion acquisition.

This task will require the writing of an introductory section to the training manual, instructions

concerning administration of the assessment scale, and a curriculum guide that specifies the methods to be used to teach the skills included in the assessment scale.

Approximately 25 teachers and community residential facility program personnel will use the comprehensive assessment and training kit for a period of six months with approximately 125 of their adolescent and adult severely retarded students/residents. An intensive in-service training workshop for participants will precede the field testing activities.

Questionnaire and actual training achievement data will be collected from all participants in the field test in order to evaluate several aspects of the materials: (1) the clarity and organization of all materials; (2) user satisfaction with method of test presentation and assessment outcome information; and (3) training achievement following use of the instrument and accompanying instructional intervention.

FINDINGS TO DATE: Specific results of this project include all content analyzed into "core skills," "functional units" and "extended clusters." Each of these units of behavior was analyzed into two levels of complexity. The product of this activity was a detailed complexity rating of all content along an easy-to-hard sequency.

A preliminary form of the assessment scale was developed based on representation of core skills across all domains; complexity ratings; and different item lengths. The preliminary form of the scale was administered to 75 severely retarded persons. Results of this field test provided an empirical basis for adding, deleting and revising test items.

A revised form of the instrument was developed and administered to 130 severely retarded adolescents and adults. The purpose of this administration was to produce full standardization and normative data on the tests in all content domains.

Project staff trained a sub-sample of 33 severely retarded persons on sample tasks from each of the content domains in order to validate the instrument. One-third of the tasks were presented at the "core skill" level, one-third at the "functional unit" level and one-third at the "extended cluster" level. Content was selected to represent an "easy" and "hard" task within each of the varying item lengths. Tasks were also selected that were not included in the assessment scale. Data analysis of the results of the validation phase of the project are currently in progress.

APPLICABILITY: The instruments, manuals, and training kit produced by the proposed project will be developed specifically for use in the rehabilitation of severely and profoundly retarded persons. This system will allow program managers to use evaluative information to estimate the amount of time and resources needed to develop client skills to an acceptable level. The information obtained from the assessment instrument will facilitate the habilitation of severely/profoundly retarded people because the training programs presented are directly related to the skills assessed and to the varying skill levels observed. This will aid program managers in individualizing program planning and monitoring progress in training activities. Skill deficits will be defined as service priorities instead of client deficiencies.

An added benefit of the proposed project is that the instruments, manuals, and training procedures will function as a self-contained training program for service providers and rehabilitation counselors. By informing the rehabilitation counselor of the necessary content and procedures needed to prepare severely/profoundly retarded clients for community adjustment, the entire rehabilitation process is facilitated. Rehabilitation counselors will further be able to use the training kit to train paraprofessional workers to deliver high quality assessment and habilitation services to severely and profoundly retarded clients.

202 Identification of Leadership Characteristics of "Successful" Supervisors in Vocational Rehabilitation

Principal Investigator:	William English, Ph.D.	
Status:	Continuing	
Dates:	January 1979-December 1980	
Cost:	Annual $33,546 RT Annual $33,546	Projected Total $70,000 RT % of Annual Total 100%
Annual Report Reference:	#14, Page 201, R-52 #15, At Press, R-52	

OBJECTIVES:

1. To develop and standardize an instrument to measure performance in major work areas of first-line supervisors in general state/federal vocational rehabilitation agencies;
2. To identify one or more widely accepted measure(s) of leadership ability which are applicable to first-line supervision within the state/federal vocational rehabilitation agency; and
3. To describe the work performance of first-line supervisors in general state/federal vocational rehabilitation agencies;
4. To describe the leadership styles of first-line supervisors in general state/federal vocational rehabilitation agencies; and
5. To examine whether more successful versus less successful vocational rehabilitation supervisors have different leadership profiles.

METHODOLOGY: Participants in this research are a national cross-section of first-line supervisors, middle managers and top level administrators within the state/federal vocational rehabilitation agency. The project is being supported by the Council of State Administrators of Vocational Rehabilitation (CSAVR) and more than 40 state rehabilitation agencies.

Both self-report and second-party report data will be collected on supervisory performance and supervisory leadership. Self-report data is being collected by mailing the Supervisory Performance Scale (Form A) and the Leadership Opinion Questionnaire (LOQ) to a representative sample of first-line agency supervisors. Second-party evaluation data is being collected by mailing the Supervisory Performance Scale (Form B) and the Leadership Behavior Description Questionnaire (LBDQ) to a representative sample of middle managers who are the immediate bosses of first-line supervisors. In addition, an overall administrative evaluation of participating supervisors' work performance is being collected from agency designated top level administrators. The measures of leadership (LOQ and LBDQ) are already standardized and have been repeatedly used in research and practice in business and human service work. The measure of work effectiveness, the Supervisory Performance Scale (SPS) is a new assessment tool that has been developed by project staff.

FINDINGS TO DATE: The choice of the LOQ and LBDQ as the measures of leadership style was made after an extensive review of literature covering business, education and human service. The SPS was drafted by project staff and then extensively reviewed after critical review by a task force group consisting of agency administrators, agency supervisors and rehabilitation educators. Further revision of SPS occurred after a pilot test and after field testing.

Endorsement of this project was sought and obtained from CSAVR. This was followed by contacting the directors of all state rehabilitation agencies. Over forty states are supporting the study and personnel lists have been selected from all participating states. These lists have been used as the basis for sampling. Data collection is now underway and will be followed by statistical analysis, report writing and product development.

APPLICABILITY: The critical importance of the first-line supervisor's role to rehabilitation agency processes and outcomes has been well documented over a period of years (Inkster, 1955; Moriarty, 1959; Scurlock, 1959; and Spears and Vialle, 1970). Recent administrative review (HEW, 1975) strongly suggests, however, that there are serious deficiencies prevalent in performance of many first-line rehabilitation counselor supervisors. Moreover, recent research (English, Oberle, and Byrne, 1979) indicates that rehabilitation professionals believe there is a great need for objective measures of leadership and supervisory performance.

Because the study is being well supported and involves both self-report and second-party data it has the potential to provide substantially more insight about the functional strengths and weaknesses of rehabilitation supervisors which can be used in planning strategies for upgrading supervisor performance. In addition, field test results suggest the project has strong potential for providing the field with a practical measure of supervisor performance which can be used – by supervisors and their colleagues and supervisors – to improve the work performance of current rehabilitation supervisors. Potentially this assessment tool could also be used to select future rehabilitation supervisors. Since first-line rehabilitation supervisors direct and monitor the work efforts of all service providers the project also has the potential to indirectly but significantly impact on improving the provision of rehabilitation services to handicapped persons.

203 Model to Teach Community Living Skills to Mildly Retarded Adults

Principal Investigator: Daniel Close, Ph.D.

Status: Continuing

Dates: March 1979-February 1982

Cost: Annual $41,718 — Projected Total $100,000
RT Annual $41,718 — RT % of Annual Total 100%

Annual Report Reference: #14, Page 223, R-53
#15, At Press, R-53

OBJECTIVES: The purpose of this project is to develop a model program to train paraprofessionals in teaching mildly retarded adults independent living skills. The project involves (1) the development of a set of training materials, suitable for use by paraprofessionals, which focus on those skills necessary for successful living in the community by retarded persons; (2) the development of in-service training technology to teach professional and direct care staff appropriate teaching procedures; and (3) the development of multiple assessment evaluation procedures to determine the impact of the model.

METHODOLOGY: Project staff selected major curricula for review based on the professional literature on community living for mentally retarded persons, products of major publishing houses, contacts made with professionals in HEW Regions IX and X, contacts with community living personnel throughout the country, and existing curricula for high school students.

Based on the review of existing curricula and the criteria stated in Objective 1, project staff developed training materials for use by paraprofessional teachers. The major content areas of this curriculum are (1) **Personal and Household Management**–grooming, clothing care, apartment cleanliness, and health and safety in the home; (2) **Money Management**–budgeting, banking, and bill paying; and (3) **Food Preparation**–nutrition, meal planning, grocery shopping, and cooking.

The curricula was pilot tested with two mildly retarded men, then field tested with paraprofessional direct-care providers. Corrections in the curriculum are being completed. Finally, development of an assessment instrument to accompany the curriculum and an in-service training technology to train users of the curriculum is in process.

FINDINGS TO DATE: Findings to date include development of four major curriculum guides. These include: **Personal Hygiene and Household Management**, **Money Management**, **Food Preparation** and **Simply Cooking**, a picture cookbook.

The skills in this curriculum are sequenced from simple to complex, so that the knowledge and acquisition of new skills are built on previously learned skills. Skills are broken down into small, logical steps, so they can be easily and systematically taught. Explicit instructions on how to teach components of skills are provided to the paraprofessional in simple, comprehensible language. The directions give the teacher specific verbal cues, modeling, and demonstration instructions in order to teach the designated task. Technical educational technology is eliminated and no assumptions are made that the person using this curriculum knows special education techniques for training mildly handicapped adults.

Verbal input is given to the student in a conversational manner before a response is demanded. The response expected from the student is provided in parentheses next to the input given. The teacher can easily determine the correctness of the response elicited via the criteria provided. In

addition, a simple data collection system is provided for the teacher. A scoring grid is placed next to the correct response expected from the student so the teacher can mark a check next to the answer if it is correct. In this way the teacher can readily see what improvement the student has made and if the student has reached criterion for a specific task.

Reinforcement and correction procedures are provided for the teacher. Furthermore practice activities and discussion questions are an integral component of the curriculum.

In many cases student worksheets or practice materials such as bank deposit slips or checks are provided for additional experience. The teaching approach is casual and conversational, conducive to teaching at home in a relaxed atmosphere. Ideas for discussions and role playing situations, which may be encountered by the student in the community, are also included in the curriculum design. In this way, the mildly handicapped adult interacts with adults in a normalized manner, and can generalize to the community and skills which are learned.

Results of the curriculum field test are now being analyzed and final changes will result on revised and complete editions of each of the four manuals.

APPLICABILITY: The overall product of this project will be a Community-Based Teaching Model curriculum and training program. This curriculum will be designed for use by paraprofessional personnel responsible for training mildly retarded adults. The curriculum and training program will be used to assist mildly retarded persons to live independently.

204 Mentally Retarded and Consumerism within the Rehabilitation System: A State-of-the-Art Study

Principal Investigator:	**Philip Browning, Ph.D.**	
Status:	**Continuing**	
Dates:	**March 1979-August 1980**	
Cost:	**Annual $63,670** **RT Annual $63,670**	**Projected Total $125,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#14, Page 320, R-55** **#15, At Press, R-55**	

OBJECTIVES: The purpose of this study is to produce a state-of-the-art document on consumerism and the vocational rehabilitation process with primary attention directed to the mentally retarded clients. This goal will be accomplished by addressing the following specific objectives:

1. To conduct an "historical" study on consumerism and rehabilitation via content analysis on congressional records related to rehabilitation, federal rehabilitation legislation since 1973;
2. To conduct a comprehensive literature and analysis on handicapped consumerism in rehabilitation;
3. To conduct a content analysis on Client Assistance Project program documents and to survey personnel of these projects via questionnaire in order to ascertain their experiences and perceptions in serving mentally retarded clients in vocational rehabilitation;
4. To conduct a survey of rehabilitation service providers via questionnaire and personal interview in order to ascertain their experiences and perceptions in serving mentally retarded clients in vocational rehabilitation; and
5. To conduct a study of mentally retarded clients via in-depth interviews in order to ascertain their experiences and perceptions in receiving rehabilitation services.

METHODOLOGY: In order to obtain a comprehensive understanding of the state-of-the-art of mentally retarded clients' involvement in consumerism, data will be derived from five major sources: (1) congressional records; (2) literature; (3) Client Assistance Projects; (4) rehabilitation service providers; and (5) mentally retarded rehabilitation consumers or their representatives.

FINDINGS TO DATE: Project Objectives One and Two have been completed. Objective One pertained to an historical study of rehabilitation related consumerism. Specifically, the purpose was to scrutinize the Congressional Records regarding rehabilitation legislation in order to better understand the

evolution of consumerism for the handicapped through Congress. Furthermore, the intent was to learn where the mentally retarded "fit in" with respect to the emergence of consumer-related legislation in rehabilitation.

Based on 57 carefully selected congressional documents representing literally thousands of pages, an historical analysis of rehabilitation legislation between 1968-1978 was conducted to trace the emergence of consumerism. This was done with relation to the following areas which are most related to consumer involvement issues: Civil rights, independent living, client assistance projects, individualized written rehabilitation plan, policy making, and procedural safeguards.

The findings pertaining to Objective One are reported in the **Advancing Your Citizenship** monograph entitled "Essays in Consumer Involvement of the Handicapped." Specifically, under the second section of the publication are a set of seven essays subsumed under the heading "The Emergence of Consumerism through Congress." Each essay is based on the 57 documents reflecting rehabilitation legislation between 1968-1978.

Objective Two has also been completed. Again, the purpose of this objective was to comprehensively review the literature on consumer involvement/advocacy for the handicapped. A comprehensive bibliographic document comprised of 289 references on consumerism/advocacy has been drawn from over 100 different periodicals, books, monographs, reports, and proceedings. Each reference is thoroughly annotated and coded according to an author, literature, and subject index. This material is now published as part of the **Advancing Your Citizenship** series entitled "Consumerism/Advocacy and Disabled Persons: An Annotated Bibliography."

APPLICABILITY: Findings from this state-of-the-art study will be primarily used as the basis for designing and proposing a large-scale research project on consumerism as it relates to mentally retarded persons. Also, the baseline knowledge acquired may be utilized in a training capacity for practitioners who are currently dealing with clients as active consumers involved in determining the content and process of service provision.

Such baseline knowledge will enhance our understanding of the effectiveness and appropriateness of consumerism as it relates to mentally retarded clients. This information has definite implications for pinpointing unforeseen problems in consumer involvement. It also indicates the actual changes which occur in policy and program changes from the congressional level to the practical implementation of regulations at the service level.

205 Identification and Assessment of Social/Interpersonal Skills Relevant to Job Tenure for Mentally Retarded Adults

Principal Investigator:	**Gilbert Foss, Ph.D.**	
Status:	**New**	
Dates:	**September 1979-August 1981**	
Cost:	**Annual $35,084** **RT Annual $35,084**	**Projected Total $80,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#14, Page 121, R-56** **#15, At Press, R-56**	

OBJECTIVES: The professional literature reflects strong agreement among writers regarding the strong relationship between social/interpersonal competence and the vocational success of mentally retarded persons. The objectives of this project are:

1. To identify those social/interpersonal skill areas deemed most relevant to job tenure.
2. To develop a strategy for assessing the competence of retarded young adults in the identified social/interpersonal skill areas.
3. To develop an interpersonal competence training program for mentally retarded adolescents and adults which focuses on skills relevant to job tenure.

METHODOLOGY: The identification of those social/interpersonal skills relevant to job tenure for mentally retarded adults followed a three step process. First, sixteen vocational behavior checklists

containing on-the-job social skills items were examined. The second component involved a review of approximately 150 articles concerned with social/interpersonal skills and work adjustment with the population of mentally retarded adolescents and adults. As the literature and checklists were reviewed, a list was made of social/interpersonal traits, skills, and behaviors. This list was condensed into 21 behavior areas and incorporated into a questionnaire. One copy of the questionnaire was sent to job placement specialists at 93 sheltered workshops in 11 western states. Respondents were asked to check the five statements they felt were most relevant and the five statements they felt were least relevant to competitive employment for mentally retarded people.

The procedures for assessing the social/interpersonal competence of mentally retarded young adults are being developed according to the behavioral-analytic model. This model suggests five stages of test development, to be applied to each of the skill areas that have been identified. In the first stage, **situational analysis**, problematic situations within the skill areas are identified, together with their particular characteristics. In stage two, **response enumeration**, a wide variety of responses, both effective and ineffective, are identified for each problematic situation. The third stage is **response evaluation**. Each possible response is evaluated for effectiveness by persons who are in positions of authority in the setting under consideration. In stage four, **development of measurement format**, the results of the first three stages are developed into an assessment instrument, using an appropriate measurement technique. Finally, stage five, **evaluation of the measure**, involves the application of appropriate statistical procedures for establishing the validity and reliability of the measure.

The procedure for developing the training program for social/interpersonal competence will involve three steps. First, the program will be developed using the content derived from the instrument development phase of this project. A training manual containing objectives, activities, and materials for each session will be written. Next, the training program will be pilot tested with 16 mentally retarded adults involved in vocational training programs. Finally, the training program will be field tested with 80 mentally retarded adults at 10 vocational training sites throughout the western United States. Process and outcome data will be compared between trainees in the experimental training groups and those who serve as a control group.

FINDINGS TO DATE: The identification of those social/interpersonal skill areas deemed most relevant to job tenure and most of the situational analysis of problematic social/interpersonal problems were conducted over the past year. Findings from each of these stages of the project follow.

Questionnaires were returned by 64 respondents in the identification phase of the project. The findings from the questionnaire serve as the framework for the data collection procedures in the situational analysis. In reviewing the items considered most relevant to tenure, those items receiving 16 or more ratings as most relevant were discussed by project staff as behavior skill areas for further data collection. As such, 11 statements were analyzed.

From this discussion, two statements were considered too vague for further data collection. These two areas were "working independently of direct supervision" and "interacting appropriately with co-workers while on the job." Beyond the vagueness of these statements, it appeared that problems in these areas would surface under the rubric of following supervisor instructions, responding to supervisor criticism or correction, requesting assistance as needed and disrupting others.

"Maintaining an appropriate personal appearance" was also deleted from further study for two reasons. First, this statement does not reflect an interpersonal skill **per se**. Personal appearance is best reflected in an individual's features of personal hygiene, grooming, and style of dress that best fit the vocational settings. The social consequence of an improper personal appearance would surface in criticism or disapproval from a supervisor or co-worker. Additionally, personal appearance and hygiene has been covered extensively in existing assessment and training procedures.

Thus, eight statements were delineated as areas for further investigation in the situational analysis stage of the project. These statements were problems with (1) following supervisor instructions, (2) accepting supervisor criticism or correction, (3) bizarre or irritating behavior, (4) aggressive behavior, (5) requesting assistance as needed, (6) disrupting other people, (7) being distracted by other people, and (8) accepting changes in supervisor or co-workers.

During the situational analysis, three populations, 19 production supervisors at sheltered workshops, 18 mentally retarded workers at sheltered workshops, and 18 competitive employers of mentally retarded people were asked to describe social/interpersonal problems of mentally retarded workers they observed in these eight broad categories.

The situation analysis produced over 450 problematic social/interpersonal situations through approximately 1,500 hours of observation that mentally retarded workers encounter in vocational settings. These situations are currently being analyzed as to their similarities for content. Those situations that are similar, e.g., five instances of a worker being criticized by a supervisor for failure to perform a work task are being combined into one problem statement. Those situations that are reported very infrequently or that give insufficient content concerning the problematic situation are being deleted. It appears that this collapsing of the data will yield approximately 100 problematic situations.

APPLICABILITY: Attention to social/interpersonal aspects of mentally retarded persons' functioning with the job setting has been identified as a high priority area by a number of rehabilitation service providers. While the technology of training retarded people to perform job tasks has been steadily improving, there has not been a corresponding development of means for remediating social/interpersonal skill deficits. The behavioral-analytic assessment method proposed here offers the advantages of providing empirically derived content for client training as well as an empirically derived assessment instrument. Thus, the result of this study will have direct application for the delivery of rehabilitation services to mentally retarded persons.

New York University (RT-17)
Deafness Rehabilitation Research and Training Center*

CORE PROBLEM

Improving the Delivery of Services to Deaf People

CORE AREAS

Developing Models for Service Delivery

Determining the systems which most effectively and efficiently deliver services to deaf people.

Developing the Data Base

Gaining accurate information on the demographic characteristics of the deaf population, necessary for effective planning and delivery of social and rehabilitation services.

Communication Research

Proximal (face-to-face) communication and telecommunication (communication at a distance) with deaf persons.

Vocational Research and Development

Examination and development of work evaluation practices with deaf persons; examination of specific occupational factors which militate against the employment and promotion of deaf workers.

Deaf Community Development

Research and training projects designed to bring deaf consumers into more active and constructive roles in planning and delivery of services to the deaf community.

Personnel Research and Development

Examination of techniques to expand the reach of existing professionals to greater numbers of deaf clients and to facilitate the preparation of new personnel.

*Funding for RT-17 was terminated November 30, 1980

NEW YORK UNIVERSITY DEAFNESS CENTER

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DISCONTINUED

Tailoring Captions for Deaf Audiences

State of the Art in Sign Language Teaching: A Comprehensive Review

Using Sign Language Interpreters Effectively in the Rehabilitation Process:
Effect of Rate of Speech Input on Structure of Sign Language Output

Vocational Significance of Differences in Sign Languages Used By Deaf People
of Hispanic Background in Region II: Implications of P.L. 95-602

University of Alabama in Birmingham (RT-19)
Medical Rehabilitation Research and Training Center

CORE AREAS

Spinal Cord Injury

Projects to impact upon the specific course of care as well as influence eventual rehabilitation outcomes of victims of this catastrophic condition. Studies address therapetuic agents, various treatment modalities and basic research questions—each intended to fill voids in knowledge gaps so as to improve the rehabilitation outlook and potential for the spinal cord injured patient. Activities are designed to provide the professional and scientific community with data and findings applicable to medical and vocational programs.

Metabolic Effects of Severe Disability in Both Static and Dynamic Conditions

Activities addressing physical disability globally, by measuring, assessing and evaluating the disability component of a broad spectrum of conditions and/or diseases.

Assessment of Long-Term Needs of the Severely Physically Handicapped

Activities designed to lead toward the development of definitive information essential to the development of strategies to prevent the occurrence of costly interruptions to successful rehabilitation and to provide necessary services which will be readily available throughout the patient's entire lifetime.

Biocommunications

Continuing research designed to create and disseminate a vast new body of knowledge relative to the process of oral communication resulting in a continual increase in the understanding of the physiologic and anatomic basis of problems—leading to the development of corrective therapeutic modalities. knowledge and skills growing out of this work will markedly improve the patient/client's ability to participate successfully in a vocational rehabilitation program.

UNIVERSITY OF ALABAMA IN BIRMINGHAM

Samuel L. Stover, M.D., Director
University of Alabama Medical
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COMPLETED — **ACCESSION NO.**

CONTINUING

NEW

DISCONTINUED

PROPOSED

Pulmonary Function and Dysfunction Following Cervical Spinal Cord Injuries

Spinal Cord Injury: Auditory Acuity, Cortical Arousal and Alertness

206 Effect of Disodium Etidronate on the Recurrence of Ectopic Calcification Following Surgical Removal

Principal Investigator: Samuel L. Stover, M.D.
Status: Completed
Dates: October 1970-June 1980
Cost: Not applicable
Annual Report Reference: #14, Page 53, R-13

OBJECTIVES:

1. To demonstrate the effectiveness of disodium etidronate (EHDP) in preventing postoperative recurrence of heterotopic ossification (HO) in patients with spinal cord injury, ankylosing spondylosis and other severe neurological conditions in which surgical excision of the heterotopic bone is indicated.
2. To demonstrate that the prevention of postoperative recurrence allows greater joint range of motion and improves function.

METHODOLOGY: This long-term study has utilized three protocols. The patient population was restricted to persons 16 years of age or older who suffered spinal cord injuries or who, because of other severe neurological injuries or illnesses, developed HO requiring surgical intervention. The experimental drug, EHDP, was administered both pre- and postoperatively for varying periods of time. In the first protocol completed in 1974 the patient served as his/her own control. Subsequent protocols were double-blind studies distinguishable by the length of postoperative administration of drug and dosage following surgery. Patients were followed closely correlating laboratory studies, clinical course, joint range of motion and x-ray findings to evaluate the efficacy of the drug.

FINDINGS TO DATE: **Initial Studies:** The first four patients participating in this study served as their own control. Without drug treatment, surgical wedge resections were followed by postoperative recurrence. Repeat surgery was deferred until the alkaline phosphatase level returned to normal. The patients were then started on EHDP.

Encouraging results led to the development of a double-blind study. Patients entering the study were assigned randomly to a treatment group (placebo or EHDP). Medication was administered in an approximate dosage of 10 mg/kg/day for one year postoperatively.

Surgery: Wedge resections of the central part of the heterotopic bone mass were performed allowing hip flexion to at least 90°. Each case had an anterior iliofemoral bar which restricted hip motion. These masses were all approached through a standard anterior iliofemoral incision. In all cases, the hip joint capsule could be easily identified and the bony mass separated from its external surface. As soon as the hip joint was freed, motion was tested and resection was continued, both proximally and distally, until 90° of hip flexion could be obtained.

Preoperative and Postoperative Care: Careful attention was given preoperatively to the condition of the skin and urinary tract. Surgery was delayed in patients with open pressure ulcers until healing was complete, and specific antibiotic treatment was given, when necessary, before surgery to sterilize the urinary tract. The antibiotic treatment was continued approximately one week postoperatively.

Complications and Side Effects: Surgical complications were limited to (1) hemorrhage postoperatively from the drain sites requiring blood transfusions in two patients, (2) anticipated seroanguinous fluid accumulation in the dead space and (3) the development of a soft tissue infection in one patient in the incisional area which healed completely after several weeks, but two years later developed a hip abscess resulting in osteomyelitis of the hip joint area.

Side effects of EHDP included only expected elevations of serum phosphate which has no known clinical effects, mild nausea and abdominal discomfort in one patient, which was controlled by giving EHDP in divided doses. Lack of other laboratory or clinical side effects in the parameters studied suggests EHDP's safety for clinical use.

During the past year, follow-up was continued on the study population who were still receiving EHDP or placebo therapy and also other patients who had already completed drug therapy were further evaluated for any recurrence of heterotopic ossification. Joint range of motion was also followed.

The entire study population consists of 16 patients who have undergone a total of 26 surgical procedures. Further breakdown of the procedures reveals removal of heterotopic bone occurring about the hip in 15 patients (25 procedures) and removal of heterotopic bone occurring about the elbow in one patient (one procedure).

In general, it appears that EHDP prevents the postoperative recurrence of heterotopic ossification during the course of drug treatment, whereas, recurrence during the control study or placebo therapy in certain patients is almost inevitable.

It is becoming obvious that patients with head injuries who have heterotopic ossification have much less likelihood for postoperative recurrence than the patients who have spinal cord injury. It also appears that patients with incomplete spinal cord injury with some motor recovery at the time of heterotopic ossification excision, have less recurrence than patients with complete spinal cord injury.

After drug termination, the extent of heterotopic ossification recurrence appears to be inversely proportional to the size of the initial bone mass and length of treatment. The maturity of heterotopic ossification at the time of surgery does not seem to influence the effects of EHDP treatment, but may influence the extent of recurrence after drug withdrawal depending on the length of EHDP treatment.

In summary, EHDP is the first therapeutic agent with definite effectiveness in delaying and partially preventing recurrent postoperative heterotopic ossification.

APPLICABILITY: HO is a common complication of spinal cord injury necessitating absenteeism and surgical removal when sufficiently severe to inhibit range of motion of the joints, particularly the hips, to make the patient functionally as independent as possible and prevent the usual recurrence of ectopic bone.

This drug shows considerable promise in preventing recurrence of ectopic bone (HO) formation after surgical excision.

207 Effect of Dantrolene Sodium on the Mixed Function Oxidase System of Rat Liver

Principal Investigator: Kennon T. Francis, Ph.D.
Status: Completed
Dates: July 1978-June 1980
Cost: Not applicable
Annual Report Reference: #14, Page 303, R-68

OBJECTIVES:

1. To study the metabolism of hexobarbital in male and female rats pretreated with acute doses of dantrolene.
2. To study the metabolism of ethylmorphine and determine the amount of cytochrome P-450 and NADPH reductase in rats pretreated with acute doses of dantrolene.
3. To study the ability of the mixed function oxidase system to be induced by phenobarbital with the simultaneous administration of dantrolene.
4. To study the dose effect relationship of dantrolene on the metabolism of ethylmorphine.
5. To study the recovery of the mixed function oxidase system after pretreatment with dantrolene.
6. To study the effect of dantrolene on the adrenal cortex and glucocorticoids.

METHODOLOGY: Rats were pretreated with varying dosages of dantrolene, hexobarbital, phenobarbital. Cortisone was also administered to some animals.

Drug administration was followed by measurement of sleeping periods, ability to metabolize ethylmorphine, amounts of cytochrome P-450, NADPH reductase activity, blood cortisol level, adrenal gland weight, and/or urinary 17-Ketosteriod secretion.

FINDINGS TO DATE: An investigation of the effect of dantrolene pretreatment on pentobarbital sleeping time indicated that dantrolene inhibited the activity of the hepatic Mixed Function Oxidase (MFO) system. Prolongation of sleeping time was dose related and was greater after five days pretreatment than after one day pretreatment.

The inhibition of the hepatic MFO system by dantrolene was confirmed by experiments investigating the effect of pretreatment with 25 or 100 mg/kg of dantrolene on various **in vitro** parameters of hepatic MFO system activity. One day pretreatment with 25 mg/kg of dantrolene did not alter drug metabolizing activity, but five days pretreatment did decrease aminopyrine N-demethylation by approximately 46%. This decrease in metabolism was not associated with a change in the apparent Km for aminopyrine, a change in hexobarbital binding, or a change in cytochrome P-450 content.

One day pretreatment with 100 mg/kg of dantrolene caused a 55% decrease in aminopyrine N-demethylation which was associated with a 50% decrease in cytochrome P-450 content. A 45% decrease in the Amax for hexobarbital binding, and significant increase in the Ks for hexobarbital binding. A single dose of 400 mg/kg of dantrolene produced similar effects on the hepatic MFO system.

One day pretreatment with 100 mg/kg of dantrolene did not alter the ability of phenobarbital to induce the MFO system. Also, five days pretreatment with 100 mg/kg of dantrolene did not block the ability of 3-methylcholanthrene to induce the MFO system. The data indicate that dantrolene, as well as phenobarbital and 3-methylcholanthrene tend to increase the milligrams of microsomal protein per gram of liver. In fact, the dantrolene and phenobarbital appear to have an additive effect.

The inhibition of the MFO by dantrolene is reversible, as demonstrated by the recovery of aminopyrine-N-demethylation over a ten day period after discontinuing dantolene treatment. Investigations of the mechanism of interaction of dantrolene with the MFO demonstrate that dantrolene competes with hexobarbital for type 1 binding sites. Also, 14C dantrolene forms a stable complex with hepatic microsomal proteins and the respective 78000 xg supernatant proteins. Phenobarbital pretreatment decreases the binding of 14C dantrolene to these hepatic proteins by approximately 40%. These observations indicate that dantrolene is a substrate for the MFO and that dantrolene or one of its metabolites forms a stable complex with hepatic proteins.

Adverse effects of dantrolene include abnormal liver function test, hepatic injury and alteration of the hepatic MFO cytochrome P-450 system. The effective dose of dantrolene that has been shown to decrease hepatic cytochrome P-450 also causes adrenal enlargement with a marked reduction in serum glucocorticoids. The ratio of adrenal wet wt/body wt was significantly increased following five days injection with a minimum dose of 25 mg dantrolene/kg body wt. The minimum effective dose of dantrolene that significantly lowered serum glucocorticoids was 50 mg/kg body wt. Serum glucocorticoids were reduced in half following five days treatment with 100 mg dantrolene/kg body wt. The levels of serum glucocorticoids were 80% of control serum levels and the adrenal wet wt./body wt. ratio was 85% of control values following three days of recovery after five days pretreatment with 100 mg/kg of dantrolene. It appears that dantrolene acts in a similar manner as phenytoin to reduce adrenal glucocorticoid secretion with a possible alteration or reduction in the negative feedback response to the pituitary with resultant enlargement of the adrenals.

APPLICABILITY: Dantrolene sodium became commercially available in 1974 and has been used to decrease skeletal muscle spasticity in patients with various disorders. However, hepatotoxicity is one reported adverse effect of this drug which should be considered in further detail. Clarification of the site of drug action in the liver is necessary so possible precautions may be taken by physicians prescribing the drug.

208 Renal Scintillation Camera Studies as a Method of Following Renal Function and Urological Management in Spinal Cord Injury Patients with Neurogenic Bladder

Principal Investigator:	**Samuel L. Stover, M.D.**	
Status:	**Continuing**	
Dates:	**June 1976-May 1981**	
Cost:	**Annual $62,607** **RT Annual $49,862**	**Projected Total $770,927** **RT % of Annual Total 80%**
Annual Report Reference:	**#14, Page 85, R-56**	

OBJECTIVES:

1. To compare results of the comprehensive renal scintigraphy procedure (CRSP) and plain film KUB x-rays with the excretory urogram (EXU) in a series of spinal cord injury (SCI) patients with neurogenic bladder to identify changes in renal function detected by the scintigraphic technique and to correlate these changes with visible anatomic and/or gross functional changes revealed by plain film KUB x-rays and excretory urograms.
2. To compare post-void residual urine volumes measured by renal scintigraphy to volumes obtained by catheterization;
3. To compare results of renal function measured using the CRSP to laboratory measurements of serum urea nitrogen and serum creatinine;
4. To compare abnormalities identified on cystourethrography to functional results obtained using the CRSP and plain film KUB x-rays;
5. To develop and test a predictive model for future urinary tract complications using past and present values of results from the CRSP, excretory urogram, cystourethrogram, plain film KUB x-ray and blood chemistry procedures.

METHODOLOGY: Morphological and functional assessment of the genitourinary system have been performed in a series of spinal cord injury patients with accompanying neurogenic bladder using two diagnostic routines: (1) CRSP and plain film x-rays of the kidneys, ureters and bladder; and (2) excretory urograms, residual urine volume measurements, serum urea nitrogen and serum creatinine determinations and cystourethrograms during the initial hospitalization and/or regularly scheduled follow-up evaluations. Test results from the two diagnostic routines will be examined to determine the comparability of data derived from various procedures. Regression equations, correlation coefficients and other statistical expressions will be calculated to determine the sensitivity and specificity of each measure.

FINDINGS TO DATE: To date, 560 CRSP's have been performed on 352 spinal cord injury patients, and 411 EXU and CRSP comparisons have been made.

It was found that 40% of the 411 comparisons involved abnormal CRSP's and abnormal EXU's while 28% had normal EXU's but abnormal CRSP's, and 8% had abnormal EXU's but normal CRSP's.

CRSP abnormalities undetected by EXU included below normal ERPF's in 75 renal units, abnormal relative function in 34 patients, and evidence of obstructive uropathy in 73 renal units.

EXU abnormalities detected in patients with normal CRSP's included pyelocaliectasis in 23 renal units and ureterectasis in 34 renal units. However, only four renal units were determined to have greater than minimal (Grade 1) changes.

These findings suggest that CRSP is both more sensitive and specific than the EXU. In patients who demonstrate an abnormal CRSP further evaluation is warranted to determine which of these abnormalities represent clinically significant changes requiring interventive therapy. Therefore, serial CRSP studies have been obtained on 142 of the 352 SCI patients in this study. To date, one patient has had 5 CRSP's, 4 patients have had 4 CRSP's, 37 have had 3 CRSP's, and the remainder have had 2 CRSP's. In these 142 patients, improvement was seen in 24 patients, no change in 70 patients and an increase in severity of parenchymal disease and/or obstructive pattern in 48 patients.

No patient has had an adverse reaction to the CRSP and virtually all patients have found it to be a far more tolerable testing procedure than the EXU.

APPLICABILITY: The spinal cord injured patient with neurogenic bladder often has multiple urological complications which may progress to renal failure and death. Of death occurring in spinal cord injury patients, approximately 50% are renal deaths. Urological problems often prolong the disability, require protracted or repeated hospitalization, and may preclude some of these severely disabled patients from returning to vocational pursuits. Improved and less complicated methods for evaluating renal function in these patients should facilitate urologic management, decrease costs of associated hospitalization and allow more continuity of vocational activities as well as prolong the life of the patient.

209 Bowel Regulation in Spinal Cord Injury

Principal Investigators:	**Cecil Nepomuceno, M.D.** **Janet Engstrand, R.N.**	
Status:	**Continuing**	
Dates:	**June 1977-June 1981**	
Cost:	**Annual $12,374** **RT Annual $11,478**	**Projected Total $28,282** **RT % of Annual Total 93%***
Annual Report Reference:	**#14, Page 155, R-63**	

***RT funding being discontinued as of 5-31-81. Project will continue through other funding sources.**

OBJECTIVES:

1. To determine the medical appropriateness and patient acceptability of a bowel training program for spinal cord injury patients utilized by the Spain Rehabilitation Center.
2. To document individual modifications of the established program instituted by the spinal cord injury patient following hospital discharge.
3. To identify individual bowel program modifications initiated by the successfully rehabilitated spinal cord injury patient which might be integrated into the established program utilized at the Spain Rehabilitation Center.

METHODOLOGY: Initial design: As originally conceived, the study population was to consist of forty patients. These patients were to be divided into two groups. Group I subjects were to include twenty spinal cord injury patients who had sustained Upper Motor Neuron (UMN) lesions within six months of admission to the Center. Group II subjects were to include twenty spinal cord injury patients who had sustained Lower Motor Neuron (LMN) lesions within six months of admission to the Center.

It was anticipated when the study population was originally described that some problem might occur in identifying an adequate number of patients who had sustained neurologically complete Lower Motor Neuron lesions. Our experience to date verified our early suspicions. Consequently, a decision was made to revise the design. The number of patients (n=40) remains the same; however, it is now our practice to include all patients with neurologically complete spinal cord injuries irrespective of their being Upper or Lower Motor Neuron lesions.

Additional selection criteria established in the initial design remain intact. The prospective subject: (1) must have sustained a neurologically complete spinal cord lesion; (2) must be able to sit on a commode, with or without assistance, for at least 45 minutes; (3) must be able to eat a regular diet; (4) must drink at least 2,000 cc fluid daily; (5) may take a prescribed stool softener, but no harsh laxatives; and (6) must engage in all usual physical activities of a routine spinal cord injury rehabilitation program.

The Bowel Training Program Logistics are as follows:

1. The patient is checked for fecal impaction, and if present, the impaction is removed by the patient or by a nursing attendant.
2. The patient assumes a sitting position on a commode within 30 minutes of completing the evening meal.

3. The patient attempts to defecate by straining, pressing and/or massaging the abdomen.
4. If the patient is unable to defecate, he/she will, if able, insert a lubricated, gloved finger into the rectum to stimulate defecation.
5. If no evacuation occurs within 15 minutes following insertion of a gloved finger into the rectum, a dulcolax (bisacodyl N.F.) or glycerine suppository is inserted into the rectum by the patient or the nursing attendant.
6. If evacuation does not occur within 30 to 40 minutes, the patient is returned to the hospital bed (with diapered protection) to await the delayed (but anticipated) response.
7. If on two successive training days adequate evacuation is not achieved, a disposable water enema (Fleets) is administered.
8. Data reflecting completion of steps 1-7, as well as information about any variation for the established procedure are recorded.

At the time of patient discharge from the Rehabilitation Center, the bowel program will be designated as medically satisfactory or medically unsatisfactory by the attending physician. In addition, the program will be rated as ACCEPTABLE or UNACCEPTABLE by the patient.

Criteria for medical evaluation of the patient's bowel training program are as follows: (1) regularity of bowel movement; (2) continence between defecations; (3) absence of gastrointestinal tract (bowel) discomfort; (4) absence of complicating conditions including fissures, hemorrhoids, etc.; and (5) adherence and compliance with parameters of the program.

The spinal cord injury patient's bowel program status is being assessed upon return for follow-up medical examination one month, six months and one year after injury and annually thereafter for a period of five years. All variations and/or adjustments, modifications, etc., instituted in the bowel management program by either the patient, his family or attendant such as time and frequency of defecation, medications, diet, fluid intake, mechanical stimulation, problems and other observations are recorded at the end of each re-evaluation. During each follow-up examination the medical success or failure, as well as the level of patient satisfaction, (acceptability/unacceptability) will be determined and recorded for eventual analysis.

FINDINGS TO DATE: As of 29 July 1980, thirty-eight discharged patients are participating in the project. Among discharged patients, six sustained their injuries less than one year ago. Hence, first annual follow-up data have not been collected. Among the remaining patients, four have had the second annual visit; sixteen have had the first. Four patients are being followed for annual evaluations by physicians residing in their local communities. When patients do not return to the SCI Center for their annual follow-up evaluation, the data collection questionnaire is mailed to the patient on the anniversary of injury along with a self-addressed stamped envelope. The patient is requested to respond to the questionnaire. To date, one patient has completed and returned the questionnaires; three remaining patients have not acceded to this request.

As anticipated and described, previously, substantial difficulty was encountered in identifying a suitable number of patients who met all criteria for inclusion in this study. High quadriplegics incapable of transferring independently to a commode are not included. In addition, study criteria exclude patients diagnosed as having neurologically incomplete lesions. As indicated, we no longer have two distinct groups of patients (Upper Motor Neuron lesions and Lower Motor Neuron lesions) in the study. If possible, at the termination of the study, we will analyze data by distinguishing between the group of Upper Motor Neuron patients and the group of Lower Motor Neuron patients. However, this categorical distinction will not be an absolute requisite for analysis.

Two unanticipated difficulties in identification of participating subjects have arisen. A number of patients who otherwise would have been suitable subjects have refused to participate and/or refused to defecate on the commode, despite their physical capacity to do so. An additional problem has resulted from the increased utilization of Halo traction in the treatment of cervical vertebral fractures. Our experience has shown that patients wearing body jackets which support the Halo traction are unable, during treatment, to develop sufficient strength and mobility to transfer independently. Therefore, even though we may assume these patients will eventually be able to perform this function, while the body jacket is worn defecation does not take place on a commode. Such patients are ineligible for inclusion in this study.

In summary there are thirty-three SCI patients presently included in the study. Subjects will continue to be identified until the cohort of forty patients has been selected. The forty subjects will each be followed over a five year period. Since all subjects have not been identified at present, analyses of preliminary data have not been pursued.

NOTE: Direct RT support for this project will be discontinued as of 5-31-81. After that time data will continue to be collected, analyzed and reported until the project has been completed as originally proposed and subsequently ammended. Those project related activities conducted after the upcoming discontinuation will be supported by non-RT sources.

APPLICABILITY: A comprehensive rehabilitation program of the spinal cord injury patient must include, if at all possible, a bowel training component. The bowel training program, if successful, must be satisfactory (from a clinical standpoint) to the physician and acceptable to the patient as well.

A bowel training program incorporating elements common to successful achievement of desired results, which can be instituted early in the rehabilitation process, may expedite the overall process and enhance the patient's long-term potential for vocational rehabilitation.

Personnel involved in the management and care of spinal cord injury patients will be able to utilize general findings and incorporate appropriate training modifications almost immediately. Of course, the exact nature of a bowel training program for a specific patient will be dictated by his/her unique medical needs. Yet, in general, appropriate modifications (if identified and validated) can be instituted at the onset of the bowel training. Likewise patients and their families or attendants will be able to benefit from new findings in addition to utilizing them as they aid and assist the patient in his/her bowel control program.

A more appropriate and acceptable bowel training program may develop from the findings of this study. The procedure has often been a "hit and miss" proposition due to lack of controlled implementation and follow-up. The project is designed to provide a more practical and scientific approach to management of the neurogenic bowel.

210 Electromyographic Findings in Spastic and Flaccid Spinal Cord Injury

Principal Investigator:	**Cecil Nepomuceno, M.D.**	
Status:	**Continuing**	
Dates:	**June 1977-August 1981 (Tentative)**	
Cost:	**Annual $12,808** **RT Annual $11,912**	**Projected Total $55,000** **RT % of Annual Total 93%**
Annual Report Reference:	**#14, Page 169, R-65**	

OBJECTIVES: To demonstrate positive sharp waves and fibrillation potentials resulting from UMN lesions and to distinguish them from similar electrical activity observed in LMN lesions. Demonstration of spontaneous activity will be achieved by use of electromyography. Differentiation will be attempted utilizing previously developed computer-assisted analysis procedures.

METHODOLOGY: Fifty spinal cord injury patients with neurologically complete lesions at the level of T10 or above will constitute the study population. These patients will be divided equally into two groups on the basis of flaccidity or spasticity of the lower extremities. A TECA, Model 4, Electromyograph will be used. The proximal middle and distal areas of both quadriceps, as well as the medial and lateral hamstrings will be examined. Positive sharp waves and/or fibrillation potentials will be recorded on magnetic tapes and light sensitive paper and graded. The magnetic tapes will be analyzed by computer to extract parameters from positive sharp waves and fibrillation potentials located by the program. For the positive sharp waves, an oscilloscope will be used to identify the locations of segments containing data of interest. These will include well defined sequences of positive sharp waves in which individual wave packets can be identified. Parameters for each wave packet will be determined and subjected to an analysis of variance to yield differences between lesions.

FINDINGS TO DATE: As of 25 August 1980, 50 spinal cord injury patients satisfying the **initial** criteria for assignment to the study had undergone EMG screening. Those subjects screened included forty (40) patients with spastic lower extremities and ten (10) patients with flaccid lower extremities. Of these fifty (50) patients screened, only 18 (12 spastic and 6 flaccid) were determined to have (a) recordable positive sharp waves **and** (b) fibrillation potentials - both of which are EMG parameters we require to be present for inclusion in the study population. These eighteen subjects represent 36% of the total patients to be studied, a figure substantially below that which we would have hoped to have identified by this juncture.

It has been somewhat of a surprise to the Investigative Team that so much difficulty has been encountered in the identification of patients with lower motor neuron (LMN) lesions which are, as described, characterized by flaccid lower extremities. Prior to initiating this inquiry, our literature review strongly suggested a much higher incidence of this type lesion. Our own experience has not borne this out and as a consequence we have found, at this time, 42% fewer patients with LMN lesions than planned. As of 25 August 1980, the originally projected data collection-analysis period had elapsed. At our present identification rate we will require a minimum of 14 additional months to identify the number of patients originally projected. Thus, we have requested permission to extend the data collection-analysis period/project termination date from 6/80 to 8/81. Recognizing the inherent problems associated with extension of a projected research/data collection-analysis time-frame, we have reduced the budget request for the coming year to compensate for the additional time required to complete the project.

The decision to request permission to extend the data collection-analysis time-frame was not unanticipated. In fact, the patient identification problem has created an on-going dilemma for the Investigative Team since the project was initiated. In the 13th Annual Report we described the patient identification difficulties being experienced when we stated:

> "Two unanticipated problems have been identified and were described in Annual Report No. 12: (1) fewer patients with flaccid paralysis have presented than originally predicted and (2) of those presenting, not all demonstrated positive sharp waves and fibrillation potentials. Thus, it is highly probable that as many as 20% more patients with flaccid lower extremities will be needed to assure acquisition of at least 25 patients meeting all criteria for inclusion in the data set. This may necessitate a slight extension of the time-frame originally projected in the original proposal. Such an extension would not necessitate an appreciable amount of funding."

Preliminary data on ten (10) patients (5 with spastic paralysis and 5 with flaccid paralysis) are presently being analyzed in our facility. During this period which is expected to be completed on or about 15 October 1980, patients will continue to be screened and, if possible, included in the study population. Following our review of the preliminary findings a decision will be made regarding whether the project should be continued, as planned, or terminated.

APPLICABILITY: The medical management problems of spinal cord injury patients who are either spastic or flaccid differ markedly.

During the stage of acute spinal shock, all bodily functions below the level of the lesion cease. The limbs and viscera become flaccid. However, as a spinal shock subsides, spasticity seems to develop in a majority of patients. Since the duration of spinal shock is uncertain (as well as difficult to quantify), the diagnostic procedure being investigated in this research initiative will, if verified, be beneficial to the clinician in helping him determine whether the patient will remain flaccid or eventually become spastic.

It follows that limited vocational rehabilitation programming can be initiated once the prediction of flaccidity or spasticity is made due to the known limitations of patients with either sequela. Certainly, some vocational assessment and planning can be initiated once the eventual physical capacity of the patient has been reasonably determined. There will be, of course, exceptions to every rule: the technique/procedure will not be, therefore, without its shortcomings in a few instances. Overall, however, the prognostic capability, which verification of the objective or hypothesis will impart to the entire rehabilitation team, will assure appropriate vocational and functional goal setting for the patient.

The information and findings growing out of this study will be of value to those physicians and paramedical personnel responsible for the care and management of the spinal cord injury patient. The procedures applied herein are capable of disclosing the pathological state of the

spinal cord segment below the neurological level of spinal cord injury, specifically the integrity of the spinal centers for bowel, bladder and sexual (genital) regulation.

At present there is no suitable way to evaluate the pathological state of the spinal cord segment below the level of injury **in vivo**. The analysis technique described and utilized in this study should prove to be an effective method of determining the condition of the spinal cord and as such, is a clinically useful "tool" for physicians treating SCI patients.

211 Development and Evaluation of a Communications, Control, Education and Entertainment System (C2E2) for the Severely Disabled Based Upon Commercially Available Microcomputer Systems

Principal Investigator: James T. Rogers, C.E.T.

Status: Continuing

Dates: October 1978-March 1981

Cost: Annual $27,570 — Projected Total $82,000
RT Annual $26,674 — RT % of Annual Total 97%

Annual Report Reference: #14, Page 347, R-69

OBJECTIVES:

1. To develop and demonstrate the usefulness and economic feasibility of microcomputer system applications for purposes of communication, environmental control, computer aided instruction (CAI) and entertainment for persons with severely disabling conditions.
2. To disseminate system information and otherwise promote, encourage and stimulate further applications and expanded utility via the development of additional software and hardware.
3. To solicit, evaluate and disseminate software and hardware designs created expressly for use by the severely physically disabled.

METHODOLOGY: A model multi-purpose microcomputer system for use by the severely disabled has been designed and constructed using commercially available and custom-made system components. Appropriate software has also been developed, implemented and refined. Project-related system information has been disseminated to the rehabilitation community, microcomputer enthusiasts, potential user groups, etc.

FINDINGS TO DATE: The model multi-purpose system for use by the severely disabled has been designed and constructed. Its usefulness and economic feasibility for purposes of communication, environmental control, computer aided instruction (CAI) and entertainment have been demonstrated. The television control, power control clock/calendar section, telephone control section, education/instruction section, text writer and games/music sections of the Master Control Program have been completed. Presently the investigators are involved in the development of an advanced voice recognition module which will have more complex programming capabilities.

APPLICABILITY: Successful development of a microcomputer system for use by the severely physically disabled, coupled with the involvement of computer hobbyists in the development of future hardware and software improvements, will allow patients to address many physical needs and perform numerous activities of daily living with minimal assistance from family members or attendants.

Utilization of units for environmental control, communication, entertainment and education also will meet numerous psychological as well as physical needs of the severely physically disabled.

212 Effects of Abdominal and Lower Limb Compression on Cardiopulmonary Response and Energy Cost in High Spinal Cord Injury Patients

Principal Investigator: Chi-Tsou Huang, M.D.
Status: Continuing
Dates: June 1978-June 1981
Cost: Annual $40,451 — Projected Total $105,000
RT Annual $31,255 — RT % of Annual Total 77%
Annual Report Reference: #14, Page 421, R-70

OBJECTIVE:

1. To determine the value of pneumatic compressive devices in preventing the occurrence of orthostatic hypotension among patients having recent injuries to the cervical spinal cord.

METHODOLOGY: Using a Mobile Automatic Metabolic Analyzer (M.A.M.A.), data will be collected on metabolic and cardiopulmonary responses of neurologically complete cervical spinal cord injury patients during movement to and maintenance of six predefined postural changes while wearing an inflatable abdominal corset or bilateral pneumatic leg splints. These patients will be divided into two groups based upon their level of lesion. Group I will be comprised of 14 patients whose level of lesion is C6 or C7 while Group II will consist of 14 patients whose lesion level is C4 or C5.

FINDINGS TO DATE: As of May 1980, 7 patients had been entered into each group. All subjects were tested according to the established protocol. This included energy expenditure measurements without compressive devices, with the abdominal corset and with pneumatic leg splints.

Based upon analysis of preliminary data, the following trends were suggested:

1. The level of lesion in quadriplegics was relatively unimportant in determining pulmonary and cardiovascular responses to tilt.
2. The application/use of assistive compressive devices did not maintain pulmonary ventilatory parameters during tilt.
3. In quadriplegic patients the application/use of assistive compressive devices helped maintain cardiovascular parameters (blood pressure and heart rate) during head-up and head-down tilt.
4. The abdominal corset appeared to be more effective than pneumatic leg splints in maintaining blood pressure at pre-tilt levels, however additional comparisons are required.
5. A tidal volume of 340-400 mls was maintained most easily by placing the subject/patient in a supine position and eschewing assistive compressive devices.

APPLICABILITY: It is desirable that tolerance to postural change be achieved during the early physical rehabilitation of patients having lesions of the cervical spinal cord so they may participate in tiltable treatments. Moreover, quadriplegics cannot begin adapting to wheelchair confinement until able to tolerate an upright position. If artificial abdominal support and/or lower limb constriction with an easily achievable effective pressure range can be shown to prevent cardiopulmonary distress and/or reduce energy costs associated with achieving and maintaining an upright posture among quadriplegics, their initial rehabilitation will be facilitated.

213 Didronel in the Prevention of Heterotopic Ossification Following Spinal Cord Injury - Determination of an Optimal Treatment Schedule

Principal Investigator:	Samuel L. Stover, M.D.	
Status:	Continuing	
Dates:	June 1979-June 1984	
Cost:	Annual $17,548 RT Annual $12,683	Projected Total $104,085 RT % of Annual Total 72%
Annual Report Reference:	#14, Page 375, R-73	

OBJECTIVES:

1. To determine the optimal time-after-injury Didronel therapy should be instituted for maximal prophylactic effect.
2. To determine the optimal duration of Didronel therapy for maximal prophylactic effect.
3. To establish dosage-administration recommendations for Didronel which will yield the maximal prophylactic effect.

METHODOLOGY: One hundred fifty (150) SCI patients who are admitted to the Regional SCI System between and 0 and 12 days after injury, whose lesions are neurologically complete (or incomplete with residual function less than a classification of motor-nonfunctional), who are at least 16 years of age and who are not pregnant will comprise the study sample. These patients will be subcategorized into early and late treatment groups and further divided into three and six month administration groups. X-ray films of both hips will be obtained one day prior to initiation of Didronel therapy, at the end of each treatment period and at one year post injury.

FINDINGS TO DATE: Nine (9) patients have been assigned to the early (15-44 days) or late (45-120 days) treatment groups based upon their time of admission to the UAB-SCI System following injury. These patients have been subcategorized into three and six month administration groups. A-P x-rays have been acquired on each patient at time of entry into the study. Didronel administration was initiated in accordance with the appropriate therapeutic regimen. Preliminary results are not yet available.

APPLICABILITY: The high incidence of heterotopic ossification following spinal cord injury and other severe neurological injury or disease suggests it is a frequent complication found in patients who are admitted for rehabilitation programs. When the heterotopic ossification is of such severity that it limits joint motion and increases or complicates the disability, impaired function may be of such degree that it limits ambulation or wheelchair independence and may even impair a patient's mobility to the extent that he/she must remain bedfast. Protracted periods of confinement in bed or abnormal sitting postures in wheelchairs may result in pressure areas and cause the formation of pressure ulcers.

In clinical studies, Didronel has been shown to be effective in preventing heterotopic ossification when given prophylactically after spinal cord injury.

Since heterotopic ossification frequently leads to extensive and costly hospitalization as well as an interruption of the vocational rehabilitation process it is warranted to pursue studies which directly impact on prevention rather than studying complications once they have occurred.

214 Prescriptive Arm Ergometry to Optimize Muscular Endurance in Spinal Cord Injury Patients

Principal Investigators: Chi-Tsou Huang, M.D.
Keith V. Kuhlemeier, Ph.D.

Status: Continuing

Dates: June 1979-June 1981

Cost: Annual $45,656 — Projected Total $96,338
RT Annual $39,833 — RT % of Annual Total 87%

Annual Report Reference: #14, Page 457, R-75

OBJECTIVES:

1. To determine the heart rate oxygen consumption relationship and mechanical efficiency in untrained paraplegics, quadriplegics and normals using graded arm ergometry and standard regression analysis.
2. To determine whether heart rate levels, optimal for increasing cardiovascular fitness in spinal cord injury patients, are best achieved during continuous, intermittent or progressive work bouts.

METHODOLOGY: Maximal work capacity for 30 SCI patients (10 with cervical lesions, 10 with upper thoracic lesions and 10 with lower thoracic lesions) as well as 10 normals will be determined by measuring heart rates during arm ergometry. All SCI patients will have neurologically complete lesions. The heart rate increment between resting levels and maximal levels will be determined. Each subject will perform work at a target work load of 50-watts for 10 minutes. Work will also be performed at faster and progressive rates. The maximal heart rate will then be determined for patients selected to participate in a personalized physical therapy program.

FINDINGS TO DATE: Five male subjects (4 normal and one T-7 paraplegic) participated in a pilot procedure to determine the maximal work capacity for SCI patients by measuring heart rates during arm ergometry. The most appropriate work rate was determined to be 50 revolutions per minute (RPM's). An initial work load of 0 watts was incremented by 25 watts each minute until a work load of 100 watts was attained. The subject was then instructed to crank the ergometer as rapidly and vigorously as possible for as long as possible. The final effort was designated as the terminal maximal work load. The heart rate of each pilot study subject increased steadily with increased work intensity, ranging from 75 bpm at 0 watts to 175 bpm at maximal intensity in the normal subjects and from 75 bpm at 0 watts to 150 bpm at maximal intensity in the T-7 paraplegic.

APPLICABILITY: It is desirable that adaptation to physical therapy programs be achieved during the early physical rehabilitation of patients having spinal cord injury, so they may participate in a personalized exercise program without creating undue fatigue or the possibility of a cardiopulmonary collapse. Ideally, the early physical therapy program should be accomplished with minimal energy expenditure since SCI patients are known to experience a marked metabolic depression and deviation from "normal" metabolism after injury.

In this study, the effect of three different exercise programs will be examined. The average work load which can be tolerated and endurance based on the patient's level and extent of injury will be identified. If an objective basis for prescribing physical therapy activities can be determined, it will be possible for many SCI patients to realize their maximum physical strength and endurance capability without untoward energy expenditure in the shortest time possible.

215 Assessing the Need for Post-Discharge Psycho-Social Services for the Spinal Cord Injury Patient

Principal Investigator:	**J. Scott Richards, Ph.D.**	
Status:	**Continuing**	
Dates:	**July 1979-July 1982**	
Cost:	**Annual $13,292** **RT Annual $10,202**	**Projected Total $76,345** **RT % of Annual Total 77%**
Annual Report Reference:	**#14, Page 657, R-76**	

OBJECTIVES:

1. To develop an instrument which will validly assess post-discharge psychological adjustment of the spinal cord injury patient.
2. To determine whether psycho-social problems exist in recently discharged spinal cord injury patients and if so identified, determine whether these problems change or shift in importance during the first post-discharge year.
3. To determine whether spinal cord injury patients or their families seek professional assistance for problems identified in Objective 2 and if they do not, for what reasons.

METHODOLOGY: A model of the psychological adjustment process to SCI will be formulated. An instrument (designed to be administered by an interviewer) consisting of a self-report component and a behavioral assessment component, will be developed to assess post-hospital adjustment to SCI. This instrument will be pilot-tested and, if needed, revised. The final instrument will be administered to 30 paraplegics and 30 quadriplegics within the first week following discharge, three months following discharge and one year after discharge. It will also be administered to 30 controls. The data will be analyzed and disseminated.

FINDINGS TO DATE: Formulation of a four stage "consensus model" describing the psychological adjustment process to spinal cord injury is near completion. The four stages are shock, denial, depression and re-integration. This project focuses on the latter three stages.

APPLICABILITY: Clinical experience suggests that adjustment to spinal cord injury can be a long and arduous process for both patient and family. A substantial portion of this process may occur after the patient is released from the rehabilitation hospital, which frequently coincides with the time the patient and family, of necessity, has lost the close professional contact they previously enjoyed with the multi-disciplinary rehabilitation team. Clearly, some patients, perhaps the majority, can make the transition from inpatient rehabilitation status to independent living without experiencing marked intrapersonal and familial distress. However, clinical experience would suggest there are certainly many others for whom the adjustment process is extremely tempestuous and prolonged, perhaps indefinitely so.

What this suggests is that an undetermined percentage of spinal cord injury patients and their immediate families experience psychological adjustment difficulties following discharge, of such profound dimensions as to require professional intervention. This is the time when the rehabilitation psychologist is typically least able to offer in-depth support because of geographic constraints, prohibitive inpatient demands, etc. The extent to which spinal cord injury patients seek out mental health or other social support services in the local community is unknown. For those who desire and/or could benefit from such services, a variety of factors may interfere with their initiation: architectural barriers, geographical constraints, transportation problems, "mental illness" stigma, etc. If the resistance to inpatient involvement with the rehabilitation psychologist or psychiatrist is an indicator, the problem of "mental illness" stigma may be the most significant barrier to the initiation of mental health service contact by the spinal cord injury patient who has returned to the pre-morbid setting.

216 Physiology of Vowel Production by Normal and Deaf Speakers

Principal Investigator: Samuel G. Fletcher, Ph.D.

Status: Continuing

Dates: September 1979-September 1981

Cost: Annual $31,192 Projected Total $64,370
RT Annual $20,546 RT % of Annual Total 66%

Annual Report Reference: #14, Page 677, R-77

OBJECTIVES:

1. To select two groups of deaf speakers with "good" and "poor" speech intelligibility.
2. To obtain listener response device and custom fitted devices for data collection.
3. To develop software program modules for acquiring data and producing a variety of graphic displays.
4. To collect a set of ten vowels in each of six consonant environments from each subject.
5. To conduct perceptual and acoustical evaluations of the vowel in the "words" spoken.
6. To generate a physiological description of the vowel spoken.
7. To analyze vowel-consonant coarticulation to identify patterns of motion to and from the vowels which appear to facilitate joint intelligibility of the sounds spoken.
8. To use factor analytic procedures to produce a mathematical model which identifies central features of tongue, lip and jaw actions of vowel articulation and use this abstraction to consider phonetic strategies that appear to underlie successful and nonsuccessful speech production patterns.

METHODOLOGY: The sample will be comprised of 30 young adult deaf persons. A recording of the utterances of 50 phonemically balanced (PB) words will be obtained and scored for intelligibility. Then five speakers with good and five with poor intelligibility will be chosen. A device will be built for listeners to identify vowels perceived.

The consonant sounds /p, t, k, f, s/ have been selected to use in standardizing vowel production patterns, while the vowels will include /i, ɪ, eɪ, ɛ, æ, ɑ, ɔ, o, ə, u/. Fifteen repetitions of each vowel in each consonant environment will be collected during each of six sessions. The pattern of consonant-vowel-consonant characteristics will be analyzed. Patterns of coarticulation that appear to facilitate or inhibit accurate sound production will be identified, and a mathematical model will be produced to isolate and identify specific physiological parameters which account for the major sources of variation in the vowel spoken.

FINDINGS TO DATE: The selection of an experimental group is progressing satisfactorily. The device for listeners to identify vowels perceived has been constructed. Pilot data on configurations of the palatal vaults of three normal subjects have been collected, and a new version of the glossometer has been developed. A program to calculate tongue position and configuration is presently being written.

The special instrumentation and pilot data were presented at the 1979 - American Speech, Language and Hearing Association in Atlanta, Georgia, November 16-19. New data on vowel production were presented at the June, 1980 meeting of the Alexander Graham Bell Society in Houston, Texas.

APPLICABILITY: Studies have shown that, on average, speech intelligibility achieved by severely to profoundly hearing impaired children is in the range of 20 to 30%. It deteriorates further in adulthood when the school environment is left. Such poor intelligibility renders the speech virtually nonfunctional in most work and social settings.

Experimental work has identified vowel distortions as a major source of listener errors in deaf speech. Acoustic disturbances have been identified in both the positions and transitions of the vowel formants.

The research will be used to test the hypothesis of restricted tongue positions and reduced consonant-vowel transitions postulated from prior acoustical studies. It will also be used to increase the effectiveness of treatment routines currently being developed to guide deaf speakers in improving speech production.

217 Voice Operated Response Unit (VORU) to be Used in the Psychological Assessment of Motor Impaired Subjects

Principal Investigator: James Rogers, C.E.T.

Status: New

Dates: June 1979-June 1981

Cost: Annual $16,760 — Projected Total $53,073
RT Annual $15,182 — RT % of Annual Total 91%

Annual Report Reference: #14, Page 393, R-74

OBJECTIVES:

1. To develop a Voice Operated Response Unit based on commercially available micro-computer components which will allow persons with impaired hand function to be administered a psychological test originally designed to be taken using paper and pencil.
2. To determine whether a voice-operated mode of responding to the MMPI creates an intrinsic bias.

METHODOLOGY: The electronic components required for configuring the Voice Operated Response Unit (VORU) will be selected, acquired, assembled and configured into a working prototype which will be tested for proper operation. Software (computer programs) for controlling the VORU system will be developed. Test items will be entered into the micro-computer and stored on magnetic disc. The reliability of the system will be tested. An Operators Manual and Patient Instruction Program will be written. The MMPI will be administered to a group of volunteers using the standard booklet format and voice operated mode. MMPI profiles will be tallied for each subject following each testing sequence. T-scores for all basic clinical and validity scales will be determined and analyzed.

FINDINGS TO DATE: VORU hardware has been acquired, configured and tested for proper operation. The hardware selected was an Apple II microcomputer with 32K of Random Access Memory (RAM), a high speed serial data interface, a Heuristics Speech Lab system and a single Disk II, disk memory system.

Development of system software is presently in progress.

APPLICABILITY: There is increasing interest in the psychological impact of spinal cord injury and other disabling conditions. Psychological tests, in conjunction with a clinical interview, are the primary tools available to rehabilitation psychologists for delineating the interaction between personality and disability. Because most psychological tests require use of the hands, there are numerous occasions in which psychological testing might be indicated but cannot be obtained. The proposed project, then, should be of interest to rehabilitation psychologists, in general, for the following reasons:

1. It will demonstrate the technology for administering the MMPI to patients for whom this instrument would be otherwise inappropriate;
2. It will demonstrate the cost-effectiveness of applying existing technology to clinical problems and settings;
3. It will create new MMPI-related research possibilities which heretofore did not exist; and
4. The technology, while designed, specifically, for MMPI adminstration, can readily be adapted for use with other kinds of psychological and vocational evaluation instruments whose use would otherwise be restricted.

218 Scleroderma-Like Changes in Spinal Cord Injury Patients

Principal Investigator: Samuel L. Stover, M.D.

Status: New

Dates: June 1980-June 1985

Cost: Annual $29,046 Projected Total $175,000
RT Annual $18,846 RT % of Annual Total 65%

Annual Report Reference: New Project - will appear in Annual Report #15. To be conducted in collaboration with the Northwestern University R&T Center.

OBJECTIVES: The objective of this study is to evaluate possible cause-effect relationships between autonomic nervous system dysfunction and scleroderma-like skin changes documented in several spinal cord injury (SCI) patients. Interest in this topic has been heightened by observations at this Center that a group of SCI patients, followed for several years after injury, developed dermatologic changes similar to those seen in non-SCI patients with a clinical diagnosis of scleroderma (progressive systemic sclerosis of PSS). In a pilot-study, skin biopsies acquired from five SCI patients revealed collagen types identical to those characteristic of generalized scleroderma. Epidemiologically, all five patients had sustained spinal cord injuries above the level of T-6. From a neurologic standpoint, it is known that patients with spinal cord lesions at or above this level frequently experience autonomic hyperreflexia. A histochemical study of skin autonomic function in one of these five patients revealed evidence of autonomic mediator changes.

Because a literature review did not reveal any previous reports of scleroderma-like skin changes in SCI patients and because the unusual incidence of scleroderma-like skin changes in patients with known autonomic dysfunction appears to be more than coincidental, we believe it is warranted, clinically, to pursue the inquiry.

METHODOLOGY: A series of 20 chronic spinal cord injury patients with scleroderma-like lesions will be identified for retrospective study; similarly, a series of 10 acute spinal cord injury patients will be identified for prospective study. The latter group will be divided into sub-groups of 5 patients each. One sub-group will be comprised of patients whose spinal cord lesions are at or above the 6th thoracic segment; the second sub-group will consist of patients whose spinal cord lesions are below the 6th thoracic segment.

Skin changes occurring in the retrospective study group will be graded in accordance with a scale developed by Rodnan and co-workers. Further extensive laboratory tests will be performed on blood and urine specimens from prospective study group subjects. In addition, serial skin biopsies will be acquired and examined, microscopically, with routine histologic staining techniques as well as indirect immunofluorescence techniques for collagen typing. Histochemical immunofluorescence will be used to study autonomic nervous system function.

Other special procedures including skin temperature gradient studies, comprehensive renal scintigraphy procedures and esophageal motility studies will also be performed.

Projected plans to analyze all data collected include the annual performance of discriminate analysis comparing data from (1) patients without evidence of scleroderma, (2) with evidence of scleroderma, (3) with injuries at or above the 6th thoracic segment, (4) with injuries below the 6th thoracic segment.

A multivariate analysis of variance may be used to compare the groups - across time - with subsequent analysis of variance if the multivariate analysis reveals/suggests any significant difference among the groups.

FINDINGS TO DATE: This project was formally approved by NIHR on 26 August 1980. No findings are presently available.

APPLICABILITY: Progressive systemic sclerosis or scleroderma is a collagen disease, the etiology and pathogenesis of which remains unknown. It has been hypothesized that collagen diseases have a vascular "basis." It has even been suggested that the autonomic nervous system is in some way responsible for these vascular changes, but supportive evidence is seriously lacking. Our clinical observations and preliminary investigations suggest, strongly, that scleroderma-like skin changes develop secondary to documented autonomic dysfunction. This study should help us understand the pathogenesis of these scleroderma-like changes. As an outgrowth, new methods of prevention and/or treatment are likely to be determined. Additional new knowledge will be acquired regarding the role of the autonomic nervous system in both normal and abnormal collagen metabolism. This could lead, in turn, to important new therapeutic modalities beneficial to SCI patients as well as patients with a variety of rheumatic disorders.

219 Skeletal Muscle Relaxants and Urological Function

Principal Investigators: Keith V. Kuhlemeier, Ph.D.
L. Keith Lloyd, M.D.

Status: New

Dates: June 1980-June 1982

Cost: Annual $26,951 Projected Total $53,687
RT Annual $18,004 RT % of Annual Total 67%

Annual Report Reference: New Project - will appear in Annual Report #15

OBJECTIVES: The overall purpose of the study is to determine the effects of skeletal muscle relaxants on smooth muscle such as that found in the human urinary tract. Agents such as diazepam, baclofen and dantrolene are used widely in spinal cord injury patients to control muscle spasms because there is little doubt they effectively diminish the severity of skeletal muscle spasms. However, there is a paucity of objective information describing their effect on smooth muscle. We will conduct **in vitro** experiments to determine the effects of skeletal muscle relaxants on contractile forces developed in human bladder muscle strips.

The following hypotheses will be tested:

1. Administration of skeletal muscle relaxants has an adverse effect on bladder function in humans.
2. Skeletal muscle relaxants reduce the intensity (force) of pharmacologically-induced contractions of canine and human bladder muscle strips **in vitro**.

In summary, the Objectives are to:

1. determine the dose-response relationship between diazepam and human bladder muscle contractile (a) tension, (b) velocity and (c) duration;
2. determine the dose-response relationship between dantrolene sodium and human bladder muscle contractile (a) tension, (b) velocity and (c) duration;
3. determine the dose-response relationship between baclofen and human bladder muscle contractile (a) tension, (b) velocity and (c) duration.

METHODOLOGY: Canine bladder tissue will be used in preliminary experiments to determine the appropriate size and configuration of muscle strips. Viability duration of these strips will also be determined to assure that observed changes are due to drug effects and not due to deterioration of the muscle preparation. The general experimental protocol will be similar to that reported by Labay and Boyarsky. We will then determine the effect of diazepam on spontaneous activity of bladder muscle. This will be accomplished as follows: A bladder muscle strip will be placed on an organ bath perfused with Locke's Solution #2. The solution will be continuously aerated with a 95% oxygen-5% carbon dioxide gas mixture. One end of the muscle strip will be anchored to the bottom of the organ bath and the other end will be attached to the tension measuring load cell. The muscle strip will be placed under an initial tension of 1.0 gm. Spontaneous alterations in tension will be measured by the load cell and recorded. A control experiment will be conducted in a system consisting solely of muscle strip and the perfusion solution. Subsequently, diazepam will be added to the system at various concentrations until the bath diazepam level is four times that of serum levels in humans who receive diazepam on a routine clinical basis. Subsequently, we will determine the effects of diazepam on acetylcholine-induced contractile tension in

bladder muscle. This will be accomplished as follows: Bladder muscle strips will be placed in the organ bath as described in the preceding comment. Following this, diazepam will be added to the perfusate. The muscle strip will be stimulated to contract by adding acetylcholine or barium chloride to the bath (acetylcholine exerts its effects through cholinergic receptors while barium chloride acts directly on muscle tissue). The maximum tensions developed, rate of tension development and the duration of induced contraction will be measured during perfusion with varying concentrations of diazepam (up to four times normal human blood serum levels or until the dose-response curve becomes asymptotic, whichever is higher).

During pilot studies, this procedure will be carried out using strips of canine bladder muscle. When pilot data have been collected and the experimental procedure perfected, we will begin using strips of human bladder muscle. Human bladder muscle strips will be obtained at the time of surgery from adults who have undergone prostatectomies and from children undergoing ureteroneocystostomies. The exact number of studies conducted will depend upon the availability of suitable bladder tissue; we anticipate performing these studies on three canine bladders and 10-15 human bladders. Following this, we will determine the effect of diazepam on barium chloride- and acetylcholine-induced muscle contraction in muscle preparations pre-treated with beta adrenergic antagonists and agonists. Specifically, in this series of experiments, the bladder muscle strips will be pre-incubated with propranolol to block, or isoproterenol to stimulate, the beta adrenergic receptors. The concentrations of diazepam used will be determined after completion of the previous experiments. This will allow us to examine the role of beta adrenergic receptors and the effects of diazepam on bladder function. Finally, the experimental procedures described for diazepam will be repeated with dantrolene sodium and baclofen being used instead of diazepam.

FINDINGS TO DATE: This project was formally approved by the NIHR on 26 August 1980. No findings are presently available.

APPLICABILITY: It is the clinical impression of many physicians that diazepam and possibly dantrolene decrease bladder tone therapy causing increased residual urine volume in patients with neurogenic bladder. As indicated, while the effect of skeletal muscle relaxants on skeletal muscle has been observed, clinically, little is known with any degree of certainty regarding their effects on smooth muscle. Information acquired through completion of this research project will, in all likelihood, improve the clinician's ability to manage SCI patients with neurogenic bladder.

220 Determinants of Optimal Enhancement of Endurance

Principal Investigator:	**Keith V. Kuhlemeier, Ph.D.**	
Status:	**New**	
Dates:	**June 1980-June 1982**	
Cost:	**Annual $28,262**	**Projected Total $56,524**
	RT Annual $22,500	**RT % of Annual Total 80%**
Annual Report Reference:	**New Project - will appear in Annual Report #15**	

OBJECTIVES: We will conduct experiments that will provide a rigorous, quantitative evaluation of the roles (1) frequency, (2) intensity and (3) duration of exercise play in increasing endurance. In addition, we will evaluate the role of creatine phosphate as the biochemical key that initiates enzymatic induction responsible for increased fitness.

The following hypotheses will be tested:

1. A decrease in the level of muscle creatine phosphate is the stimulus for development of increased muscular endurance:
    a. Exercise at an intensity which does not decrease creatine phosphate is insufficient for the development of increased endurance.
    b. The rate at which endurance increases is proportional to creatine phosphate depletion and is independent of the duration, intensity and frequency of exercise, except for indirect effects on creatine phosphate depletion.

2. The effects of training program parameters such as frequency, intensity and duration of exercise can be quantitatively assessed and analyzed if training regimens are rigorously controlled and appropriate analytic techniques are employed to analyze collected data.
3. The efficacy of prolonged training programs can be predicted on the basis of data acquired during the first week of conditioning activities if the effects of the specific program on muscle creatine and creatine phosphate levels are determined.

In summary, the Objectives are to:

1. determine, quantitatively, the relative importance of frequency, intensity and duration of exercise in a training program designed to increase endurance, using a rodent model;
2. determine whether creatine and creatine phosphate levels in muscle, measured immediately post-exercise, are significantly correlated with increased fitness;
3. determine if data acquired during a one-week training program can be coupled with knowledge of muscular levels of creatine and creatine phosphate and used, in turn, to predict results of a protracted training regimen.

METHODOLOGY: The work plan will enable us to determine the relative importance of various parameters (e.g., frequency, intensity and duration) of an exercise/conditioning program, and the importance of creatine and creatine phosphate as the "biochemical switch" facilitating increases in physical endurance.

The protocol, itself, calls for subjecting rats to one of several training regimens. Baseline performance data will be acquired at the beginning of the study period. After eight weeks of training, the endurance of each animal will be determined. At the end of a regular training bout - one week later - (end of week nine), the animal will be sacrificed, the gastrocnemius muscle rapidly removed, frozen and analyzed for creatine and creatine phosphate.

We will study the parameters of **frequency** (the number of exercise bouts per week), **intensity** (the severity of exercise which can be altered by varying the treadmill speed or the degree of incline up which the rats must run) and **duration** (minutes of exercise per bout). These parameters will be examined utilizing a factorial design. This statistical approach should yield maximum information per animal. In the initial experiments, rats will be forced to run at 15 or 30 meters/minute (15 meters/minute is a "stroll" for laboratory rats; 30 meters/minute is a "brisk jog"). For this set of experiments the incline of the treadmill will be varied from 0 to 8° and ultimately to 16°. There will be a frequency of 1, 3 or 5 exercise bouts per week. The varying combination of frequency, intensity and duration will be used to "train" a total of 10 laboratory rats. It should be pointed out, however, that not all animals are able to learn to run on treadmill. Approximately 80% of the Long Evans strain can be trained to run (K. Kuhlemeier, unpublished observations) and a somewhat smaller fraction of Sprague Dawley rats can be trained to run on a treadmill. This fact necessitates the acquisition of more rats for study purposes than will ultimately participate in endurance training. We will use female rats since their body weight is affected less by an exercise program than that of male rats. Male rats fed **ad lib** and exercised with some degree of regularity, typically gain less weight than unexercised control; exercised female rats gain weight at approximately the same rate as unexercised control animals. In this set of experiments, each exercise bout will be 30 minutes in length during the early stages since this is sufficient to elicit significant training effects (K. Kuhlemeier, unpublished observations); later experiments will examine the effects of longer and shorter exercise bouts.

We will then study an additional group of animals trained three times per week at each of the frequencies, intensities, and durations described previously. If there are significant differences in endurance between animals trained one time per week and those trained three times per week, additional studies utilizing twice per week exercise bouts will be conducted. Next, we will study an additional group of laboratory rats trained five times per week. Similarly, if there are significant differences in animals trained three and five times per week, additional studies utilizing four times per week exercise bouts will be conducted. Following this, we will study the frequency of exercise, per day, and the effect of speed and incline (degree pitch) of running. Specifically, upon completion of the initial experiments, other parameters will be examined. These will include but not be restricted to: (1) frequency of exercise per day, since some evidence suggests multiple bouts are more effective than longer, single bouts even though the amount of work performed is mathematically equivalent (viz., "is running one-half mile in the morning and one-half mile in the

afternoon more or less effective in increasing endurance than running one mile one time per day?" and (2) the effect of speed and incline (degree of pitch) of running **per se** as opposed to the amount of effort as reflected in energy consumption. It is presently held that it is the level of oxygen consumption that determines effectiveness of training/conditioning. However, running uphill may be more (or less) effective than running at a faster pace on level ground, despite the fact oxygen consumption for these different types of exercise may be identical.

We will then seek to determine the quantitative importance of the parameters such as frequency, duration and intensity through use of multiple regression analyses. Next, we will study the role of creatine and creatine phosphate as the "switch" using correlation techniques.

The levels of these substances at the end of an exercise bout will be determined with standard techniques and correlated statistically with the increase in endurance. A significant correlation will mean there is a relationship between the variables, although not necessarily a "cause-and-effect relationship."

Finally, we will consider the possibility of utilizing short-term exercise programs, coupled with creatine and creatine phosphate levels in muscle, as a possible predictor of the efficacy of longer training programs. If a significant correlation between muscle creatine or creatine phosphate levels and endurance exists, four different exercise programs ranging from modest to heavy will be conducted. This process should yield a wide range in measurable endurance after eight weeks of training. Subsequently, 20 rats will be assigned to each exercise regimen. Ten rats will be sacrificed after one week of training and their muscles removed, immediately post-exercise, and analyzed for creatine and creatine phosphate. The remaining ten rats in each group will complete the eight-week program and then be retested for quantification of their "physical endurance level." If creatine and creatine phosphate levels after one week of training are highly correlated with the results of an eight-week training program, the knowledge of the effects of various training programs can be accrued at eight times the previous rate.

FINDINGS TO DATE: This project was formally approved by NIHR on 26 August 1980. No findings are presently available.

APPLICABILITY: If the mechanical determinants and molecular stimulus for increased physical fitness can be identified, it will be possible to formulate highly efficient physical therapy programs for persons with a wide variety of physical disabilities. Ideally, we will be able to apply our findings to the clinical setting thereby increasing the rate of the rehabilitation process (shortening the required period of hospitalization) while concomitantly increasing the gamut of activities in which persons with severe physical disabilities may participate after hospital discharge.

221 Increasing Social Comfort and Social Skills Level of Individuals with Obvious Physical Disabilities

Principal Investigator:	**Sue Hobart, M.A.**	
Status:	**New**	
Dates:	**June 1980-June 1982**	
Cost:	**Annual $13,306**	**Projected Total $26,612**
	RT Annual $8,885	**RT % of Annual Total 67%**
Annual Report Reference:	**New Project - will appear in Annual Report #15**	

OBJECTIVES: The overall purpose of this project is to:

1. develop a structured Social Skills Training Package (SSTP) (in videotape format) for use with physically disabled rehabilitation clients;
2. assess the SSTP's ability to improve social comfort and social skills in this population;
3. determine whether recently disabled and long-term disabled clients differ in the benefits derived from training with this package;
4. determine whether there are interactions between specific client (organismic) variables and specific treatment (situation) variables.

To achieve the overall purpose, the following hypotheses will be tested:

1. Patients with low self-devaluatic e., little loss of self-esteem following disability) will demonstrate greater overall social c mfort and social skills, both before and after training, than will patients with high self-devaluation (i.e., greater loss of self-esteem following disability).
2. Regardless of self-devaluation level, patients receiving cognitive/social skills training will demonstrate greater changes in social comfort and social skills than will patients receiving a no-treatment, attention-only control.
3. There will be an interaction effect between self-devaluation and training:
    a. Cognitive/social skills training will result in greater changes in social comfort for patients with high self-devaluation than for patients with low self-devaluation.
    b. Cognitive/social skills training will result in greater changes in social skills for patients with low self-devaluation than for patients with high self-devaluation.
4. The following factors will be related to social comfort level: (a) age, (b) extent of neurological impairment, (c) marital status, (d) occupational status, (e) time since injury, (f) locus of control, (g) self-esteem, (h) functional impairment and (i) self-evaluation of body, intelligence and personality.

METHODOLOGY: We will, first, (1) identify interpersonal situations having the potential to create discomfort for disabled individuals and (2) select those situations to be used in the SSTP tapes. To devise a program directed toward sensitive interaction situations most likely to arise as a function of disability, the procedures established by Goldfried and D'Zurilla will be followed. These investigators presented a methodology for systematically and empirically developing valid skill training programs directed to the behaviors required by specific populations.

Content of training tapes will be based on situations judged to create social discomfort for wheelchair-bound individuals, as determined from interviews with patients, disabled persons in the community and rehabilitation center staff members. Scenes may focus on refusing insistent offers of help, asking for assistance, dealing with intrusive questions about disability, and/or initiating conversation with able-bodied people. Such situations were ranked as relatively high in producing social discomfort in Dunn's study with spinal cord injured patients.

Subsequently, we will produce the tapes to be used in the project. The specific treatment which will be presented on videotape although focusing on training situations appropriate to the needs of the physically disabled, will follow a format for automated presentations devised by McFall and Lillesand for general assertion training which has been found to be effective with college students and psychiatric inpatients. The treatment paradigm consists of seven parts: (1) the narrator describes the situation, (2) clients are instructed to imagine an acceptable social response to the situation, (3) clients then view a model handling the situation appropriately, (4) the narrator provides coaching comments about an appropriate social response to the situation, (5) clients are instructed to reflect on their response and its correspondence to criteria for an appropriate response, (6) the situation is redescribed, and (7) clients are once again asked to imagine responding appropriately.

Each training session will follow the same format. However, different situations will be covered during the first two sessions, while the third will be a review.

Following production of the SSTP tapes, we will utilize existing material to produce a small series of videotapes on some non-social aspects of physical disability for use as controls. Specifically, control tapes will be created that are approximately equal in length to the training tapes, but which do not include content relevant to social functioning.

When both the "experimental" and "control" tapes have been completed, appropriate training procedures will be developed. A Training Specialist who will work with project participants will be trained in the use of the training procedures to ensure consistent presentation of materials.

At this point pre-selected psychological testing instrument (Rotter Locus of Control Scale and the Physical Disability Assertion Inventory developed by Dunn, Van Horn and Herman) will be adopted for oral presentation to subjects with limited hand function.

We will then develop behavioral role-play situations. Half the items will be situations utilized as stimulus materials on the training tapes; the remaining situations will serve as generalization items to be administered only at pre-test and post-test. Clients will be presented with audiotaped

situations and will be asked to provide an appropriate response which will be recorded on a second audiotape.

A validation session will be conducted using physically disabled community members and hospitalized volunteers. Revision in the audio-tape stimulus scenes will be made as required to arrive at a task for which there is variation in response among subjects.

Prior to actual use of the "experimental" and "control" tapes we will develop a scoring procedure for rating role-play responses. We hasten to add that criteria of socially comfortable behavior will be determined from the social skills training literature. For example, a subject's response to a given stimulus situation could be evaluated on relevance, assertiveness (as opposed to aggression or passivity), and hesitancy (latency to respond). Comments from socially-skilled physically disabled people obtained during identification of treatment/evaluation situations will serve as sample responses. Observers (who will be unaware of each treatment subject's locus of control status) will be trained to rate responses. Reliability of observer ratings will be assessed on sample responses prior to data collection.

Prior to assignment to treatment or control groups, the Locus of Control Scale will be administered to all subjects.

A block randomization procedure will be followed so that approximately equal numbers of high-scoring (externally-oriented) and low-scoring (internally-oriented) subjects will be assigned to treatment and control groupings. To the extent that it is possible, subjects will be matched on variables such as sex and level of functional independence. This method of assignment yields a design in which locus of control and treatment grouping are independent variables.

All subjects will also complete the Assertion Inventory and the Behavioral Role-Play Test during the pretreatment session. Subjects will then return for three 45-minute sessions (either training or control) spaced within a two-week interval. Following these sessions, all subjects will complete the post-treatment assessment, using the Assertion Inventory and the Behavioral Role-Play Test. Control group members will then be offered an opportunity to receive treatment at a future time.

Data will then be acquired and analyzed from (1) the early rehabilitation population sample (n=40) and from the long-term rehabilitation sample (n=40) in accordance with analytic techniques selected during the design phase of the project. (NOTE: several analysis techniques have been considered. They include: analysis of variance with repeated measures, analysis of covariance with pretesting scores serving as covariates for post-testing scores, or use of correlational techniques. Correspondence between outcomes from the various analyses will be noted.)

NDINGS TO DATE: This project was formally approved by NIHR on 26 August 1980. No findings are presently available.

PPLICABILITY: It is commonly acknowledged by rehabilitation personnel that following discharge from the rehabilitation setting, many clients withdraw socially, becoming significantly less active than prior to their disability. Frequently, these clients do not function anywhere near the level of their physical capacity. Similarly, clients who do remain active may experience considerable stress when interacting with the non-disabled. It would be beneficial if this discomfort could be alleviated by appropriate training incorporated into the overall rehabilitation process.

In this study we plan to develop a Social Skills Training Package for physically disabled persons that is largely self-contained and capable of being administered in different settings by personnel with markedly different professional experience and training. Video-taped modeling is the experimental treatment modality we have chosen because of its versatility and documented ability to reduce anxiety and increase knowledge. The research plan includes evaluation components to assess whether (1) the social skills training package improves social comfort and social skills and (2) client locus of control orientation differentially affects response to training.

222 Mechanisms of Pyelonephritis in Spinal Cord Injured Patients

Principal Investigator: George P. Hemstreet, M.D.
Status: Discontinued
Dates: June 1977-October 1980
Cost: Not Applicable
Annual Report Reference: #14, Page 205, R 67

OBJECTIVES: To investigate the mechanisms involved in kidney tubule cell destruction in chronic pyelonephritis.

METHODOLOGY: In the first phase of this project, kidney tubule cells from rat and human kidneys were cultured and radiolabeled with ^{51}Cr. The second phase focused on development of the ^{51}Cr microcytotoxicity assay and the growth of gram negative **E.coli** bacteria and the preparation of lipopolysaccharides. In the final phase, various cytotoxic mechanisms that may be involved in kidney tubule cell destruction were investigated. These mechanisms include measurement of direct cell mediated cytotoxicity and antibody dependent cellularcytotoxicity. Target cells include normal cultured kidney cells, normal cultured kidney cells treated with lipopolysaccharides and normal cultured kidney cells incubated with bacterial exotoxins.

FINDINGS TO DATE: Rats have been injected with purified glycolipid form **Salmonella minnesota** Re 595 in one kidney and injections of saline in the contralateral control kidney. Statistically significant differences ($p < .005$) in the inflammatory responses, with lesions similar to pyelonephritis have been observed in the Re glycolipid injected kidneys compared to the saline injected kidneys.

To investigate the presence of cytotoxic antibody to cultured rat kidney tubule cells, a ^{51}Cr release assay was used in which per cent cytotoxicity was determined by the amount of ^{51}Cr released by cell lysis, in the presence of antibody and complement. Normal rat kidney tubule cells were disaggregated and labeled with sodium ^{51}chromate. Cells were then incubated in the presence of guinea pig complement with sera from normal rats or rats receiving either intraperitoneal (i.p.) injections of Re glycolipid or intrarenal injections of Re glycolipid or saline. Control sera were either rabbit anti-rat kidney tubule cell serum (positive control) or fetal bovine serum (FBS, negative control).

Analysis of the data revealed a significant difference in per cent cytotoxicity at the 1:1 and 1:2 serum dilutions between normal rat serum and intrarenal saline injected serum when compared to intrarenal glycolipid injected serum ($p < .01$). There was no difference between normal rat serum or saline injected rat serum. A comparison of normal rat serum with i.p. injected glycolipid rat serum and rabbit anti-rat kidney tubule cell serum showed a significant difference between all groups ($p < .01$) at serum dilutions ranging from 1:1 to 1:8.

To investigate possible genetic predisposition to kidney tubule cell death and pyelonephritis, lipopolysaccharide (LPS) responsive C3H/HeN mice and LPS non-responsive C3H/HeJ mice were studied. Each strain of mice received weekly injections of purified glycolipid prepared from **Salmonella minnesota** Re 595 in the right kidney. The contralateral kidney served as a saline injected control. At the end of four weeks, animals were sacrificed and kidneys removed for histologic evaluation.

A pronounced inflammatory response was observed in the C3H/HeN responder kidneys which was significantly different ($p < .01$) from those observed in the C3H/HeJ non-responder kidneys. A significant difference ($p < .04$) was observed in the degree of inflammation between glycolipid injected kidneys and saline injected kidneys in the C3H/HeN mice. Further analysis revealed no significant difference in the degree of inflammation between glycolipid and saline injected kidneys of the non-responder mice.

Competitive inhibition hemagglutination assays were performed on purified C3H/HeN and C3H/HeJ kidney tubule cell membranes to determine lipopolysaccharide receptor density variability. Analysis of results from six separate experiments revealed C3H/HeN kidney membranes bind and remove from solution significantly more ($p < .01$) glycolipid than C3H/HeJ kidney membranes. These results are indicative of greater LPS receptor density on the kidney tubule cell membranes of the responder mouse strain.

Antibody cytotoxicity tests were performed on cultured C3H/HeN and C3H/HeJ kidney tubule cells using a ^{51}Cr release assay. Per cent cytotoxicity was determined by the amount of ^{51}Cr released at

cell lysis. Kidney tubule cells from both strains of mice were pre-incubated with either Re glycolipid or cell culture media (to serve as a control group), labeled with sodium ^{51}chromate and incubated with either rabbit anti-Re glycolipid serum or fetal bovine serum (FBS, to serve as a control) in the presence of guinea pig complement. Tests were repeated four times.

The per cent cytotoxicity (averaged from four tests) of all anti-Re glycolipid serum dilutions tested on the C$_3$H/HeN responder kidney tubule cells pre-incubated with Re glycolipid was consistently higher than the C$_3$H/HeN cells pre-incubated with media alone, or the C$_3$H/HeJ kidney cells pre-incubated with either Re glycolipid or media.

As a continuation of the ^{51}Cr release cytotoxicity assays and competitive hemagglutination inhibition tests performed on rats and mice, these assays were extended to include cultured human kidney tubule cells. However, before these tests could be performed on the kidney cells, a method had to be developed for the isolation and purification of kidney cells from other human renal tissue components.

Human kidneys were acquired from patients undergoing radical nephrectomy or nephrectomy for benign disease. Kidneys were perfused and sections without gross evidence of extensive scarring were minced and washed with tissue culture media. For disaggregation, various enzymes and enzyme combinations were tested to determine techniques which yielded the greatest number of viable cells. A combination of trypsin and collagenase (type II) was found to yield the greatest number of viable cells per gram of tissue, with a range of 40.4 X 10^6 total viable cells/gram of tissue to 0.6 x 10^6 total viable cells / gram of tissue among 16 different normal kidneys. Viability ranged from 94% to 75% with a mean viability of 85.4% ± 1.6%.

Cells were further purified by fractionation in isokinetic or isopycnic gradients by velocity sedimentation. The average composition of cell suspensions prior to separation was 61.3% ± 7.4% pure with respect to kidney cells. Purification of kidney epithelial cells by isokinetic gradient effected a 90.4% ± 2.2% purification as compared to 79.8% ± 4.5% in the isopycnic gradient.

The importance of freshly purified human kidney cells is emphasized by the aforementioned ADCC and ^{51}Cr cytotoxicity tests in the rat and mouse model systems.

The ability to obtain pure human kidney tubule cell suspensions will enable us to extend the animal models to the human system in future research activities.

Since the last **Research Directory** reporting cycle, the following manuscripts have been submitted for editorial consideration or published or are currently "in press":

1. Hemstreet, G.P., Enoch, P.G., Lloyd, L.K. and Fine, P.R. (1980) Lipid A induction of cytotoxic antibody to cultured syngeneic kidney tubule cells. **Kid. Int.** (In press).
2. Hemstreet, G.P. and Brown, A.L. (1980) Re glycolipid induced pyelonephritis in responder (C$_3$H/HeN) and non-responder (C$_3$H/HeJ) mice. **Fed. Proc.** 39:141.
3. Hemstreet, G.P., Brown, A.L., Fine, P.R. and Cassell, G.H. (1980) Experimental pyelonephritis induced by Re glycolipid from **Salmonella minnesota** Re 595. **Abstr. 80th Ann. Meet. Am. Soc. Microbiol.** (B33) 22.
4. Hemstreet, G.P., Brown, A.L. and Fine, P.R. (1980) Immunological mechanisms of Re glycolipid induced pyelonephritis in responder (C$_3$H/HeN) and non-responder (C$_3$H/HeJ) mice. **4th Int. Cong. Immunol.** (In press).
5. Enoch, P.G., Hemstreet, G.P. and Fine, P.R. (1980) Tissue disaggregation of human kidney cells with further isopycnic and isokinetic gradient purification. **Invest. Urol.** (In press).
6. Hemstreet, G.P., Brown, A.L., Fine, P.R., Molay, M.P. and Wheat, R.W. Kidney tubule cell death induced by Re glycolipid from **Salmonella minnesota** Re 595. (Submitted for publication) **Invest. Urol.**
7. Hemstreet, G.P., Brown, A.L. and Fine, P.R. Lipid A induced kidney tubule cell cytotoxicity in C$_3$H/HeN and C$_3$H/HeJ mice. (Submitted for publication) **J. Exp. Med.**

APPLICABILITY: A more precise understanding of immunologic mechanisms associated with pyelonephritis will be useful in developing more appropriate techniques for the management of urinary tract infection and recurrent pyelonephritis. Understanding host-defense mechanisms may be important in prevention of acute and chronic pyelonephritis.

Northwestern University (RT-20)
Medical Rehabilitation Research and Training Center

CORE AREAS

Neuromuscular Studies Unit

To improve clinical management of neuromuscular dysfunction through development of advanced techniques in diagnosis and understanding of cause and control of neuro motor disturbance.

Rehabilitation Services Evaluation Unit

Improving management and delivery of rehabilitation services through evaluative feedback of programs, procedures and devices constituting the rehabilitative process.

Spinal Cord Injury Rehabilitation Studies

To develop new knowledge in the prevention of medical complications, the maximization of physical and psychologic function, resocialization and vocational achievement of the spinal cord injured.

Behavioral Studies Unit

To improve human performance of the physically disabled through new understanding of the behavior of the disabled individual, significant others and the providers of rehabilitative assistance.

NORTHWESTERN UNIVERSITY

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COMPLETED

CONTINUING

NEW

PROPOSED

Prediction of Driver Safety in Patients with Brain Dysfunction

Voiding Cystogram During Anal Stretch

Scleroderma-Like Changes in Spinal Cord Injury Patients (Collaborative Study with RT-19)

223 Post Rehabilitation Problems and Costs

Principal Investigator:	**S. Harasymiw, Ph.D.**	
Status:	**Completed**	
Dates:	**April 1977-June 1980**	
Cost:	**Annual $15,689** **RT Annual 0**	**Projected Total $97,057** **RT % of Annual Total 0**
Annual Report Reference:	**#13, Page 40, R-60**	

OBJECTIVES: The overall purpose of this project is to study severely disabled individuals during the rehabilitation post-discharge period to determine why some patients are maintaining successful adjustments while others require multiple hospital readmissions. The specific objectives are:

1. to obtain an accurate knowledge (type and rate) for each major disability of follow-up stresses and complications in medicine, mobility, self-care, work adjustment and performance, involvement with family and significant others;
2. to identify ways that patients have adjusted to problems arising post-discharge and identify techniques that can prevent complications and facilitate adjustment in other patients; and
3. to compare the needs, costs and recovery stages of the disabled who have gone through rehabilitation on first admittance and those of patients who have had several readmissions.

METHODOLOGY: The subjects for this study will consist of 320 randomly selected RIC patients discharged in 1976, 1977 and 1978. Dichotomus classification will be made in terms of patients who are **first admits** and **readmits**, regardless of the reason for readmittance. Patients will be categorized under the major categories of spinal cord injured, focal cerebral and "other."

The instruments for data collection are specially designed questionnaires to be administered through telephone and personal interviews.

Initial patient functional performance data at admission and at discharge will be taken from the Rehabilitation Information System (REHABIS) for patients discharged in 1976, 1977 and 1978. The information consists of demographic data, type and extent of impairment, type and extent of disability, type, amount and cost of services provided. REHABIS also has the capacity to input post-discharge follow-up data relevant to continuing handicapping conditions, vocational placement or extent of independent living and the amount and cost of continuing services. Home visits are also being made by research staff in instances where data is not otherwise available.

FINDINGS TO DATE: The project is currently in a six-month extension phase to analyze, implement, and disseminate the information to potential users.

Initial analysis on a selected sample of patients shows a statistically significant relationship when costs are grouped into single, double and multiple hospitalizations.

In terms of support services received up to the time of the six month interview, some 70% of the patients had accessed physician services. Physical therapy and nursing services were utilized by 50% of the sample, with an additional 25% receiving occupational therapy services.

Utilizing the Prognosis Indicator Instrument social workers rated patients on ten adjective scales, indicating the likelihood that the patient would develop problems in four major topical areas; estimating also the probability of unplanned readmission for a given patient. A factor analysis of the ratings for Time 1 and Time 2 were performed to reveal the underlying structure of the staff's judgments. These three factors can be labeled Potency (F1), Prognosis (F2), and Sociability (F3). All variables are uniquely accounted for, except for the intelligence variable, which seems to be related to all three factors.

These data, when correlated with empirical evidence of patients' readmissions and difficulties with reintegration into the community will provide a solid base for high risk patient identification. Subsequently, more cost-efficient intervention programs may then be established to anticipate problems before they precipitate unnecessary and enduring costs to the individual and society.

APPLICABILITY: It is anticipated that the close involvement of the RIC Social Work Department in the project will facilitate further dissemination and implementation of programmatic changes into the department's service delivery system. If service delivery modifications are implemented in an operating system, a much more efficient model can then be devised.

Policy change implications include third-party payments of follow-up services as an integral component of comprehensive medical rehabilitation. Of specific relevance is the concept of appropriate discharge point and monitoring of patients post-discharge to establish a preventive maintenance linkage with those patients who are specifically identified as high risk.

224 Therapeutic Recreation Outcome

Principal Investigator:	**S. Harasymiw, Ph.D.**	
Status:	**Completed**	
Dates:	**October 1977-September 1979**	
Cost:	**Annual Not Specified** **RT Annual Not Specified**	**Projected Total $58,066** **RT % of Annual Total 89%**
Annual Report Reference:	**#13, Page 56, R-72**	

OBJECTIVES:

1. To examine the type and degree of patient participation in therapeutic recreation activities and to develop a scaled measure of this participation.
2. To develop an index of social adjustment which reflects patient functional performance in the physical and social environment considered relevant to the expected outcomes of therapeutic recreation.
3. To determine whether there are interrelationships between type and frequency of participation in therapeutic recreation activities and the patient's functional performance during and following rehabilitation.
4. To determine the costs of rehabilitation and therapeutic recreation; particularly to determine the relationships between costs and adjustment outcomes.
5. To identify formal therapeutic recreation follow-up procedures which will optimize social and recreational achievement by the patient in the community.

METHODOLOGY: The study population consisted of 650 subjects, divided into cross-sectional and longitudinal groups. The cross-sectional sample consisted of over 500 first admission inpatients whose therapeutic recreation participation records were coded and entered into the Rehabilitation Information System (REHABIS). The longitudinal population consisted of 145 subjects, who were interviewed initially at hospital admission to determine their premorbid leisure activities and again at one month post discharge. These data were subsequently merged into the REHABIS system.

The cross-sectional study analysis consisted of 303 randomly selected therapeutic recreation (TR) participants at RIC. The TR participation data were collected as part of the normal therapeutic recreation activities monitoring process. This participation information was used as the basis of the random sample selection, coded and matched with the computerized records of the same patients derived from REHABIS. Linking the two data sets allowed comparison of TR information with demographic, medical, cost and psychosocial information contained within the larger data base.

In addition to data obtained on pre-morbid and in-house activities, activities twelve months post-discharge were monitored by telephone. The brief interview contained questions designed to gather information on activity patterns after leaving the hospital.

FINDINGS TO DATE: Cross-sectional data analysis shows a steady increase in recreation activity participation to about the midportion of the study period during which a plateau is in evidence. A slight increase is seen in the last period. This pattern seems logical since as patients begin to improve in function, they become progressively more active. The curve also mirrors the TR Departments'

activities in contacting new patients to make them aware of the TR program. Younger patients tend to have greater participation in TR activities than older ones. Also, as would be expected, individuals with higher functional levels participate more.

The longitudinal analysis part of the study was concerned with activities in which the individual continued to participate or no longer participates and the reasons why. Not surprisingly, the more active or strenuous the activity, the larger the proportion of individuals reporting cessation of that activity during the reporting period. Almost 60 percent of the subjects list physical limitations as the cause of their lack of participation in previously valued activities. Problems related to transportation, access, cost, equipment, personnel needs and feelings of comfort only slightly influence the reported changes in activity patterns.

Finally, new activity patterns post-discharge were investigated. The two most popular new individual activities were playing board games (ex. checkers) and walking for physical benefit.

APPLICABILITY: The information generated in this study is expected to be employed in the planning of recreation programs in clinical rehabilitation settings. In addition, this information would be useful to community recreation managers in the incorporation of programs for the physically disabled.

225 Comparative Study of Sling Supports for the Subluxed Hemiplegic Shoulder

Principal Investigator: B. Ritt, B.S., O.T.R.

Status: Completed

Dates: October 1978-April 1980

Cost: Annual $5,036 — Projected Total $17,090
RT Annual 0 — RT % of Annual Total 0

Annual Report Reference: #13, Page 90, R-109

OBJECTIVES:

1. Design a simple, safe and inexpensive method to accurately and objectively measure subluxation in the hemiplegic shoulder.
2. Develop criteria for adequate fitting of a sling.
3. Compare four major slings used at RIC to determine their effectiveness in reducing subluxation.
4. Determine to what extent normal activity changes the fit of a sling.
5. Establish guidelines for what type of sling to prescribe for the flaccid versus spastic subluxed hemiplegic shoulder.

METHODOLOGY:

Hypotheses:

1. Simple external (skin surface) measurements of the subluxed hemiplegic shoulder correlate with radiological findings in determining: (a) presence of subluxation and (b) degree of subluxation.
2. A correlation exists between extent of subluxation and the degree of elbow flexion in any given subject (Lever arm forces influence extent of subluxation).
3. Four types of slings: the Cuff type, Clavicular Strap, Figure 8 and the Shoulder Saddle effectively reduce subluxation of the hemiplegic shoulder in sitting and standing positions (a) after initial fitting and prior to activity and (b) after activity.
4. The Cuff type sling reduces subluxation in the flaccid hemiplegic shoulder better than the Clavicular Strap, Figure 8 or Shoulder Saddle slings.
5. The Clavicular Strap sling reduces subluxation in the spastic hemiplegic shoulder better than the Cuff type, Figure 8 or Shoulder Saddle slings.

A total population of 50 persons will be involved in this study. Of these, 10 will be able-bodied persons between the ages of fifty and eighty to serve as method controls. The remaining 40 persons will be chosen from inpatients at RIC. Ten (10) of these 40 persons will have three x-rays and external measurements to confirm extent of subluxation. The remaining 30 patients will have external measurements only and will undergo a prescribed set of activities and measurements

using the four test slings.

FINDINGS TO DATE: A quantitative method to measure subluxation without need for x-ray was designed and clinically evaluated in this study. The method utilizes an inexpensive device which measures the distance between a fixed point on the upper arm and the shoulder. X-rays of the shoulders of groups of normal and hemiplegic subjects validated the measurement technique. Using this method, four slings (Clavical Strap, Kagle, Shoulder Saddle, and Figure 8) were compared. Thirty hemiplegic subjects were measured with each sling, before and after activity, to determine the effectiveness of the sling's support. Results of the comparison demonstrated that all slings reduced subluxation; the Figure 8 sling maintained reduction the best after activity.

Clinical variables of muscle tone, pain, and range of motion showed no significant relationship with adequacy of sling reduction. However, these variables must be considered in meeting a patient's individual needs. Thus, guidelines for sling fit and prescription were developed for clinical use.

APPLICABILITY: The rehabilitation team can use the data collected to more efficiently determine what type of sling, if any, to issue to hemiplegic patients with subluxed shoulders. If the hypotheses are disproved, then the rehabilitation team can further explore alternative methods of treatment. If the data support the hypotheses then guidelines can be established for the most effective sling to issue to hemiplegic patients with flaccd or spastic subluxed shoulders.

226 Patterns of Sensory Integrative Dysfunction in Adult Hemiplegia

Principal Investigator:	**C. Chapparo, O.T.R.**	
Status:	**Completed**	
Dates:	**October 1978-May 1980**	
Cost:	**Annual $4,426**	**Projected Total $20,058**
	RT Annual 0	**RT % of Annual Total 0**
Annual Report Reference:	**#13, Page 109, R-112**	

OBJECTIVES: Previously, therapists at the Rehabilitation Institute of Chicago have not been equipped with one evaluation instrument which is specifically designed to identify types and patterns of existing sensory integrative dysfunction involving the variety of sensory systems affected by stroke. A tool, the Sensory Integration Test Battery, has been developed at the Rehabilitation Institute to aid occupational therapists in particular in determining such sensory integrative problems and their effect on functional ability.

It is the intent of the investigators that this be a pilot study, attempting to measure clusters or patterns of sensory integrative dysfunction and their relationship to functional ability in adult hemiplegia.

The main objectives of this project are:

1. To identify patterns of sensory integrative dysfunction in adult hemiplegia secondary to cerebral vascular accident.
2. To determine if there is an existing relationship between specific patterns of sensory integrative dysfunction and functional ability.
3. To determine if there is an existing relationship between types of sensory integrative dysfunction, psychometric status, types of speech and language dysfunction and neurological status.
4. To determine the effectiveness of the Sensory Integrative Test Battery for Adult Hemiplegia in identifying deficits in processing sensory information.

METHODOLOGY: A sample of 80 patients between the ages of 50 and 69 years with a diagnosis of hemiplegia secondary to cerebral vascular accident who are under the care of the Rehabilitation Institute attending physicians will be tested. Cluster analysis will be computed on scores obtained from the Sensory Integration Test Battery to determine existing patterns of dysfunction. In addition, these scores will be compared with scores obtained from a functional abilities profile and supplemental speech language and psychology information retrieved through REHABIS (computerized

rehabilitation information system at RIC). A neurological screening exam will be performed by a neurologist to verify diagnosis and to clinically localize the lesion site.

FINDINGS TO DATE: A Sensory Integrative Test Battery for Adult Hemiplegia has been developed at the Rehabilitation Institute of Chicago for use in determining the extent of such processing problems and their effects on functional ability.

This pilot study explored the efficacy of the use of this test battery on adult hemiplegic patients; and determined specific types and patterns of multisensory processing problems in right and left hemiplegia. Additionally, relationships between age, sex, neurological classification, speech and language classification, functional status and measures of sensory integrative dysfunction were computed.

APPLICABILITY: Occupational therapists at the Rehabilitation Institute of Chicago have begun to utilize this test instrument as a more consistent method of evaluating sensory processing problems in adult hemiplegics.

227 Vocational Follow-Up of Physically Restored Unemployed

Principal Investigator:	**S. Harasymiw, Ph.D.**	
Status:	**Continuing**	
Dates:	**April 1978-September 1981**	
Cost:	**Annual $49,610**	**Projected Total $133,233**
	RT Annual $27,131	**RT % of Annual Total 55%**
Annual Report Reference:	**#13, Page 33, R-45B**	

OBJECTIVES.

1. To establish a systematic vocational rehabilitation follow-up program for the spinal cord injured RIC inpatient population.
2. To validate the Job Potential Readiness Scale, a predictor instrument, which will assist the vocational counselor with preliminary screening of those patients who may be ready for a vocational program.
3. To demonstrate effectiveness and cost of such a systematic vocational follow-up program.

METHODOLOGY: The purpose of this project is to increase vocational placement of severely disabled, physically restored who are unemployed (PRU), by use and demonstration of a pre-planned vocational service follow-up program.

Pilot project R-45A demonstrated preliminary feasibility and operating procedures for such a program. This present definitive project will prospectively demonstrate the effectiveness of the program.

Current systematic application of earlier identified follow-up procedures as well as advanced development of a vocational predictive instrument, the Job Potential Readiness Scale (JPRS), should result in increased frequency, speed, and duration of vocational placement of the spinal cord injured.

The subjects will consist of former and prospective RIC patients discharged between January 1978 and June 1980 whose cases are considered closed (e.g., physically restored but unemployed) by the Vocational Rehabilitation Department at RIC. Additional criteria for sample selection are clients discharged from RIC who are in the labor market (not students, housewives or retired), and clients residing in the 312 telephone area code region.

The study population will be divided into two samples, cross-sectional and longitudinal. The cross-sectional group will be composed of 300 subjects. The longitudinal group will be composed of a sample of 100 SCI patients discharged from RIC during the project period. These subjects will be administered the JPRS at five points in time: 3, 6, 12, 18 and 24 months post discharge.

Rehabilitation data (medical and functional status, degree of disability, recidivism, costing information, activities of living functioning, etc.) will be monitored as retrieved from the com-

puterized data bases. MRSCICS and REHABIS (MRSCICS is the Midwest Regional Spinal Cord Injury Care System and REHABIS is the Rehabilitation Information System of the Rehabilitation Institute of Chicago).

FINDINGS TO DATE. The achievements to date include 94 completed JPRS longitudinal interviews which comprise a total active follow-up sample of 65 discharged rehabilitated RIC inpatients currently being monitored for possible vocational rehabilitation intervention. A separate cross-sectional sample utilized for JPRS development and validation includes 118 clients to date.

Findings will not be available until 1981.

APPLICABILITY: It is hoped that the procedures being studied and demonstrated in this project will maximize the frequency and speed of vocational placement of the severely physically disabled by integrating the vocational follow-up procedure into the comprehensive medical rehabilitation process.

228 Idiopathic Scoliosis: Structural, Ultrastructural and Chemical Pathology of Paraspinal Muscles

Principal Investigator: V. Sahgal, M.D.

Status: Continuing

Dates: October 1978-September 1982

Cost: Annual $22,311 — Projected Total $100,311
RT Annual $9,269 — RT % of Annual Total 42%

Annual Report Reference: #13, Page 72, R-98A

OBJECTIVES: The possible role of the spinal muscles in the causation and progression of some cases of "idiopathic" scoliosis has long been suspected. In this study morphological, histochemical, ultrastructural and quantitative electron microscope analysis will be done on the paravertebral muscles at the apex of the curve on either side of the curvature, with a biopsy from the gluteus maximus acting as a control muscle. The questions asked in the investigation are:

1. Is there a "side-related" pathology in paraspinal muscles?
2. Can gluteus muscle be taken as an "unaffected" region?
3. What is the nature of abnormality?
4. Is there any significant difference in quantitative distribution of cell organelles?

METHODOLOGY: The studies carried out on biopsy specimens are done in depth and include:

1. Morphology with standard haematoxylin and eosin, modified Gomori's trichrome and other stains. Enzyme histochemistry to detect myofibrillary ATPase, DPNH and phosphorylase activity which would differentiate fiber types having oxidative and glycolytic metabolism.
2. Histograms are made depicting the distribution and the number of Type I and Type II fibers for three regions in each biopsy (i.e., gluteus maximus, concave and convex apex). Mean fiber size diameter is also calculated for each fiber type in each region of paraspinal muscle.
3. Electron microscopic studies of all three kinds of muscles (gluteus maximus, concave apex and convex apex) for each biopsy.
4. Morphometric studies on electronmicrographs as described in detail in the report on chronic renal disease by Loud's method (1962).

Methods of muscle biopsy, histochemistry and morphometrics have been described in earlier Project RR-98. Routine EM processing and EM quantitative methods have been described in RT-20 Report #10, Project R-98A.

FINDINGS TO DATE. In this project six cases of "idiopathic scoliosis" have been carefully analyzed. Histochemical ATPase activity and morphometric studies on Paraspinal and non-spinal muscle reveal

Type II atrophy and unusual 2:1 ratio of Type I to Type II fibers. Pathological changes were not confined to the muscles in the spine region but were also found in gluteus muscle of the buttocks. Ultrastructural study showed the presence of abnormal hematine rods in two biopsies. Other changes included lipid and glycogen in the subsarcolemmal region. Ultrastructural quantitative studies of cellular organelles in four biopsies indicated high variations in the distribution of mitochondria, glycogen, lipid, etc., in various biopsies. The latter work is still in a preliminary stage and promises to be very useful when extended.

APPLICABILITY: Study findings will be applied toward a rational basis for diagnosis and ultimate clinical management of idiopathic and perhaps secondary scoliosis. The principal immediate use will be for establishing the basis of the pathologic mechanism causing scoliosis.

229 Muscle in Chronic Renal Disease

Principal Investigator:	**V. Sahgal, M.D.**	
Status:	**Continuing**	
Dates:	**October 1978-September 1982**	
Cost:	**Annual $21,019** **RT Annual $5,007**	**Projected Total $107,809** **RT % of Annual Total 24%**
Annual Report Reference:	**#13, Page 136, R-113**	

OBJECTIVES: The following questions were primarily asked:

1. What is the nature of the morphological or structural changes observed in the biopsy?
2. How are the different fiber types affected when seen on the basis of glycolytic or oxidative enzyme staining?
3. Is there any unusual storage of metabolic product or accumulation of other organelles in a cell?
4. Is there any quantitative significance as regards to fiber size and fiber type?
5. Is muscle involvement a primary or secondary effect?
6. What organelles in a fiber are especially affected at subcellular level?
7. What is the distribution of various cellular organelles in these biopsies?

METHODOLOGY: Fifteen patients who have been on chronic peritoneal or hemodialysis for over 6 months duration and who have clinically apparent muscle weakness will be included in this study. Patients with renal disease secondary to lupus erythematosus and diabetes will be excluded since these disorders can independently cause muscle involvement.

1. The patients will be examined clinically and muscle strength, both proximally and distally, graded from 0-5 according to the recognized technique.
2. The following blood tests will be performed on all patients: CBC and differential, SMA-12, serum calcium, phosphorous, CPK, Aldolase, LDH, sodium and potassium will also be done.
3. Nerve conduction velocities and EMG will be done in all subjects.
4. Muscle biopsies will be taken when clinically indicated from the appropriate proximal muscle. The proximal muscle is chosen to guard against the possible effects of chronic denervation in distal muscles due to dense polyneuropathy. When open biopsy cannot be obtained, needle biopsy will be used. The muscle obtained will be divided into two segments for studying morphology and histochemistry and electron microscopy.

FINDINGS TO DATE: The following points have been brought out very clearly in the present study of muscle biopsies from patients with chronic renal disease (10 patients studied to date):

1. There is a clear indication of nonspecific myopathic changes in muscle as seen histochemically as well as ultrastructurally. Degenerative changes are also apparent in some biopsies.
2. These degenerative changes, in most cases, are accompanied by distinct type II atrophy as seen from histochemical ATPase staining as well as histogram analyses.

3. Histochemically, both Sudan Black and Oil-red-O staining showed high lipid content in fibers of 3 biopsies. This high lipid content indicated the presence of neutral as well as conjugated lipid in the fibers.
4. EM quantitative studies showed that accumulations of glycogen granules, lipid/lipofuscin material and mitochondria were higher in subsarcolemmel areas than in central regions of muscle fibers.
5. High lipid content in three muscle biopsies of renal patients is particularly noteworthy. Except for polymyositis, other neuromuscular disorders do not show such high lipid content in their muscle fibers.
6. High lipid content of these 3 cases can not be correlated to their clinical diagnosis.

APPLICABILITY: This study hopes to provide a basis for understanding the mechanisms leading to neuromuscular complications in chronic renal disease. Its results will be utilized by physicians and scientists in medical schools, comprehensive rehabilitation medicine centers and renal dialysis units in hospitals.

230 Physical Therapy Functional Assessment Scale Validation

Principal Investigator: P. Kammerer, R.P.T.

Status: New

Dates: October 1979-September 1980

Cost: Annual $37,999 — Projected Total $37,999
RT Annual $10,508 — RT % of Annual Total 28%

Annual Report Reference: #13, Page 154, R-135

OBJECTIVES:

1. To develop and validate more sensitive and precisely scaled physical therapy testing measures for use in assessment of patient functional ability and functional restoration gain.
2. To develop normative data using the validated scale, for rehabilitation patients during the course of rehabilitation.
3. To determine the overall effectiveness and utility of the developed assessment instrument in clinical practice.

METHODOLOGY:The methods include an exhaustive review of the relevant literature which will identify the various functional ability scales appropriate for **physical therapy** (mobility and certain areas of activities of daily living). Items used in currently existing instruments will be arranged in hierarchical fashion and assessed for response patterns and quality of response. Gradations of item scales will be developed to provide more structured item bases. Patient prototype data will be gathered through qualitative observations and quantitative measures by the physical therapist. The patient assessments will then be correlated with existing ADL measures and rehabilitation outcome factors, routinely gathered in the REHABIS (rehabilitation information system at RIC) data base. Statistical analysis will then be performed to standardize the instrument and provide rehabilitation patient diagnostic norms that could be used in other comprehensive medical rehabilitation centers. A total of 200 first admission patients, 100 each with spinal cord injury and stroke will be employed to validate the new instrument, using item analysis, factor and cluster analysis and regression analysis to determine instrument reliability, validity, stability and utility.

FINDINGS TO DATE: Preliminary data analysis has begun. However, the full sample of 200 test results will be necessary in order for meaningful conclusions to be drawn.

APPLICABILITY: The completed functional assessment scale will be of use to a variety of persons in rehabilitation medicine. Specifically, the scale can be used by physical and possibly occupational therapists in the identification of behavioral units that require treatment and in the assessment of patient progress.

231 Pathogenesis of Muscle Atrophy in Hemiplegia

Principal Investigator: V. Sahgal, M.D.

Status: New

Dates: October 1979-September 1981

Cost: Annual $39,792 Projected Total $82,269

RT Annual $8,494 RT % of Annual Total 22%

Annual Report Reference: #13, Page 162, R-136

OBJECTIVES: To determine:

1. The abnormalities in nerve conduction velocities and EMGs in hemiplegia.
2. The possibility of an associated lower motor neuron dysfunction in some patients with hemiplegia.
3. Whether amyotrophy is a significant finding in hemiplegic patients.
4. Whether disuse, frozen shoulder and vasomotor alterations are contributing factors in the pathogenesis of hemiplegic amyotrophy.
5. Whether impairment of nerve conduction velocities is related to either reduction of cutaneous temperature or neural compression to which hemiplegic limbs are more susceptible than normal extremities.
6. Whether EMG and pathologic findings are suggestive of "myopathic"pattern.
7. The ultrastructural features of involved muscle in hemiplegia.
8. Whether the neurophysiological, histochemical and ultrastructural changes in the hemiplegic muscles are indicative of "loss of neural trophic influence" on skeletal muscles.

METHODOLOGY:

Clinical Examination: Twenty patients with CVA-caused hemiplegia will be given a detailed neurological examination. Special emphasis will be placed on parietal lobe signs. Muscular system examination will emphasize the presence or absence of tone and atrophy. Atrophy would be defined as loss of muscle bulk as compared to the normal side. A clinical method will be used to grade atrophy. Whenever possible, the results of EEG, CT Scan and/or angiography will be incorporated for localization of the lesion.

Electrophysiologic Studies: Nerve conduction velocities of the median and common peroneal nerves will be performed by the conventional techniques. The sound side will serve as control. F-loop latencies will be performed in the upper extremities to assess the integrity of the intraspinal pathway.

Electromyography: The proximal and distal muscles of the hemiplegic limb will be subjected to electromyographic examination using monopolar electrodes and a TECA-4 machine. The integrity of the myoneural junction will be studied using conventional techniques of repetitive stimulation. Permanent records will be kept of all the electrical studies.

Muscle Biopsies. To determine and quantify the structural and ultrastructural characteristics of muscles in 20 patients with stroke and hemiplegia. Mainly biopsies from the biceps muscle will be observed. The biopsies will be studied for their morphology using histological, histochemical, histometric and ultrastructural studies, including EM stereology.

Myoneural Junction: There have been reports (Chokroverty and Barron, 1970; Chokroverty, et al., 1973) of increase in size of subneural apparatus. The presence of cholinesterase activity at the myaneural junction would indicate the presence of motor innervation. Size of the subneural apparatus would be determined by morphometric studies and by staining method using an incubation medium with acetylthiocholine as substrate. Motor end-plate will be located at EM level by Engel's method (1970).

FINDINGS TO DATE: To date, three cases of hemiplegia have been studied. In all three cases there was marked atrophy of both proximal and distal muscles with hypotonia. The difference of

circumference between the normal side and the paralyzed side ranges from one-half inch to an inch. Circumference of arm was measured 6 cms. from the acromion process. Deep tendon reflexes were brisk in all of these cases. No fasciculations were observed. There was distinct range of motion limitation only at the shoulder-girdle level in all three cases.

All three cases were undergoing regular physical therapy programs consisting of passive range of motion and positioning.

Analysis of Data: The findings to date show that the significant atrophy seen in our cases was associated with parietal lobe syndrome with normal nerve conduction velocities indicating intact distal nerve segments, normal F-wave latencies indicating normal proximal nerve segment and, perhaps, anterior horn. Decreased interference pattern reflects inability to recruit motor units while positive sharp waves indicate membrane irritability. These findings suggest an intact anterior horn but an altered volitional control. The muscle biopsies show Type II fiber atrophy both histochemically and ultrastructurally, indicating selective involvement of the Type II variety of motor units. The presence of brisk reflexes indicates an intact or heightened stretch reflex.

From this data we conclude that the atrophy in these patients is not caused by any lesion of the anterior horn, the plexus, or peripheral nerve. Further studies to rule out the effect of disuse are in progress. To that end the patients with spastic hemiparesis of long duration with atrophy will be studied.

APPLICABILITY: The goals in the treatment of a hemiplegic limb are to maintain range-of-motion, muscle bulk and strength, and to restore functional use. Muscle atrophy and contraction are significant deterrents to effective range-of-motion and muscle strengthening and, thus, the total rehabilitative process. The mainstay of therapy now is passive range-of-motion and waiting for functional return. If we knew the mechanism of muscle wasting, then appropriate techniques could be applied for maintenance of muscle bulk. Reasons for muscular atrophy are going to be investigated. Depending on the findings of pathogenesis for muscle atrophy, appropriate measures would be taken and the mode of therapy accordingly would be determined. Effects of exercise on these patients will also be investigated.

232 Prediction of Post-Rehabilitation Clinical Risk

Principal Investigators:	**Carolyn Carlson, R.N., Ph.D.** **Nancye Holt, R.N., M.S.**	
Status:	**New**	
Dates:	**May 1980-December 1982**	
Cost:	**Annual $26,407** **RT Annual 0**	**Projected Total $183,217** **RT % of Annual Total 0**
Annual Report Reference:	**#13, Page 175, R-144**	

OBJECTIVES: The project intends to develop two reliable and valid instruments that will facilitate prediction of the degree of success or difficulty a client will have in maintaining health and preventing complications following discharge from a rehabilitation program. Following are specific objectives for the study.

1. To further develop and validate predictor instruments which are efficient and "transportable". These instruments will give an objective measure of those patients with varying degrees of risk for physical complications and/or psycho-social deterioration (regression) following discharge from a rehabilitation hospital. These predictive instruments will include prognosis scales relating to the following eight independent variables:

a. Knowledge of the effect of the disability on the body and subsequent health care needs, compliance, and utilization of learning
b. Physical status
c. Family and social support systems
d. Psycho-social functioning
e. Adjustment to disability
f. Financial resources
g. Community resources
h. Premorbid lifestyle and coping style

2. To determine the significance of demographic data in identifying predictive risk factors. Demographic data from the medical record (face sheet) and REHABIS will be incorporated into the study:

   a. Age
   b. Sex
   c. Marital status
   d. Level of education
   e. Ethnicity
   f. Length of time of initial acute care and rehabilitation hospitalization cost

3. To establish "norms" for degrees of risk and significant variables.

4. To establish a training program for professional nurses at the Rehabilitation Institute of Chicago to use predictor instruments in discharge planning.

5. Evaluate impact of instruments in preventing problems.

METHODOLOGY: Methods for developing an effective and valid predictor instrument are the: (1) Spinal Cord Injury Knowledge Questionnaire, for the first phase of the study and (2) The Outcome Predictor Scales, for the first phase and an adapted version for the second phase of the study on brain injured clients. Both tests have been developed and pilot tested by nurse clinicians and nurse educators in rehabilitation.

The SCI Knowledge Questionnaire will be administered to 150 first admission spinal cord injury patients one to two weeks prior to discharge and at the time of the first follow-up visit within four to eight weeks of discharge. The Outcome Predictor Scales will be completed by the nurse therapist assigned to the patient and by the assistant head nurse on the unit within two weeks of discharge. Outcomes will be assessed at four to eight weeks, six to eight months, and one year by someone who does not have knowledge of the predictions. Procedures using appropriately modified Outcome Predictor Scales will be followed for 150 first admission brain damaged, non-psychotic patients. The instruments will undergo data analysis and validation scrutiny to determine their consistency and reliability.

FINDINGS TO DATE: This project began in May, 1980. It is still in the first phase of data collection; no analysis of data has yet been done.

APPLICABILITY: Valid clinical risk prediction instruments would aid in the establishment of objective criteria for terminating a patient from an active Institute follow-up program. Therapist use of the predictive instruments early in the course of rehabilitation would identify those patients in need of more creative programs to improve the predictor variables. Finally, the instruments will provide an objective base that will allow for more efficient use of resources available to the patient.

233 Evaluation of Recliner Wheelchair

Principal Investigator: S. Harasymiw, Ph.D.

Status: New

Dates: October 1979-September 1980

Cost: Annual $34,627 — Projected Total $34,627
RT Annual $7,110 — RT % of Annual Total 21%

Annual Report Reference: #13, Page 176, R-159

OBJECTIVES:

1. To determine demographic and other characteristics that distinguish current recliner wheelchair users from nonusers in the relevant quadriplegic population.
2. To measure benefits of using the recliner, including avoidance of pressure ulcers and consequent rehospitalization, increased employment and earnings, and improved household income.
3. To measure the costs of purchase and maintenance of recliner units, and the average years of use of such units.
4. To determine the different methods of financing purchase of the chair.

METHODOLOGY: Two samples of functionally equivalent disabled persons will be identified, each group composed of 80 people. The recliner chair users will be paired with a similar "control" sample of nonusers identified from available registers of disabled persons. The individuals in both groups will be interviewed to determine the extent of functional capabilities, medical complication incidence, employment and educational status. In addition, the hospitals in which individuals have received treatment will be accessed for length of stay, cost, and reason for hospitalization admission.

FINDINGS TO DATE: To date, the subject population has been identified and a literature review conducted. The first phase of interviews directed at recliner chair users is nearly completed. Selection of the diagnostic specific samples to whom the nonuser study invitations will be sent is in progress.

APPLICABILITY: At present, many physicians do not know of the claims of the recliner chair for relief of decubitus ulcers nor have these claims been substantiated by controlled research techniques, though examination of individual welfare before and after chair purchase has led many physicians to prescribe recliners to subsequent patients. Description of the specific purpose and payback features of the chair could, if they were supported by reliable evidence, lead to wider prescription and use of the chair in appropriate circumstances. Reimbursement and voucher approval policies of insurance companies, welfare departments, and other third party payers would also be affected.

Texas Tech University (RT-21)
Research and Training Center in Mental Retardation

CORE AREAS

Work Potential of the Retarded

An exploration of the capacities for employment of mentally retarded persons including those not traditionally eligible for vocational rehabilitation services.

Counseling the Mentally Retarded and Improving Service Delivery

Central to this core is the role of the counselor in habilitating mentally retarded client. It has been broadened to include research which evaluates rehabilitation programs toward the end of improving service delivery

Research on the Special Needs of the Mentally Retarded with Multiple Handicaps

Activities which include special studies of the blind retarded and deaf retarded

Deinstitutionalization and Community Adjustment of the Retarded

Exploring key variables associated with successful community adjustment of the retarded and dealing with social skill training, community attitudes and community based residential facilities.

TEXAS TECH UNIVERSITY

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COMPLETED

CONTINUING

NEW

Texas Tech University

TRANSFERRED

Effects of Goal Setting Training on the Job Performance of the Mentally Retarded

PROPOSED

Family Involvement in the Habilitation of Developmentally Disabled Youth

Normative Vocational Evaluation Data for the Multiply Handicapped

Home Respite Care Services

234 Factors Underlying Successful Adjustment of the Retarded Released from Institutions

Principal Investigator:	Nancy J. Bell, Ph.D.	
Status:	Completed	
Dates:	July 1973-December 1979	
Cost:	Annual $11,665 RT Annual $8,395	Projected Total $195,000 RT % of Annual Total 72%
Annual Report Reference:	#9, Page 134, R-21	

OBJECTIVES:

1. To assess changes in the characteristics of the retarded individuals who are furloughed and discharged from residential facilities during an eight-year period.
2. To study the relationship between individual characteristics of the retarded persons and the critical behaviors they exhibit which result in success or failure in community adjustment.
3. To evaluate the role of various supportive services which are important in maintaining retarded persons in the community.
4. To study the quality of the personal, social and vocational life of retarded persons who have been furloughed or discharged from state residential facilities.
5. To compare the procedures and operational philosophies regarding furlough and discharge of residents in eleven residential facilities.
6. To assist not only the Texas Department of Mental Health and Mental Retardation, but agencies throughout the country, in developing more effective plans for selecting and training retarded individuals for community placement and for developing community services.

METHODOLOGY: The first stage of this project involved mailing questionnaires to a sample of 500 former residents of Texas state schools for the retarded who were discharged from 1968-1973. Various topics relating to community adjustment were addressed in these questionnaires. Background data on each subject were provided by the institutions. Personal interviews were conducted with a sub-sample of both those who responded and those who did not return the mail questionnaire. Stage One of the study was designed to permit comparison of those discharged in past years with those furloughed from institutions in 1974 in Stage Two. Stage Two of the study involved a longitudinal follow-up of those individuals furloughed for at least 90 days from any of the Texas state schools during 1974. These people were contacted shortly after separation from the institution and then periodically thereafter for approximately 2-½ years. Individuals from all age and ability levels were included in the sample. At each community contact, information was obtained from a personal interview with the client, a guardian or houseparent interview, and observations made by the interviewer about the client's behavior and environment. Guardians or houseparents were also asked to complete an adaptive behavior rating form. This rating, along with ratings of work skills, were also provided by state school personnel at the time of a subject's furlough. Upon a client's return to the institution, guardians and state personnel were asked to provide information about reasons for return and problems encountered in the community. Information was obtained for all subjects in the form of background and psychometric data from institution records. In order to compare community lifestyles and problems of previously institutionalized retarded persons with those of nonretarded community residents, a short form of the client interview was administered to 151 residents of Lubbock, Texas, who were similar to the retarded sample in age, sex, and ethnic characteristics.

FINDINGS TO DATE: **Mail Survey.** Based upon information obtained from approximately 39% of the sample, there were lifestyle differences between ability groups (IQ below 55 and IQ 55 or above) on most variables examined. The lower ability group was living a more sheltered life and appeared to be more dependent upon others than the high ability group. Examining adaptive behavior scores in relation to employment suggested that some minimal level of skills may be important, but beyond this minimum level, increasingly higher scores did not differentiate the unemployed from those employed. Thus, while it might be possible to develop predictive estimates of the likelihood of employment and degree of independent living based upon IQ and adaptive behavior scores, this prediction would not be very precise. The most important difference between high and low ability individuals may involve a variety of community support factors. These environmental factors include kind of training received while in the institution and agency assistance in the community. Those with IQ's above 55 received more training and agency support than did the lower ability group, which may in itself be a primary reason for community lifestyle differences. In comparing leisure activities of retarded persons with the non-retarded, the respondents were divided into three major groups for analysis: moderately retarded (IQ below 55), mildly retarded (IQ 55 and above), and community sample. Types of leisure activities were categorized as community interaction (attendance at movies, restaurants, clubs, etc.) or social activities (contact with friends, dating, etc.). In community interaction activities, the mildly retarded did not differ from the community sample. In the areas of social activities, however, participation of the community sample exceeded that of the mildly retarded group, which in turn exceeded that of the moderately retarded. Differences between the groups in socio-economic and marital status are possible explanations, as are IQ-related differences in social knowledge and skills, differences in opportunities to meet people and possible constraints placed on social life by living at home with parents. Personal evaluation of lifestyle was measured by responses to items asking which things were problems from the respondent's point of view. A greater number of the retarded than of the community group reported problems findings friends (same and opposite sex) and problems figuring out what to do with their time. **Longitudinal Follow-Up.** Data collection was completed in June, 1976. A total of 582 individuals were included in the sample. The final current status on each client was established as of October 31, 1976, three years after the first furlough reports were received. As of that date, 55% had received discharges from the institutions, 32% were still on furlough status, 12% had returned and were residents of the institutions, and 1% were deceased. Analysis of differences between those who remained in the community versus those who returned to the institution at any point has revealed that the returnees were likely to be older (over 30); placed in group homes or with employers; and placed near state schools. Returnees also tended to have less income and less involvement in social relationships and activities. Interestingly, lower IQ clients were no more likely to return than higher IQ clients. Major analyses of the longitudinal data currently underway are designed to clarify: (1) what the status and experiences of clients are at different time periods after furlough; (2) what variables change significantly over time; and (3) what variables predict adjustment at various times. Findings to date indicate that most indicators of community adjustment are remarkably stable over time.

APPLICABILITY: This study will provide general feedback on the current status of clients who have been institution residents and permit comparisons of those discharged in the past with those currently being placed in community settings. The identification of particular areas of difficulty shortly after separation from the institution can provide the basis for expanding or altering emphasis in existing pre-release training programs. Similarly, difficulties occurring later after separation may suggest the need for certain types of community support programs. These are potential long-range implications of this information for selecting and placing residents. This study, perhaps in combination with the results of other recent studies of the same type, may permit fairly good prediction of which individuals will do well in community placement at a given point in time and thus are ready for separation, as opposed to those who would benefit from additional training. Also, it may aid in identifying important determinants of the type of placement most suitable for a given individual. It is hoped that the findings will aid both institutions and community agencies in deinstitutionalization efforts and in providing appropriate supportive services.

235 Study of Consumer Needs, Circumstances, and Attitudes

Principal Investigator:	Carol K. Sigelman, Ph.D.	
Status:	Completed	
Dates:	January 1977-June 1980	
Cost:	Annual Not Applicable RT Annual Not Applicable	Projected Total $120,000 RT % of Annual Total Not Applicable
Annual Report Reference:	#9, Page 166, R-34	

OBJECTIVES: The President's Committee on Mental Retardation commissioned this study with the main objective of determining whether a national consumer sampling approach is a feasible way of quickly determining the needs and attitudes of the retarded in such a way that national policy could be formulated based on the information received. The feasibility of such an approach will be determined by (a) developing procedures which address problems of identifying and accessing a representative sample of retarded persons; (b) determining the most valid and reliable interviewing techniques to be used with a retarded population; (c) developing written guides and training procedures for interviewers; and (d) testing the adequacy of interviewing techniques used as a data base for policy-making. This study will also seek to meet PCMR's second objective of providing information on the needs, circumstances and attitudes of a sample of retarded persons with respect to (a) the extent to which community services are available, known to, utilized, and positively received by the retarded consumer; (b) the nature and quality of his/her living circumstances; and (c) the extent to which he/she has the opportunity for decision making in regard to his/her life circumstances.

METHODOLOGY: Review of previous prevalence estimation studies will be the primary methodology for identifying issues in sampling. In order to determine the feasibility of actually locating, gaining clearance for, and obtaining consent from subjects, major agencies will be polled by mail on their policies regarding release of information about clients. Also, during the interviewing of the retarded subjects, extensive records will be compiled on problems encountered and time spent with various techniques of accessing subjects. Content areas have been limited to (a) availability, accessibility, need for, use of, knowledge of, and attitudes toward services for the retarded; (b) nature and quality of residence, income, and social life; and (c) opportunity for and experience in decision making. Instruments to be developed include a background information form, and agency survey, a client interview form, a parent or "significant other" form, and an interviewer observation form. A series of pilot studies will be completed to explore determinants of responsiveness, reliability and validity, as well as to guide the selection of questions for the final interview schedule. This series of pilot studies will result in a final questionnaire which optimizes responsiveness and reliability and validity of response as well as research reports which clarify several critical issues in the feasibility of interviewing mentally retarded persons.

FINDINGS TO DATE: A series of activities, involving input from PCMR and preliminary interviewing, culminated in the development of questionnaires to be used in assessing the feasibility of interviewing mentally retarded persons across the IQ range. Literature reviews are nearly completed of communication skills of the mentally retarded, response sets in interview research and prevalence estimation; and research regulations have been studied through national mailings requesting information on a variety of agencies and organizations. Two interview studies, one of institutionalized children and one of institutionalized adults, was conducted. In each case, 50-60 residents of different levels of mental retardation were interviewed with alternate forms of an interview schedule administered a week apart, and attendants at the institution provided answers to most of the same questions that clients answered. Analyses indicate a strong relationship between IQ and ability to respond appropriately to questions; several difficulties at all levels of retardation involving inconsistencies among responses to alternate phrasings of questions on the same topic e.g., the operation of an acquiescent response set; and relationships of both responsiveness and consistency of response to the type of question format used (e.g., yes-no, either-or, open-ended).

Response biases on the part of clients have tended to reduce agreement between clients and their parents or attendants, especially on yes-no questions. Either-or questions, sometimes accompanied by pictures, have emerged as the most promising way of optimizing responsiveness and validity of response. Findings of the study raise major questions about and provide some solutions to the problems in using survey research methodology with retarded populations to examine reliability of response.

Children living in the community and a small sample of adults living in the community have also been interviewed, and severely retarded subjects at the institution involved in the reliability studies have also been reinterviewed in an attempt to further explore promising techniques of interviewing low verbal persons.

APPLICABILITY: The study will provide an assessment of the needs of the severely retarded and the multiply handicapped, as well as information about how well agencies are meeting their needs and those of the entire range of mentally retarded persons. This is especially relevant due to the current emphasis on serving the severely handicapped and providing programs for them at the community level. In order to fulfill the spirit of consumerism in current legislation for the handicapped and to provide a mechanism for feedback, some assessment of the attitudes of the handicapped toward rehabilitation agencies needs to be made. This project will be designed so as to obtain information which should be readily used by service agencies in better understanding their clients and enabling them to better meet the clients' needs.

236 Interview Skills of the Retarded: Deficiencies, Consequences, and Training Approaches

Principal Investigator:	**Carol K. Sigelman, Ph.D.**	
Status:	**Completed**	
Dates:	**September 1977-May 1980**	
Cost:	**Annual $31,950** **RT Annual $24,725**	**Projected Total $63,900** **RT % of Annual Total 77%**
Annual Report Reference:	**#9, Page 187, R-41**	

OBJECTIVES: The main objective of the study is to establish, by presenting videotaped interviews to personnel interviewers, rehabilitation counselors, and college students for ratings, which verbal and nonverbal skills are predictive of the mentally retarded client's making a favorable impression in a job interview situation, and which, as a consequence, would be prime targets for training efforts. Additional objectives are as follows:

1. To establish for a population of severely to mildly retarded adults the level and variability across subjects of verbal and nonverbal communication behaviors;
2. to determine relationships among communication behaviors;
3. to assess the relationships between communication behaviors and client characteristics such as sex, IQ, adaptive behaviors, and length of institutionalization;
4. to determine whether communication skills are predictive of current vocational functioning levels;
5. to determine the extent to which responsiveness to the demands of a question is a function of the type of question asked;
6. to assess the extent to which providing raters with information about client intelligence, motivation, and job skill reduces reliance on communication behaviors as a basis for evaluative judgment; and
7. to test the relative effectiveness of modeling and videotape feedback procedures in modifying communication skills found to be deficient and associated with making negative impressions on raters.

METHODOLOGY: Eighty-eight mentally retarded adults (both males and females) in the severe, moderate, and mild ranges of retardation were videotaped while participating in a "pretend" job interview situation. All of the subjects came from an institutional setting.

A standard interview format was constructed covering two topic areas: vocational maturity and social maturity, with sixteen parallel questions in each topic area. Within topic areas, the types of questions asked (e.g., yes-no, either-or, what questions, and open-ended questions) were systematically varied so that responsiveness to communication demands could be examined as a function of question type. The interviews lasted approximately 5-10 minutes, and were preceded by a warm-up period during which the research and the presence of the videotape camera were explained.

Measures of communication performance in the interviews consist of the following: (1) responsiveness to communication demands of questions; (2) number of words in garbles, phrases and one word responses, and T-units; (3) total number of words; (4) number of T-units; (5) frequency of eye contact; (6) smiling; (7) head obstruction; (8) fidgeting; (9) speech intelligibility; and (10) physical attractiveness. Many of the verbal and nonverbal measures were used in the pilot research, but several new measures have been added to enhance predictive power.

Data on client characteristics such as sex, IQ, length of institutionalization, and adaptive behavior have been collected from client files. Correlational analysis and analysis of variance were used to examine the relationships of these variables to communication behaviors, as well as the relationships among communication measures.

Segments of the videotapes for the 88 subjects were arranged in random order and prepared for presentation to rating groups. All interviewees were shown responding to the same 8 questions from the job interview format with each segment lasting approximately one minute. Three rating groups viewed the tapes: (a) personnel interviewers, obtained through business administration classes at Texas Tech; (b) vocational rehabilitation grad students; and (c) graduate students in Special Education. An interview rating scale which consists of semantic differential style items with seven points along a positive-negative continuum concerning intelligence, communication, personality, employability, was used. Each rating group viewed all 88 taped interviews so that differences among rating panels would not confound the analysis. Each of the three rating panels consisted of four to six persons and reviewed tapes in four installments of 22-23, so that fatigue would not enter in.

The previous analysis provided the basis for selection of skills to be trained. Skills which proved to be deficient in a substantial proportion of the population and which were significantly correlated with evaluative ratings became the target behaviors to be modified. These skills included eye contact, smiling, speech intelligibility, and responsiveness to the communication demands of questions. Subjects were randomly assigned to one of three groups: (1) videotaped feedback, (2) nonvideotaped feedback, and (3) interview practice control.

The subjects' performance in the standard interview will serve as pretest measures of baseline performance. Following treatment, the subjects were again videotaped responding to the same interview questions administered by the same interviewer. Posttreatment communication scores will be obtained on the target behaviors. The posttreatment videotapes will also be viewed by one of the same group raters previously used, new ratings will be obtained, and changes calculated.

FINDINGS TO DATE: The following findings have emerged from the study in which 88 retarded adults at the Lubbock State School participated in simulated job interviews:

1. Responsiveness to communication demands of different types of questions was in part a function of the type of question asked.
2. Verbal and nonverbal behaviors were generally independent of one another. With the exception of smiling, highly verbal subjects were no more likely than those with limited verbal skills to engage in positive nonverbal behavior.
3. While one could predict verbal skill from IQ score, nonverbal performance could not be so predicted.
4. While verbal measures overshadowed the nonverbal measures as predictors of ratings, both nonverbal and verbal performance measures predicted impressions made in the interview.

IQ, the four verbal measures and the five nonverbal measures were used to predict ratings of intelligence, personality, quality of communication, general impressions made in the interview, and the likelihood that the rater would hire the applicant. These ten measures accounted for nearly 70% of the variance in the total ratings given by business administration students, graduate students in special education, and graduate students in rehabilitation counseling, and 50 to 70% of the variance in hiring decisions. Subjects who gave adequate responses to questions, made frequent contact with the interviewer, smiled appropriately, and whose speech was understandable tended to be rated positively. While verbal behaviors were the most powerful predictors of ratings and hiring decisions, nonverbal behaviors were the subject of 57% of the raters' comments in response to a question asking them which things the applicant said or did which made a marked impression on them.

It was felt that these findings were promising enough that they should be pursued. The findings of the study suggest that training in conversation skills is especially important. Moreover, there is some justification for training certain nonverbal behaviors such as smiling and appropriate grooming. The next step will be to analyze the data from the training phase of the program to determine whether training in these skills does indeed enhance impressions made by mentally retarded persons in interviews.

APPLICABILITY: The study is directly relevant to rehabilitation practitioners concerned with communicating with mentally retarded clients and increasing their clients' competencies in job interviews and other social interactions. Specifically, it identifies communication skills which are deficient; sheds light on the effects of the types of questions posed to the mentally retarded on their communication behavior; offers information about how rehabilitation professionals and others react to the communication behaviors of the mentally retarded; indicates which communication behaviors are consequential enough to warrant intensive training efforts; and evaluates alternative methods of training important communication skills.

237 Increasing Parent and Caretaker Effectiveness in Understanding and Dealing with the Sexual Development of the Retarded

Principal Investigator:	**Susan F. Elias, Ed.D.**	
Status:	**Completed**	
Dates:	**June 1978-May 1980**	
Cost:	**Annual $33,550** **RT Annual $27,600**	**Projected Total $71,100** **RT % of Annual Total 78%**
Annual Report Reference:	**#9, Page 224, R-48**	

OBJECTIVES:

1. To demonstrate a need for and benefits to be derived from sex education programs for parents and caretakers of retarded people.
2. To assess the needs and/or problems associated with sexuality of retarded people as viewed by parents and the personnel of schools and institutions serving retarded children, adolescents, and adults.
3. To elicit parent and caretaker involvement in establishing guidelines for sex education programs and materials for other parents and professionals.
4. To establish a flexible format for sex education programs for parents and caretakers of retarded individuals.
5. To conduct a series of sex-education workshops for parents and caretakers of retarded individuals.
6. To conduct improvement-oriented evaluation of the workshops for parents and professionals, according to the following criteria: (a) client satisfaction with the program, (b) attitude change, (c) increased knowledge regarding sexuality and the retarded, (d) increased confidence and competence in dealing with sexuality of retarded individuals, (e) changes in parent and caretaker handling of sexual development and problems of retarded children, adolescents, and young adults, and (f) changes in mentally retarded students' knowledge and attitudes regarding sexuality.

METHODOLOGY: A written survey of concerns and perceived needs and problem areas with respect to sexuality of the mentally handicapped was given to parents, professionals, paraprofessionals, and teachers in special education or rehabilitation. The results of this survey served as guidelines in developing the workshop program. In conjunction with the survey, respondents were asked to indicate their interest in participating in the sex education workshop.

At the present time, workshops have been conducted for professionals in rehabilitation, for teachers in special education, and for staff members of a residential institution. All participants were asked to complete several assessment measures, including a dating scale assessing attitudes toward dating behavior of retarded individuals, a survey of knowledge and beliefs about the sexuality of the retarded, a questionnaire on feelings of confidence in dealing with the sexuality of retarded people, and a questionnaire which ascertains how sexual problems are typically handled by the respondents, both prior to participation in the workshop and immediately following the last session of the workshop. Control groups consisting of individuals with similar professional backgrounds as the participants also completed the pre- and post-assessment measures, while they did not take part in the workshops.

The workshop program itself consists of presentations as well as small group discussion meetings and question and answer sessions. Dramatic play (pantomime, improvisation, and role playing) are used to provide practice in dealing with difficult or problem situations. Time is set aside for materials evaluation and incorporating available materials into an organized curriculum for retarded individuals.

Topics covered in the workshop sessions are (a) introductory material on the physiology of sex, (b) attitudes toward sexuality in general, (c) attitudes about retarded individuals as sexual beings, (d) social and marital potentials and limitations, (e) fears and anxieties of parents and caretakers over sexual behavior, and (f) methods of communicating constructively with retarded people in this area.

The independent variable of major interest is the workshop program. Dependent variables include trainee satisfaction with the program, changes in attitudes toward sexuality and retarded individuals, increased knowledge of sexuality and the retarded, and changes in parent, professional, and paraprofessional handling of sexual development and problems.

FINDINGS TO DATE: A preliminary analysis of the initial survey given to 190 staff members of a residential institution led to some interesting findings. Ninety-four percent of the respondents believed that sexual behavior represents a problem area in caring for retarded individuals, and 93% said they thought sex education for retarded persons is as necessary or more necessary than it is for "normal" people. Yet 55% responded that they had given no sex education to the residents, and only 3% had ever started discussions about sex with the residents. Sixty-five percent claimed they dealt with sexual problems as they arose, but 14% said they did nothing at all, only 5% had any clear guidelines for responding to sexual problems. The gap between recognition of the need for sex education and the hesitation to actively take a part in the sex education of residents may be due at least in part to a feeling of being unprepared. Twenty-nine percent of the respondents felt they did not have enough knowledge of sexual functioning, and 33% did not feel prepared enough to give the residents sexual information. Eighty-nine percent of the respondents said they would be interested in taking part in a workshop on how to talk and communicate better with the residents about sexuality.

Analyses of the pre- and post-assessment data have not been completed at this time. However, the results of evaluation forms completed by workshop participants have been examined. The following scores were obtained from the 6-point scale with 1 being the most favorable response (strongly agree) and 6 being the least favorable response (strongly disagree):

I really enjoyed attending this workshop - 2.42
I feel more comfortable talking about sexuality - 2.58
The material was presented very effectively - 2.38
The workshop was very well organized - 2.19
I plan to apply what I learned in my work - 2.19

In response to some additional questions, 71% of the participants reported that the workshop had been worth the time invested, and 67% said that they definitely would recommend the workshop to other professionals and parents, and an additional 22% said that they probably would recommend the workshop to others. While only 57% believed their attitudes had changed as a result of the workshop, many of those who said their attitudes had not changed reported that their attitudes and feelings had been clarified by attending the workshop session. Many of the participants reported that they had increased their knowledge in the area of human sexuality, and a majority of those who said their attitudes had changed mentioned finding it easier to talk to clients about sexuality.

These preliminary findings indicate that the workshop program has been a positive experience for most of the participants. The feedback suggests that by the end of the workshop, participants feel better prepared and more comfortable about dealing with the sexual development, growth, concerns and problems of their clients. Hopefully, a more extensive analysis of the information provided by pre- and post-measures will further support the suggestion that the sex education workshops have had the desired effects of increased awareness of retarded people as sexual human beings, greater comfort in dealing with sexuality, and increased knowledge of practical approaches to sex education for mentally handicapped individuals.

APPLICABILITY: Retarded individuals capable of using the recreational and vocational resources of a community and living in independent or semi-independent housing must have a basic and practical knowledge of sexuality if they are to be expected to behave responsibly in the sexual realm. The mentally handicapped are not likely to make a successful adjustment to the community or to their work situation if their sexual behavior is inappropriate and therefore socially unacceptable.

However, parents and caretakers have tended to be extremely overprotective with respect to the sexuality and their charges. At the same time, parents and professionals recognize that the overprotective approach is generally not effective in preventing sexual problems, and they have begun to request materials and training to help them in an area which makes them uncomfortable. It is hoped that through educating the parents and the professionals who most frequently interact with mentally retarded youngsters and adults, the mentally handicapped may be better prepared for sexual responsibility and more adequate adjustment to community life as adults.

238 Group Homes for the Mentally Retarded in the Rehabilitation Process: Barriers to the Delivery of Habilitation Training to the Severely and Profoundly Retarded in Community Residential Facilities

Principal Investigator:	**David H. Bostwick, Ph.D.**	
Status:	**Continuing**	
Dates:	**July 1980-July 1983**	
Cost:	**Annual $79,443** **RT Annual $72,367**	**Projected Total $250,796** **RT % of Annual Total 91%**
Annual Report Reference:	**#9, Page 125, R-14**	

OBJECTIVES: The project is a comprehensive inquiry into the nature and effectiveness of group homes for the mentally retarded as environments for personal and social growth essential to vocational success. The research focuses upon three interlocking organisms: the mentally retarded person, the group home as a social system, and the community. Its objectives are (1) to determine critical differences between the institution and the group home as environments for developing social adjustment skills; (2) to determine the interrelationships between group homes and the communities in which they exist, focusing upon integration of the retarded into community life and responses of the community toward group homes and their residents; (3) to identify critical social adjustment problems encountered in group home placements, with an eye toward developing personal-social adjustment training programs designed to correct problems identified; (4) to assess the effects of group home placement upon retarded clients with respect to personal, social, and vocational adjustment; and (5) to relate changes in group home residents to variables in the group home and its community. The study is, in general, designed to further knowledge of the support system and training strategies conducive to optimal social and vocational adjustment.

METHODOLOGY: Institutions, halfway houses, and small group homes have been compared through use of scale of normalization developed and administered to houseparents and residential supervisors, and observational studies were conducted to compare actual activity patterns and supervision styles in small group homes and larger, institutional settings. Interrelationships between group homes and their community settings were assessed through use of a group home survey and an indirect attitude questionnaire designed to measure attitudes in the Lubbock, Texas community. A long-range goal of improving personal-social adjustment training in transitional facilities was approached through a multiple step process to culminate in the development of guidelines and recommendations for adjustment training. Facility logbooks and behavior rating forms were the primary data sources. Where agreements with operating facilities could be made, a checklist of Skills and Knowledge important for Community Adjustment was administered to houseparents at six month intervals for each resident in the facility, supplemented by observation where possible.

FINDINGS TO DATE: A group home survey was completed by almost 50 facilities to yield basic descriptive information. Further information has been collected on each of the major study areas. There were not significant differences with respect to normalization between facilities for the retarded and facilities for the non-retarded. However, analysis of facilities for the mentally retarded indicated that as the number of residents increases, normalization decreases.

Two observational studies have been conducted. The results of one study indicated that leisure behaviors in two group homes were very similar but differed systematically from leisure behaviors in an institutional cottage. The study also indicated that the group homes were characterized by more balance among activity types, particularly by a reduction in the amount of passive leisure and an increase in the amount of household performance. However, the group homes did not seem to be encouraging the kind of goal-oriented, creative leisure which would help the retarded to adjust to independent living. The single most important finding to emerge from the second study was that residential environments differ from one another in complex ways. The study did not uncover differences in staff-resident interaction patterns which would discriminate reliably between group homes and larger, institutional settings.

A study of community attitudes relevant to community placement of retarded adults conducted in Lubbock, Texas, suggested that Lubbock residents lack well-formulated opinions for or against group homes, but are generally somewhat unfavorable. Demographic variables did not go far in predicting which types of people are most receptive to group homes and legal rights for the retarded.

Staff logbooks have been used as a source of data concerning adjustment problems in four facilities of the halfway house design. Individual problem behavior tends to be consistent over time, and often centered on failures of responsibility. However, individual problem behavior could not be readily predicted on the basis of IQ adaptive behavior, or sex.

A study of personal-social functioning with implications for adjustment in the community developed a method of assessing the job interview skills of the mentally retarded client. Nonverbal behaviors, verbal behaviors, and measured intelligence predicted the favorability of ratings given to interviewees by personnel interviewers.

Analysis of results of studies to establish the utility of the Skills and Knowledge checklist suggested that checklist performance is highly related to IQ score. The checklist discriminated among clients at different levels in a deinstitutionalization program. Reliability was judged minimally adequate.

Analysis of changes in checklist scores for institutionalized and group home samples indicated that institution residents exposed to a community living skills tutoring program improved over a 6-month period as much as group home residents but more than residents of another institution without such a tutoring program.

Overall, the project uncovered many problems in deinstitutionalization and did not support the idea that group homes and halfway houses are always preferable to institutional environments.

APPLICABILITY: Better understanding of the nature and effectiveness of group homes will be immediately useful to vocational rehabilitation agencies currently using or planning to use group homes as a rehabilitative tool. In addition, analysis of social adjustment problems of retarded residents in group homes will expedite analysis of similar problems in other settings. Finally, the study was designed to uncover the types of environmental intervention which produce positive change in personal and social attitudes and behaviors relevant to employability and vocational success.

239 Effects of Job Enrichment on Work Performance of the Mentally Retarded

Principal Investigator: Andrew S. Martin, Ph.D.

Status: Continuing

Dates: June 1977-June 1981

Cost: Annual $36,089 — Projected Total $36,089
RT Annual $28,736 — RT % of Annual Total 80%

Annual Report Reference: #9, Page 14, R-36

OBJECTIVES: The overall objective of this project is to study the process of job enrichment and the effects of enriched jobs on the work behavior of retarded persons.

The specific questions under investigation are:

1. Does an enriched job provide more **intrinsic** motivation than a simplified job for retarded workers? More precisely, do retarded persons perform better (i.e., have higher output and fewer errors) in a job which contains more varied elements (horizontal loading) and more discretionary or decision elements (vertical loading) than they do in simplified low cycle time jobs?
2. Are any benefits which accrue from enriched jobs due to the enriched jobs themselves, or to the **process** of job enrichment?

METHODOLOGY: The participants in this pilot study were fourteen clients at the sheltered workshop of the local MHMR center. There were six females and eight males with an IQ range of 17 to 68 (m=42). The simplified and enriched jobs were, respectively, the partial and total assembly of eight piece ball point pens. These jobs were novel to all clients at the beginning of the study. The clients worked for thirty minutes a day in a small room which was separate from the main workshop area.

The study used two levels of jobs (simplified vs. enriched) and two sequences of program implementation in an A-B: B-A design. Half of the participants started on the enriched job and changed to the simplified job after approximately 24 days, while the other half of the participants performed the two jobs in reverse order.

The clients were paid two cents for each total pen assembled and a proportionate fraction for each partial assembly. They were paid at the end of the study for all of the work they had done during the study.

FINDINGS TO DATE: Preliminary inspection of the data indicated that some of the participants responded to the treatments as hypothesized (better performance under the enriched condition) while others seemed to behave just the opposite. Self-reports by some of the higher level participants during the course of the study indicated that they preferred the enriched condition. Thus, for further analysis, the clients were divided into high and low IQ groups. The low group had an IQ range of 17-41 (m=29.8) while the high group ranged from 44-68 (m=52.7).

The data were transformed to percent of "normal" output based on a sample of R&T staff members so that comparisons could be made between the two jobs. Analysis of the data from the two IQ groups led to some rather unexpected findings. The high IQ participants who started on the simplified job showed a substantial increase when they were switched to the enriched job. Those high IQ participants who started on the enriched job decreased slightly when changed to the simplified job. These results are consistent with those typically found with non-retarded workers in job enrichment studies. However, the low IQ participants performed in an opposite and quite unpredicted manner. Those who began on the simplified job decreased when changed to the enriched job while those who started on the enriched job increased when changed to the simplified job.

Dividing the groups by IQ produced sample sizes so small as to preclude parametric analyses. For this reason, median tests were performed on the data from the low and high IQ groups. These tests indicated that the high IQ group performed significantly better on the simplified job.

As mentioned earlier, several of the high IQ participants expressed their preference for the enriched job and often complained that the simplified job was boring. No such complaints were voiced by the low IQ participants. However, several of the low IQ participants seemed to be interested in the sheer number of assemblies they completed each day. Of course, they were able to produce many more of the assemblies in the simplified condition. Perhaps this is what motivated them to work faster on the simplified job.

Admittedly, these findings are based on very small sample sizes and, thus, probably should be taken as a pilot study until replicated with larger numbers of participants. Further studies are planned with larger samples and other jobs.

APPLICABILITY: Past efforts at rehabilitation of mentally retarded persons through work-vocational rehabilitation have been haphazard efforts to establish a work situation, or a "work like" atmosphere, in which it is hoped that something would happen to the retarded client to make him/her a better person. These efforts are not haphazard by design, but are, in most instances, extremely well intentioned efforts to help, in the absence of knowledge of how to help. This line of research seeks to provide information about the ways in which job organization affects the work behavior of mentally retarded workers. This particular study indicates that mentally retarded workers are sensitive to the enrichment and simplification of tasks. However, the study also demonstrated that high and low IQ workers are not affected in the same way and thus, further serves to caution us that mentally retarded people do not consititute a single, homogeneous population.

240 Vocational Handicapping Conditions as a Function of IQ

Principal Investigator:	**Larry McCarron, Ph.D.**	
Status:	**Continuing**	
Dates:	**June 1977-May 1981**	
Cost:	**Annual $106,625** **RT Annual $64,543**	**Projected Total $120,000** **RT % of Annual Total 61%**
Annual Report Reference:	**#9, Page 51, R-40**	

OBJECTIVES:

1. To identify and compare the needs and deficits of persons in the severe, moderate, mild, and borderline levels of intelligence in such areas as personality, adaptive behavior, sensory and motor functioning, vocational aptitudes, and work-related behaviors.
2. To describe the rehabilitation process for such persons in both rehabilitation and school settings and to examine how the process differs for clients of different intellectual levels.
3. To measure outcomes of rehabilitation services and determine relationships between outcome and (a) intellectual level, (b) functional levels, and (c) types of services received.

METHODOLOGY: In response to input from state rehabilitation agencies in the region, the study will focus on school populations as well as on clients referred to rehabilitation agencies from other sources in Arkansas, data collection will center on a vocational evaluation unit which serves the entire state; in Texas, the study will focus on school populations, and will have a secondary objective of evaluating the benefits of programs which stress vocational training for the handicapped as compared to more traditional work-study programs. In all settings, subjects identified for study will first be evaluated with a comprehensive battery measuring functional capacities considered to be predictive of later adjustment. Most of the measures will involve individual testing, although ratings of adaptive behavior will also be collected. Questionnaires will be used to collect information about the programs and services which these clients then receive. Adjustment to a work setting will be assessed with a rating scale completed by work supervisors, and finally, through interview procedures and client evaluation, benefits derived from rehabilitation services will be assessed approximately two years after the initial assessments are conducted.

FINDINGS TO DATE: Literature reviews on the relationship of IQ to social and vocational adjustment of the mentally retarded and on the special problems of learning disabled persons were completed, and a battery of assessments was identified. Data collection began in the summer of 1978 at a rehabilitation unit in Arkansas, where comprehensive assessments of approximately 45 persons were completed. Analyses of these evaluations focused on differences between clients in different IQ ranges. Surprisingly, few differences were found between clients in the moderate range of retardation (IQ 40-54), the mild range of retardation (IQ 55-69), and the range previously labeled "borderline retarded" (IQ 70-84). These findings suggested that many persons in the borderline IQ range have functional deficits much like those of lower IQ retarded clients and that adoption of the new American Association of Mental Deficiency definition of mental retardation would mean denial of rehabilitation services to individuals with significant vocational handicaps. Negotiations with the rehabilitation agencies in the region will guide future studies.

APPLICABILITY: Rehabilitation agencies have expressed concern regarding the implications of introducing the American Association on Mental Deficiency's definition of mental retardation into rehabilitation practice because they perceive that many persons in the borderline range of intelligence, who would no longer be considered mentally retarded, have difficulties which constitute a vocational handicap and can benefit from rehabilitation services. Thus, this study should identify the nature and extent of deficits in this group as compared to mentally retarded groups, as well as indicate problems the borderline IQ person encounters during rehabilitation and eventual outcomes. At the same time, by attending to the severely mentally retarded client, the study will provide guidance to rehabilitation agencies as they strive to fulfill the mandate to give priority to the severely handicapped by indicating the functional deficits in this group and the clinical relationships between process and outcome in their rehabilitation.

241 Issues in Deinstitutionalization

Principal Investigator:	**David H. Bostwick, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1978-July 1980**	
Cost:	**Annual $30,345** **RT Annual $22,325**	**Projected Total $60,000** **RT % of Annual Total 74%**
Annual Report Reference:	**#9, Page 213, R-42**	

OBJECTIVES:

1. To describe the adjustment processes of more severely disabled persons furloughed from state institutions for the mentally retarded in Texas to the community, comparing them to higher level clients.
2. To assess which types of clients receive which types of environmental support, which types of environmental support facilitate adjustment, and which types of clients benefit from such supports.
3. To determine, for a sample of persons for whom both clients and guardian or houseparent interviews were collected, the extent to which clients and significant others agree in their responses, and the extent to which profiles of adjustment and correlates of adjustment from these two sources of data are consistent.

METHODOLOGY: This study is an extension of analyses of a large longitudinal data set collected as part of Project R-21. The methodology consists of data set organization, data reduction, and statistical analysis appropriate to the stated objectives.

FINDINGS TO DATE: Due to shortages of funds, the present project, although approved for initiation, has been held in reserve for a late start until appropriate staff are available.

APPLICABILITY: Deinstitutionalization has been a priority in both RSA and the Office of Development Disabilities. The Center's rich longitudinal data set is unique and can provide knowledge relevant to community adjustment processes and the facilities and services which facilitate those processes. In this study, special attention will be focused on the more severely handicapped person and on environmental, as opposed to personal, correlates of adjustment.

242 Development of Exemplary Models of Achieving Effective Coordination of Education and Vocational Rehabilitation in Local Communities

Principal Investigator:	Gerard J. Bensberg, Ph.D.	
Status:	Continuing	
Dates:	October 1977-April 1980	
Cost:	Annual $133,712 RT Annual $120,750	Projected Total $133,712 RT % of Annual Total 90%
Annual Report Reference:	#9, Page 70, R-44	

OBJECTIVES: The purpose of the project is to determine what forms and mechanisms of cooperative programming by vocational rehabilitation, public school programs, and other community agencies can improve the quality of services to handicapped youth. Specifically, the project will culminate in a state of the art report, detailed descriptions and analyses of ten exemplary programs involving interagency cooperation, and a synthesis of models in a model or models replicable nationally.

METHODOLOGY: Literature review will focus on describing current public school/vocational rehabilitation programs and interagency linkages and will serve as background for describing the state of the art and constructing questionnaires and interview schedules to be used in site visits. A form will be developed to solicit nominations of outstanding programs from vocational rehabilitation agencies, state education agencies, and other relevant sources. A follow-up questionnaire will be sent to nominated programs to solicit information that can be used, along with telephone contacts, as a basis for selection of ten exemplary programs. Site visits will be conducted by a carefully chosen visitation team using structured and open-format questionnaires, interview schedules, and data collection forms. The data collected from site visits, along with the material identified through literature review, will serve as the basis for developing program models which represent comprehensive and effective cooperative programs to maximize the vocational potential of handicapped youth.

FINDINGS TO DATE: The 10 exemplary programs have been selected and they have each been site visited by a team of experts in rehabilitation, vocational education, and special education. The ten programs are:

Kent Intermediate (Grand Rapids, MI)	La Grange, IL
St. Paul, MN	Manchester, CT
Cleveland, OH	Town and Country (St. Louis County), MO
Salt Lake City, UT	Houma, LA
York, SC	Bakersfield, CA

Detailed descriptions of each of these programs is now being written. In addition to these program descriptions and a state-of-the-art review of career education at the secondary level, the final report will include a history of the federal legislation, an analysis of state laws and regulations related to cooperative programs, and an analysis of the 100 programs nominated as meeting the criteria of the project.

APPLICABILITY: Interagency linkages are a priority in RSA research and evaluation objectives. This project should provide guidance to vocational rehabilitation agencies as to how they can work most effectively with public schools and other community agencies to provide vocationally-oriented training and experiences to handicapped youth. This project is particularly timely in view of recent legislation in vocational rehabilitation and in education which has altered the missions and responsibilities of both and which requires a reshaping of cooperative relationships between agencies.

243 Applications of Behavioral Training Strategies with the Mentally Retarded in Sheltered Work Settings

Principal Investigator:	Andrew S. Martin, Ph.D.	
Status:	Continuing	
Dates:	June 1978-May 1981	
Cost:	Annual $29,380 RT Annual $28,166	Projected Total $67,919 RT % of Annual Total 95%
Annual Report Reference:	#9, Page 42, R-45	

OBJECTIVES: The general objectives of this program are to apply techniques developed in more closely controlled laboratory-like training situations to less controlled settings. The techniques to be applied involve goal setting and progress feedback to train specific job skills and generalizable work adjustment and work ethic attitudes and habits in severely retarded clients at the Lubbock MH/MR facility. These techniques have been shown to be effective with small groups of clients who work in a training laboratory established by R&T Center researchers at the Lubbock State School.

The next logical step in this work appears to be the adaptation of the findings of this work to a full-sized, ongoing sheltered work/training environment as part of the habilitation process for the retarded clients in the workshop.

METHODOLOGY. It may be said that many clients lack a "functional work ethic" and, therefore, have no real reason or motivation to work. Thus, many clients do not continue to perform well after they have been trained on a particular job or task, which often leads to an increase in off-task, distracting behaviors.

The researchers have identified three components of a functional work ethic which seem to be necessary prerequisites for independent functioning in work settings. Briefly, these are:

1. A concept of work as a renumerative activity. The retarded client must have a concept of the relationship between work and play.
2. Money must be established as a strong secondary reinforcer which has been referred to as the "buying power of money." The client must want to acquire money, for whatever reason.
3. A work history in which a person has been reinforced for working in situations in which the job or task is well defined and the compensation rate is known to the worker. A work history is differentiated from a labor history in which the "job" may be ill defined and in which compensation is either lacking or not tied to specific task performance.

The first cooperatively planned study in the series which was conducted at the Lubbock MH/MR Center, involved six mentally retarded clients ranging in age from 23 to 38 with a mean IQ of 36 (range 15-46).

All of the clients for this study were selected by workshop personnel at the request of the experimenters who asked that the trainers select a group of clients who "didn't have any concept of working, or what they were supposed to be doing in the workshop."

At the time the study began, the clients were paid (as were all clients in the workshop) by check once a month. Observation of the clients in the study and other clients in the workshop revealed that the paychecks seemed to be highly reinforcing, but conversations with the clients (including the ones to be included in the study) kept raising the question—reinforcing what? Clients seemed to be just as content with a check for $2.00 as with one for $50.00, and continued observation seemed to confirm the hypotheses that the act of getting a paycheck was reinforcing in the social context of everyone getting a check, but that it was not perceived as compensation for the number of units assembled in the preceding thirty-day period.

The study involved alternating baseline conditions as they had existed in the workshop for about 2 years and training conditions in an ABAB design. During the initial baseline condition, clients were paid once a month by check, and experimenters did nothing more than record time spent working and collect production data.

Feedback and the forming of a direct link between work behavior and paychecks were accomplished by tallying production twice each day and placing accumulated earnings in clear plexiglas tubes placed in front of each client. The method of calculating paychecks was altered in that the amount of each client's check was fixed at the amount of coins (nickels) contained in a full tube, and clients were instructed that they would "earn" a paycheck when their tube was filled. When a client filled the tube, the coins were emptied, and traded for a paycheck.

The first training phase lasted for nine weeks. The second baseline was a return to the same conditions as the first baseline in that clients got no daily feedback, and returned to regular monthly paychecks. The second training condition reinstated the coin tubes and the ratio paychecks. The second baseline and second training condition each lasted eight weeks.

Because this project is a cooperative effort with sheltered workshops, future studies are geared to be responsive to training needs; therefore, specific methodologies cannot be detailed at this time. However, they will be aimed at creating stable relationships in work settings and investigating training techniques which will produce durable and generalizable work habits.

FINDINGS TO DATE: One study in this programmatic effort was completed during the year. The design and procedure for the first study are described in some detail in the methodology section of this report. The results show a statistically significant 14.5% increase in production from the initial baseline to the first training phase. There was a slight drop in production at the beginning of the second baseline, but after about 3 weeks all clients began to show an increase in production which continued throughout the rest of the second baseline, and by the end of the second baseline, were producing 8% greater than in the first training phase and 22% above initial baseline. Clients made a mean 16% increase from the first half to the last half of the second baseline. The beginning of the increase during the second baseline phase corresponded with the receipt of the first monthly paycheck, and one more paycheck was received during this eight-week baseline phase. The causal connection is only speculative at the present. The second training phase was initiated in order to try to capitalize on and stabilize the increasing production seen in the last half of the second baseline. An additional 2% increase over the last half of the second baseline was realized and maintained until the end of the study which terminated eight weeks into the second training phase with a change in production methods in the workshop. During the approximately eight months of this study, clients gained and maintained a mean 24% increase in production. The overall gains for each of the 6 clients were 65%, 26%, -2%, 16%, 7%, and 35%.

The data of most relevance to the hypotheses under investigation is the increase in production during the second baseline condition, which should have constituted an extinction phase if the daily feedback and social reinforcement were the factors maintaining production increases during the first training phase. It is impossible that this upswing in performance reflected a delayed internalization of a work ethic, although this is only speculative.

The authors conclude from the results obtained in this study that it is desirable and feasible to train the relationships which exist in work environments and which we may take for granted, but which are probably more important in **maintaining** work skill training than that training itself.

APPLICABILITY: This study seeks to extend the findings from previous laboratory research on goal setting and the development of a work ethic to an actual sheltered workshop for the mentally retarded. In essence, the purpose of the present study is to test the generalizability of techniques found to be of value in increasing and maintaining work performance of mentally retarded clients. Previous research has shown that moderately and even severely retarded clients can acquire relatively complex skills in a laboratory setting but that productivity often deteriorates in an actual workshop setting. Earlier research has demonstrated successful techniques for maintaining behavior in isolated, laboratory simulations of workshops. It is not known at this time if previous findings are valid in real workshops where there may be much more distraction and less control of the environment by the supervisor. Techniques which are found to be successful in maintaining skills acquired in training could be utilized to keep production rates high and possibly to reduce or eliminate workshop problems such as off-task behavior, client disturbances, and absenteeism. In addition, the project may lead to the development of additional techniques aimed at solving frequently encountered problems in a sheltered workshop.

244 Predicting Future Trends in Rehabilitation of Mentally Retarded Persons

Principal Investigator: J.D. Parham, Ph.D.
Status: Continuing
Dates: September 1978-June 1980
Cost: Annual $15,420 — Projected Total $15,420
RT Annual $13,099 — RT % of Annual Total 84%
Annual Report Reference: #9, Page 90, R-46

OBJECTIVES:

1. To establish, with help from leaders in the field, a prioritized list of possible new trends in rehabilitation of mentally retarded people.
2. To provide a data base for forward planning of continuing or career education for rehabilitationists.
3. To prioritize training needs for future rehabilitationists.
4. To provide data for establishing timelines for preparing to meet new manpower needs.
5. To identify priority directions for future research.

METHODOLOGY: A modified version of the Delphi technique will be used for this study. Essentially, the Delphi technique is a series of questionnaires interspersed with opinion feedback. Typically, the method for conducting a study involves sending questionnaires in rounds to individual panel members after a preliminary letter has been sent inviting them to participate. In this study a preliminary letter will be sent to influential individuals involved in policy issues asking them for responses to a questionnaire/outline. Their responses will assist the researchers in formulating areas of investigation for the Delphi study. A letter will then be sent to persons identified as experts in vocational rehabilitation services for the mentally retarded, asking them to participate. These panel members will consist of people from the following groups:

1. Specialists in mental retardation and/or training in state vocational rehabilitation agencies.
2. Staff at the three Research and Training Centers in Mental Retardation.
3. Rehabilitation educators and/or other university or community experts.

If they agree to serve, the experts will be asked to respond to a first round questionnaire concerning future trends with regard to (a) social attitudes, (b) utilization of support personnel, (c) legislation, and (d) economics. The responses to the round one questionnaire/outline will help the staff in developing the open-ended statements in these areas, and possibly highlight other areas. Combining these responses through a process of screening, these statements will be reduced for round two. In round two, those participants who responded to round one will be asked to rate each of the factors on a seven-point continuum from least important to most important. At the end of round two, the mean for each factor under each of the six basic content areas will be placed in rank order. The result is a priority ranking which has a variety of uses. (Hopkins, 1972; Skutsch, 1973; Weaver, 1972).

In round three, those members of the population who responded to round two will be asked to agree or disagree with the panel's rankings, stating their reason for any disagreement. These predictions (agreements regarding perspectives of the future) along with the rationales regarding alternative possible futures (disagreements) will be condensed to form a picture of the complications of various alternatives. From this data, staff will also generate specific recommendations for training and factors to consider regarding alternative decisions and their anticipated consequences.

FINDINGS TO DATE: The preliminary step to seek input from those influential in setting policy was directed at a relatively few individuals involved in policy at the national level. Four of these individuals returned the questionnaire/outline; some excellent input was received; and, in general, the responses reflected areas of concern that were along the same lines that the research team felt might be important. More specifically, the concerns were in areas such as personnel needs, preservice and inservice training, legislation, litigation, and current trends toward community treatment and resultant changes; and other areas of concern such as interagency cooperation and effects of minimum wage laws.

After the preliminary effort to define areas of concern, sixteen panel members were selected and their participation solicited. Having received their positive responses to participate, the panel members were sent round one questionnaires to complete and return. Due to the open-ended nature of this questinnaire, the responses were diverse. It would be premature at this point to give the results of this round since the move toward consensus will come in the second and third rounds.

The second round of the Delphi has been prepared and sent to the panel which now consists of fifteen members. The responses to this round have begun returning, but again it is premature to draw general conclusions from this round until more responses are returned.

APPLICABILITY: The findings of this study will be disseminated through standard publications and through short-term training programs conducted by the Research and Training Center. They will be made available in special mailing to continuing education and university related rehabilitation programs.

The findings of this project have potential use for all indivdiuals who work with retarded persons. They should be particularly helpful to state agency counselors in evaluating and improving their performance with mentally retarded clients and to state rehabilitation agency administrators in selecting, preparing, and utilizing rehabilitation personnel for work with retarded persons. The findings of this study can also be incorporated into undergraduate and graduate rehabilitation programs and into continuing education and inservice training.

The results of this study and those of the program of research and training which it is designed to generate should have implications for the pre-service and in-service training of rehabilitation counselors and should modify the practices of counselors related to the rehabilitation-habilitation of the mentally retarded, improving service delivery to this disability group. The results should also be utilized by legislators and RSA staff for forward planning related to training priorities and legislation.

245 Program Evaluation for an Integrated Community-Based Extended Rehabilitation Service System

Principal Investigator:	**J. D. Parham, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1978-May 1981**	
Cost:	**Annual $41,462** **RT Annual $27,400**	**Projected Total $79,690** **RT % of Annual Total 66%**
Annual Report Reference:	**#9, Page 99, R-47**	

OBJECTIVES.

1. To document the development and growth of an integrated continuum of community-based extended rehabilitation services.

2. To develop a comprehensive program evaluation model suitable for use by a community-based integrated service delivery system.
3. To implement that model among member agencies of the community-based service system.
4. To document the implementation procedure.
5. To develop mechanisms for integrating program evaluation as a part of the ongoing management system.
6. To develop mechanisms for information feedback that have impact on program and client services.
7. To develop procedures that involve all levels of the community-based provider agency staff in the decision-making process and program evaluation.
8. To develop procedures for replication of the program evaluation and community-based models.

METHODOLOGY: The methodology of this study is designed to determine what steps are necessary and sufficient to develop a successful comprehensive community-based integrated service-delivery system for the severely disabled. One of the necessary components within such a system is an integrated and continuous process of self-evaluation. This program evaluation process would determine how well individual programs within the agency meet their goals; it would also examine the agency or system as a whole for the purpose of increasing the effectiveness of that body.

The program evaluation process must integrate both research and dissemination mechanisms. This would ensure the continuity and validity of the process; evaluative research outcome data (specifically designed to meet the needs of the system for relevant information on its effectiveness) can then be interpreted and translated into recommendations. The recommendations can be presented to the appropriate decision makers for implementation, and evaluation can be made of the effects of those implemented recommendations.

FINDINGS TO DATE: Three specific areas of interest have prompted investigation thus far: (1) consensus of board members regarding goals and objectives of LAERS, (2) impact of LAERS on the ERS clients served, and (3) changes in LAERS clients as perceived by their families.

The questionnaires used to assess board members revealed a strong commitment to establish and upgrade sheltered work facilities and a general agreement that program planning was deficit. A large part of the organization's problems were attributed to a lack of interagency communication and coordination. All of the board members agreed that LAERS was fulfilling a vital community function and was a worthwhile project. One additional factor became apparent as a result of open-ended questioning, and that is the importance of public relations and the maintenance of a visible profile in the community.

The impact of LAERS program on the clients was measured by means of analyzing a small number of cost benefit factors. Covering the first year of operations, these were simply reported in terms of frequency and percentage rates. Overall, results indicated an average increase in per capita income which in turn served to decrease the amount of subsidy provided by LAERS funds and sheltered work facilities. The clients also showed rather marked increases in number of hours worked during the year.

Many of the results reported above were reflected in the parent's observations of the LAERS clients. Fifty percent of the sample clients had begun to pay rent and reimburse their families for food. A majority of the clients were purchasing many of their own clothes and personal items. As a result, a number of the parents reported noticeable increases in self-confidence and pride in that the clients were feeling more self-sufficient. The client also felt more useful and motivated to work.

Other information gathered during this process covered cost to the families of maintaining the clients and cost-benefit factors relevant to LAERS as an organization.

APPLICABILITY: The first phase of results have been disseminated to members of the LAERS board and have precipitated consideration of a number of issues which heretofore had been generally taken for granted. The final results will be particularly helpful to the consortium agencies of LAERS and to federal and state planners entertaining the concept of cooperative community services.

246 Case Management and the Individual Program Planning Process

Principal Investigator: Larry McCarron, Ph.D.

Status: New

Dates: June 1979-December 1981

Cost: Annual $37,677 — Projected Total $73,455
RT Annual $29,382 — RT % of Annual Total 78%

Annual Report Reference: #9, Page 107, R-49

OBJECTIVES:

1. To describe and compare IWRPs, IEPs, and IPPs for the mentally retarded with respect to their form, elements, and adequacy by reference to standards within rehabilitation agencies, public schools, public residential facilities, and community MR settings.
2. To describe and compare the resources and procedures involved in developing, implementing, monitoring, evaluating, and modifying individual plans in the various settings.
3. To describe staff assessments of the adequacy of the individual program planning process and outcome in their settings, including their identifications of both critical problem areas and procedures which have proven effective.
4. To identify mechanisms and procedures of individual program planning positively related to staff assessments that the system is effective and efficient.
5. Drawing on the results of the survey findings, to develop a training manual aimed at describing how to implement an effective and efficient system for individual program planning and case management.

METHODOLOGY: The study will begin with a review of the literature on individual program planning and case management, as well as collection of standards and operations manuals from agencies in the Region and discussions with agency representatives to identify important topics for inclusion in facility surveys, which will be the primary method of data collection.

Three surveys will be sent to each setting, one for the appropriate administrator (i.e., director of rehabilitation office, director of special, state school superintendent) another to a teacher or team leader, and the other to be passed on to a staff member who has been intimately involved in the individual program planning process (i.e., rehabilitation counselor, special education aide, or social worker). Surveys will also be prefaced by an explanation of the project and a call for candid responses in view of the fact that the identity of facilities and respondents will remain confidential.

FINDINGS TO DATE: Initial findings indicate that there are wide differences in opinions regarding individualized programs. This is manifested in differences among administrators, teachers, and aides, as well as differences among different types of agencies and institutions utilizing various planning formats. There is some indication that the individual planning process is not working as efficiently as would be desirable, although present data is not conclusive.

APPLICABILITY: In recent years, legislation in rehabilitation, education and developmental disabilities has mandated that individual program plans be developed and implemented as a means of insuring that clients or students receive services appropriate to their needs. The obstacles to truly individualized services are numerous, and it has become clear that agencies and facilities are struggling to make the individual planning process a meaningful one rather than a useless exercise in paperwork. Through input from its advisory committee (see advisory committee notes at the end of this report), as well as through a session to elicit research ideas from practitioners (see the introduction to research at the beginning of this volume), the Center has identified this area as a critical need area in improving the service delivery system. Since developmentally disabled persons are served in rehabilitation, special education, and mental retardation settings, a focus on individual program planning for them provides a unique opportunity to determine how the case planning and management process is approached in varied settings and the degree to which problems cut across these settings. The kinds of problem areas that have already been mentioned to the Center by people in the region suggest both diversity and commonality. That is, some difficulties are unique to state schools or rehabilitation agencies, but at the same time, there

appears to be a consensus that there are key functions of case management that must be performed in virtually any setting where individual program planning is done. As one of our contacts in the region indicated, it would perhaps be enough at this point to describe what is happening and to identify the most prevalent kinds of difficulties which face persons playing case management roles. However, this project will also attempt to identify and disseminate techniques for solving difficulties and making the individual program planning process not only more efficient but more facilitative of the ultimate goal of improving services to individual clients. Although the research will not focus exclusively on state rehabilitation agencies and the IWRP, it will include such agencies as part of its focus. Moreover, since rehabilitation agencies relate to education and mental retardation programs, the results of the study should contribute to coordination of program planning across agency lines.

247 Assertiveness Training for Retarded Clients in Vocational Settings

Principal Investigator: Andrew S. Martin, Ph.D.

Status: New

Dates: July 1979-June 1982

Cost: Annual $21,502 — Projected Total $66,960
RT Annual $19,260 — RT % of Annual Total 89%

Annual Report Reference: #9, Page 240, R-50

OBJECTIVES: Many mentally retarded clients in sheltered workshops tend to be passive, non-assertive, acquiescent and withdrawn in personal interactions both inside and outside the workshop. This lack of social competence poses no particular problem as long as the client is living with family members, is employed by a sheltered workshop, is transported to and from the workshop by family or workshop staff, eats all meals in the home or workshop,and attends sheltered social functions (sponsored by the workshop or some other MR agencies)--in short, lives an entirely sheltered life. However, if the retarded adult is to become less dependent, this lack of social competence may prove a hindrance to adequate vocational and community adjustment.

Whalen and Henker (1969) taught retarded adolescents to apply behavior modification techniques to teach young children basic skills. While the primary focus of their research was the feasibility of using mentally retarded persons to teach mentally retarded children, the authors report anecdotal evidence of serendipitous changes in the tutors themselves. Whalen and Henker noted that their retarded tutors seemed to learn how to handle responsibility and show initiative, and they noted apparent increases in self-esteem, self-confidence, and assertive behaviors, presumably as a result of the retarded clients having taken on the role of the teacher. This approach, in which benefits to the nonprofessional "therapist" often equal or outweigh the benefits to the "client" has been called the "double change phenomenon" (Guerney, 1969).

A number of other authors have reported this "double change phenomenon" as a serendipitous outcome of employing mentally retarded individuals to train such behaviors as social skills (Kazdin, 1971), self-help skills (Dilley, 1969), and verbal fluency (Weisen, Hartley, Richardson, and Roske, 1967). While increases in social competence accruing to mentally retarded persons serving as teachers or trainers have been noted by a number of authors, these increases in appropriate types of behavior have not been investigated directly nor have the effects of the "double change phenomenon" been measured objectively.

The purpose of this study was to attempt to use the "double change phenomenon" to improve personal interaction skills in a vocational setting for mentally retarded persons and to measure these changes directly.

METHODOLOGY: Mentally retarded adult workers served as supervisors of peers in a sheltered workshop as a strategy to increase social competence. Each experimental subject supervised three retarded workers on an assembly task. Social competence, measured by the Kohn Social Competence Scale and the Predicted Behavior Scale was compared for experimental and control subjects before and after the peer supervision training program.

FINDINGS TO DATE: The change from pre-test to post-test on the Kohn Social Competence Scale was significantly greater for the experimental subjects compared to the control subjects (Mann Whitney U = 0, p< .05). On the Predicted Behavior Scale, all three experimental subjects showed positive change, whereas only one control subject changed positively while the remaining two control subjects did not change at all. The change scores on the Predicted Behavior Scale indicated that the experimental subjects gained more than the control subjects (Mann Whitney U = 1, p< .10).

The results show that the experimental subjects who served as peer supervisors for three other clients on an assembly task did show significant gains compared to the control subjects on the Kohn Social Competence Scale, and made greater gains than control subjects on the Predicted Behavior Scale.

APPLICABILITY: While significant gains in standardized test scores can only lead to inferences about changes in underlying behaviors and attitudes, the technique of utilizing retarded workers as supervisors of peers seems to have merit as an easy to employ strategy for improving client's interpersonal skills in workshop settings.

248 Programming Independent Living Skills for the Developmentally Disabled in Secondary Schools

Principal Investigator:	**Larry McCarron, Ph.D.**	
Status:	**New**	
Dates:	**January 1980-December 1982**	
Cost:	**Annual $119,944**	**Projected Total $300,000**
	RT Annual $0	**RT % of Annual Total 0**
Annual Report Reference:	**#9, Page 225, R-51**	

OBJECTIVES: The project is directed at two service issues: 1) the use of evaluation procedures to formulate a method of training developmentally disabled persons in social, independent living, and prevocational skills. 2) programming of innovative methods of training developmentally disabled persons in the secondary school setting.

The expansion of educational services for the severe developmentally disabled has dictated the need for innovative training in social adaptation skills for community living. The community service practitioner as well as the educator is attempting to understand the behavioral competencies which influence successful adaptation to the demands of community living. For an individual to become proficient in community living skills, it has become apparent that assessment techniques are required which can act as guidelines for prescribing curriculum which match the specific needs of the individual. Current studies in secondary schools (McCarron, Clement and Champ, 1979) have indicated that the most productive approach is to provide detailed information on the individual's functional skills which relate to an appropriate selection, sequence and method of presentation of curriculum. Success in social, independent living and prevocational skills can be appreciably increased by effective secondary school programs.

METHODOLOGY: A systematic approach to evaluation and training organizes the evaluation data in terms of underlying neuropsychological processes (sensory, fine and gross motor, perceptual memory, communication, behavioral and adaptive skills, etc.) and then relates the individualized profile of neuropsychological processes to a specific sequence and format of training which takes into account or accommodates for individual strengths and needs. Since developmentally disabled persons generally have multiple handicapping conditions, a systematic approach of describing the individual's current functional behaviors is used. The assessment procedure provides documentation for placing an individual in an appropriate program level. The secondary school program may be organized according to the developmental levels from primary self-help skills to community life skills. The assessment profile is further used to determine the sequence and presentation of curriculum. Specifically, the proposed project will be directed at establishing a systematic and applicable method of utilizing evaluation information for the formulation of effective educational programs for the developmentally disabled.

FINDINGS TO DATE. The procedures are currently being field tested in two secondary school settings. The results of the systematic evaluation are being used to develop individual educational plans for developmentally disabled students at these sites. Programming of curriculum is underway and data on the progress of each student is being collected.

Research on the evaluation procedures has indicated that valid and reliable data are provided for determining the training needs of a wide range of developmentally disabled. This evaluation system has been found to be particularly effective when used with physically or mentally disabled persons in secondary schools.

APPLICABILITY: Such a system of evaluation/training enables the secondary schools to facilitate a habilitation program for handicapped persons in educational settings.

University of Wisconsin-Stout (RT-22)
Vocational Rehabilitation Research and Training Center

CORE AREA

Vocational Evaluation

The development and dissemination of new knowledge in vocational evaluation and the client service areas interfacing with vocational evaluation (which include work adjustment, vocational training, follow-up and counselor/client decision making), and also the development of demonstration programs in the areas of client referral to vocational facilities and effective facility service utilization.

UNIVERSITY OF WISCONSIN-STOUT

Daniel McAlees, Ph.D., Director
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COMPLETED

CONTINUING

NEW

PROPOSED

Estimation of the Development of Personal-Social, Vocational, and Independent Living Capacities of Vocational Evaluation and Adjustment Clients

The Impact of Independent Living on Vocational Evaluation

249 Factors Influencing Counselors Determination of Client Eligibility and Referral for Facility Services

Principal Investigator:	Fredrick Menz, Ph.D.	
Status:	Completed	
Dates:	March 1977-June 1980	
Cost:	Annual $29,918 RT Annual $21,894	Projected Total $97,500 RT % of Annual Total 73%
Annual Report Reference:	#8, Page 19, R-26	

OBJECTIVES:

1. To determine whether sequence of report selection and the number of reports used per se have effects on counselor eligibility decisions.
2. To determine whether there is an optimal number and sequence of types of reports for efficient eligibility determination with specific client disability or rehabilitation risk groups.
3. To develop a case management training package using case simulations.

METHODOLOGY: **Subjects:** The subjects in this study were vocational rehabilitation counselors in Wisconsin randomly selected throughout the state and assigned to experimental packages containing three of the six case studies. Sixty-four counselors balanced across the four administrative regions (18 offices) participated in the study.

Instrument: The instrument is based on the six case files used in the Coker, et al. (1976) study. The set of six cases presents a range of severities of disability and rehabilitation risks (as defined by Lorenz, 1973 and Scheinkman, et al., 1975). Each case contains a standard vocational rehabilitation application and a total of twenty possible informational reports (casenotes, medical reports, and consultant records). The counselor selects any reports up to the point he/she was ready to make an eligibility decision. These experimental packages (expected to be useable as a training package) present all case materials in a casefile format and follow basic principles of programmed learning to maximize consistency of the experimental conditions and efficiency of data collection.

The recording format gathered data with respect to eligibility decision; number of information choices; specific types and sequence of information chosen; and estimated probability of rehabilitation success. Additional data were gathered on the counselors plan for the applicant's rehabilitation; the counselor's perceptions of factors influencing the applicant's rehabilitation; counselor experience, education and preparation; present caseload; and administrative policies and constraints under which the counselor functions.

Procedures: The experimental packages were administered during site visits to each office by the principal investigator. Each of the fourteen packages contained three of the six cases, crossed by severity of the "applicants" disability and rehabilitation risk and balanced by order in which cases were processed. Assignment of packages was monitored to insure that at least one counselor completed one of the fourteen combinations in each administrative area and that at least thirty-two counselors completed each case. These procedures to assign subjects to case combinations allowed collection of all data needed to address the research objectives. A survey of the participants, after providing them feedback on their performance, acquired evaluative data needed to translate and refine the packages for training purposes.

Rates of acceptance (percents) of each case for rehabilitation were computed and compared with rates obtained in earlier research conducted by the Center in 1973 to determine the comparability of counselor responses to simulations between states and over time. The rates of acceptance between administrative regions within Wisconsin were examined to determine whether client acceptance for rehabilitation differs in urban and rural settings.

Both analyses of variance and discriminant functions were computed with the data on information selected to determine whether counselors use different amounts and types of information with different severity and risk groups, when making different decisions about eligibility, and if the

counselor is functioning in different administrative regions of the state. The four factors in the basic analysis of variance design used with the sets of independent variables were Severity of Applicant's Disability, Rehabilitation Risk, Administrative Region, and Eligibility Decision (2x3x4x2 factorial). Where main or interactive effects were found under this design, discriminant functions were computed to isolate the interrelationships among dependent variables which contributed to distinguishing between levels on the independent variable(s).

The three sets of dependent variables analyzed were the total number of reports selected to reach a decision; the total numbers of medical consultant reports, nonmedical consultant reports, and applicant contacts used; and the relative emphases given to different sources of information. This last set of dependent variables was constructed by classifying the twenty reports as to their purposes in decision-making: Screening for physical disability (General Medical); Estimating severity of primary disability (appropriate consultant report(s)); estimating secondary medical aspects of disability (other medical consultant reports); estimating psychosocial aspects of disability (psychological and social histories); estimating vocational potential (vocational evaluation report and employment history); clinical screening and evaluation of potential to benefit from rehabilitation (casenotes); and other (educational history). Frequencies of selection were adjusted, within each of the seven classes, by availability for selection.

FINDINGS TO DATE: Analyses of how information is used in eligibility determination are still underway.

Comparability with Previous Simulation Research:

1. Acceptance of applicants for rehabilitation by Iowa and Wisconsin counselors was found to be quite consistent when examined across the six cases (79% vs. 82%) and rates did not differ by more than 7% and usually by only 2 or 3% when rates of acceptance for each case were compared. Greater variability in acceptance was found among the four administrative regions in Wisconsin than between the two states.
2. The average number of pieces of information selected by Iowa and Wisconsin counselors was also fairly consistent (7.09 in Iowa vs. 6.99, including the application for services in Wisconsin.
3. Counselors in the two states (and over the five years between the studies) respond similarly to case simulations, are similar to each other in terms of the amount of information they use to make an eligibility decision, and the data collected from them should convey a fairly accurate picture of counselor use of information (the types available in the simulation package) to reach an eligibility decision.

Counselor Use of Information in Eligibility Determination:

1. The total number of pieces of information selected in eligibility determination is unrelated to the severity of applicant's disability, the rehabilitation risk involved, and whether the applicant is accepted for services. Differences, however, were found between the four administrative regions of the state. These differences are with respect to the numbers of contacts which counselors prefer to have with the applicant before arriving at a decision. If the counselor was in the northern, more rural and less heavily populated, regions they preferred having 1.053 more contacts with the applicant than counselors in the southern and more urban regions of the state. Throughout the state, counselors select an average 2.245 medical consultant reports and 1.734 nonmedical consultant reports.
2. Severity of the applicant's disability **per se**, is unrelated to the numbers of medical consultant reports, nonmedical consultant reports and contact with the applicant used. Rehabilitation risk and severity, in interaction with risk, though, do account for significant amounts of variance. Greater use of applicant contacts and rather equal use of medical and nonmedical resources will be made with a high and low risk applicant. With a medium risk applicant, however, more reliance will be made on medical resources and less reliance on both nonmedical reports and on applicant contacts. With respect to the numbers of each resource used the High Risk Non-severely (HNS) disabled and the Medium Risk Severely Disabled (MS) applicant present contrasting problems for the counselor in his/her decision-making as reflected in their use of medical resources and casenotes. With the HNS, more direct contact is sought and less use of consultant resources is made, while with the MS, greater numbers of medical (2.391) and nonmedical (1.969) consultant reports are drawn upon.

3. Based upon the comparative emphases counselors give to different classes of information, counselors make eligibility decisions regarding four distinct types of applicants: Nonseverely Disabled (NS); Severely Disabled (S); Medium Risk Severely Disabled (MS); and High Risk Non-severely Disabled (HNS).

4. The NS applicant presents the most uncomplicated type of applicant. Major emphasis is given to determining the extent of a primary or presence of a secondary disability, along with a fairly low level or modest screening of the applicant's social, psychological and vocational background. This approach is apparently geared toward determining whether some clear and direct benefits might be accrued from rehabilitation should the applicant be accepted.

5. The S applicant presents a more variable challenge to the counselor depending on whether the applicant is high or low risk. Major emphasis is given to determining the severity of the presenting disability, regardless, but a somewhat more intense inquiry process is involved if the applicant is also high risk. More emphasis will also be given with this high risk client to determining both secondary psychosocial aspects of disability and whether the applicant has a clear vocational potential.

6. The MS represents the most typical rehabilitation applicant/client. The applicant's disability can be determined through a general medical screening. Moderate attention is given to determining the degree of severity and/or other related medical conditions along with a fairly equal attention to investigating other aspects of the applicant's background which might be related to a disability or the applicant's vocational potential.

7. The HNS applicant presents the most dramatically different problem for the counselor in selecting and processing information in eligibility determination. The HNS applicant is least likely to be accepted for services. It is with the HNS that the counselor's efforts are most clearly directed at determining whether there is some severe disability. Comparatively higher emphases are given to both physical and psychosocial aspects of disability. Reliance on consultant resources will be greatest and most variable with this applicant type.

8. For all four types of applicants, general screening for physical disability is given higher emphasis and clinical evaluation and screening for potential to benefit from rehabilitation is given modest emphasis.

APPLICABILITY: The results of this project are anticipated to have one of the following uses: (1) the determination of guidelines for assessment and eligibility determination with specific client groups which could be used to establish case review standards; (2) the determination of critical report content which could be used to establish guidelines for preparing reports as well as performance evaluation of professional consultants; (3) the determination of the types of biases which occur in making referrals and preparing reports which could be used to develop guidelines for referral and report writing.

Additionally, the results will provide basic information regarding the eligibility determination process which can be used in both pre-service and in-service counselor training programs.

The case vignettes used in this project will be packaged in the form of a training program on eligibility determination. This package could be used by rehabilitation counselor training programs for pre-service training and by state vocational rehabilitation agencies for in-service training.

50 The Effects of Vocational Evaluation on the Rehabilitation Client and Counselor

incipal Investigator: Charles Coker, Ph.D.

atus: Completed

ates: July 1978-June 1980

ost: Annual $17,211 — Projected Total $46,120
RT Annual $12,591 — RT % of Annual Total 73%

nnual Report Reference: #8, Page 143, R-38

BJECTIVES: The goal of this project is to determine the effects of Vocational Evaluation on the client and counselor. This goal will be attained through the following objectives.

1. Analysis of data from pilot research examining the effects of Vocational Evaluation with respect to client change and functional disability.
2. Analysis of data from pilot research examining the effects of Vocational Evaluation with respect to counselor information gain.
3. Interpret research findings and propose further research in this area.

ETHODOLOGY: In the two studies, data from rehabilitation clients and counselors in Michigan have been collected. In one, approximately 46 rehabilitation clients referred to or awaiting Vocational Evaluation have been studied to determine the effects of Vocational Evaluation on their self-concept, vocational needs, and vocational information. In the second study, thirty vocational rehabilitation counselors have been assessed as to the degree of information they gained about a client as a result of their client receiving vocational evaluation services.

Study I: Client Change. The assessment of client change as a result of Vocational Evaluation consists of three areas: (1) general self-concept: (2) identification of vocational needs: (3) information gained. The following instruments were used: (1) The Tennessee Self-Concept Scale was used to assess individuals' perceptions of themselves: (2) The Attitude Scale of the Career Maturity Inventory was used to measure clients' vocational needs: and (3) A survey instrument was developed which consisted of client information in three categories: (a) information about general worker traits: (b) information about specific work skills, aptitudes, interests: and (c) information about specific work environments.

Twelve rehabilitation facilities in Michigan were selected. The three instruments measuring client change were administered to each client entering the facility for evaluation services during a four week period. As each client completed evaluation, the tests were readministered to him/her. Clients awaiting vocational evaluation services in the participatory facilities were also tested on pre post-test basis over a time interval equal to the length of time of evaluation services. A total of 46 clients were tested, 34 clients who had completed evaluation and 12 clients who had not participated in evaluation.

Study II: Counselor Information Gain. An instrument (Client Assessment Survey) was designed to measure counselor knowledge concerning their clients' vocational abilities and skills. In addition, a 6 point Likert Scale was used to further measure the counselors' degree of certainty concerning the accuracy of each response. Each counselor was administered the Client Assessment Survey (CAS) prior to their clients' commencement of evaluation services. After each client completed evaluation, the CAS was readministered to the counselor. Another CAS was completed by the participating counselors on a pre post-test basis for a client referred to but awaiting evaluation services. Counselor and client demographic information was collected for analysis.

NDINGS TO DATE: This year's activities have examined the utility of Vocational Evaluation Services for the referring counselor and client. The findings which are reported below are based upon a preliminary analysis of the data collected respective to the two prime objectives of the project. The final analyses of the data from the studies will be completed by the end of the grant year.

Counselor Information Gain (Study II): Assessment of the amount of information counselors gain of client information and the extent to which their certainty of the information increased as a

result of Vocational Evaluation Services was explored. Thirty-five counselors from Michigan Bureau of Rehabilitation were pre- and post-tested as to the amount of information they possessed concerning a client's vocational assets and liabilities whom they had referred to vocational evaluation using a Client Assessment Survey.

The instrument was used to test two hypotheses: (1) Counselors will gain significantly greater amounts of information with respect to clients who complete work evaluation than for a matched group of clients who do not complete evaluation, and (2) Counselors will gain a significantly greater amount of certainty with regards to information possessed for those clients who complete work evaluation than for those clients who do not complete work evaluation.

Weinstein (1978) concluded that counselors gained both a significant amount of information as well as an increase in the certainty of that information following a client's involvement in vocational evaluation services. The results further indicated that evaluation provides counselors with the ability to effectively define their client's vocational assets and liabilities with regard to job goals, General Educational Development, Aptitudes, Temperaments, Work Attitudes, Attributes and Interests, Job Retention Skills, and Stability Characteristics. The results, however, did not indicate that evaluation provides the counselor with any additional information concerning the client's Physical Capacities and Job Seeking Skills.

While additional information concerning Physical Capacities and Job Seeking Skills did not seem to be an outcome of a client's involvement in vocational evaluation, counselors did seem more certain of this type of the Physical Capacities and Job Seeking Skills information they already possessed. Increases in certainty also occurred for information counselors possessed on the other six scales. This suggests that vocational evaluation services may serve the dual function of both providing the counselor with new information and confirming or disconfirming information the counselor already possesses.

Client Change (Study I): Two studies examined the effects of Vocational Evaluation on clients. Chandler (1978) conducted a study of client change as measured on several dimensions. Change in self-concept was measured using the Tennessee Self-Concept Scale. The Career Maturity Inventory-Attitude Scale was used to measure change in vocational maturity. Ability to state a job goal was assessed in an interview with the client. In addition to these dimensions, a survey was developed to explore the possibility that clients gain information about their vocationally related assets and liabilities as a result of vocational evaluation. As reported by Chandler, (1978), there were no significant differences between clients participating in vocational evaluation and clients not participating in vocational evaluation as measured on the three instruments.

Post hoc analysis of Chandler's data was restricted, due to the few number of subjects across facilities, prohibiting a regression analysis from being computed to determine variables significant in predicting change. It was anticipated by Chandler that the twelve vocational evaluation programs would differ in the level of client participation and that possible interaction of this effect on client change would exist. Again, the small sample of subjects (34) across twelve facilities did not permit a post hoc analysis of this data.

The methodological problems encountered by Chandler were considered and controlled in a study initiated by Hein (1979). Hein investigated 32 clients participating in vocational evaluation at the Vocational Development Center, identified as a high level client participatory program. Hein used the same measuring instruments as Chandler in a pre-test, post-test design. A preliminary analysis of the data with respect to the Career Maturity Inventory (CMI) Attitude Scale and Tennessee Self-Concept Scale indicated that statistical significant changes did occur. Participants in the study were involved in vocational evaluation, but either entered a two week evaluation program or a three week program consisting of two weeks of evaluation similar to the other group, and one week of values clarification. All clients (two week and three week client groups) had significant changes in their post-test scores on the CMI-Attitudinal Scale when compared to their pre-test scores.

A t-test was computed on the mean change scores from the pre-test and post-test scores between the two and three week groups. The results indicated the mean change for the two groups of clients did not differ significantly from each other. With respect to the same clients and programs, the analysis of data obtained from the Tennessee Self-Concept Scale (TSCS)

indicated some differences occurring from the pre-testing of clients to the post-testing.

For all clients, the following six sub-scales were significant: (1) Total Positive, (2) Self-Satisfaction, (3) Behavior, (4) Physical Self, (5) Personal Self, and (6) Social Self. The clients in the two week program changed significantly on the following scales: (1) Self Satisfaction, (2) Behavior, (3) Physical Self, (4) Personal Self, and (5) Social Self; whereas, the clients in the three week program only changes on one scale, Social Self.

Further analysis of the TSCS data obtained on the clients in the two and three week program was computed. The mean change scores for all scales, between the pre-test and post-test for the two and three week program participants were compared. The results indicate only one scale (Self Satisfaction) where the difference in the pre-test and post-test scores for the two week group was significantly different compared to the change of pre-test and post-test scores for the three week group. On examining the Self Satisfaction dimension, two week clients changes significantly ($t(17)=-4.33$; $p < .001$), whereas three week clients did not change ($t(13)=-.146$; $p < .05$).

Preliminary analyses indicates that there are significant differences occurring for persons during their vocational evaluation program as measured by the CMI-Attitude Scale and TSCS on pre- and post-administrations. Hein also suggests that the differences occurring between the two and three week groups in favor of the two week group could possibly be with respect to the demographic variables, age, and referral source. A significant difference between the groups exists with respect to age; the two week group being older.

Since Hein (1979) and Chandler (1978) differ in their initial analyses of data and design, further analyses are expected to be continued prior to any final report.

APPLICABILITY: The purposes of these studies were to indicate the effects of Vocational Evaluation on: (1) counselor gain of client information; and (2) client change in vocational maturity, vocational needs, and self concept. Since vocational services are becoming more and more scrutinized by various interest groups, legislative groups, and service purchasers; the findings of these studies are applicable to the issue of measurement of expected outcomes of services.

Preliminary findings from this study indicate that the measurement assessing Vocational Evaluation effects on counselor gain of client information is sensitive and a valid estimate. State and facility personnel can use this approach to determine effectiveness for professionals. The initial analyses of Chandler (1978) and Hein (1979) data indicates different outcomes. Whereas, Chandler did not find significant change for clients, Hein did. The difference occurring in the studies' design needs to be further investigated. Presently, the instruments measuring the effects on clients are sensitive with given client population. Should more detailed analysis of these data indicate that this approach is sufficiently sensitive, a needed method will be available to state and facility personnel.

251 Development of Programmatic Research Issues Within Vocational Assessment

Principal Investigator: Charles Coker, Ph.D.

Status: Continuing

Dates: July 1977-June 1982

Cost: Annual $44,244 — Projected Total $240,163
RT Annual $32,369 — RT % of Annual Total 73%

Annual Report Reference: #8, Page 99, R-30

OBJECTIVES: The goal of this project is to develop, implement, and monitor a line of programmatic research and research utilization activities in the area of client selection and rehabilitation planning, with a particular focus upon those severely disabled persons who are referred to rehabilitation facilities for assessment and evaluation of rehabilitation potential.

This goal will be attained through the following specific objectives:

1. To identify researchable issues in the area of client selection and rehabilitation services planning, using the Center Advisory Committee, RSA R&E strategy, state rehabilitation agency personnel, rehabilitation facility personnel, and other input sources.

2. To develop a programmatic research strategy and research utilization plan based upon identified researchable issues, knowledge gaps, and priority concerns.
3. To prepare issue analysis and position papers based on literature reviews which identify specific knowledge gaps and which formulate researchable problems.
4. To conduct pilot studies which demonstrate research feasibility and/or resolve methodological and instrumentation issues related to identified knowledge gaps and researchable problems.
5. To make available for dissemination, research findings not included in other projects.
6. To develop research project proposals for submission to the Center's Advisory Committee, RSA Regional Office, and RSA Special Centers Office for review and approval.
7. To review the findings of Center programmatic research activities with the Center training section to insure that optimal dissemination and utilization of all findings is occurring.
8. To monitor and evaluate Center programmatic research and research from other sources related to client selection, rehabilitation planning, and the use of vocational evaluation procedures in client assessment and planning with the purpose of periodically revising the programmatic research strategy, research priorities, research activities, and research dissemination and utilization procedures.

METHODOLOGY: The methodology consists of four major activities:

1. **Programmatic Research Strategy:** The purpose of this step is to allow for the identification of a continuing research strategy which (1) identifies issues of priority concern; (2) defines the interrelationships between the issues; and (3) presents an orderly, systematic, and integrated programmatic research strategy for resolving the issues.

   The programmatic research strategy is circulated for review, revision, and approval. It will be the basic programmatic research guide and will be periodically revised and updated to take into account new knowledge, changes in priority groups, etc.

2. **Issue Analyses:** Issue analyses will be concerned with (1) the analysis and synthesis of existing knowledge related to the issue based upon literature reviews, (2) the identification of knolwedge gaps which prevent resolution of the issues, (3) the formulation of specific researchable problems or questions which need to be answered to remove the knowledge gaps, and (4) identification of priorities and allocation of responsibility for dealing with the researchable problems and questions. The preparation, development, and publication of specific issue analysis will follow the sequence of issues identified in the programmatic research strategy.

3. **Pilot Studies:** The purpose of the pilot study is to determine whether it is feasible to conduct a research project related to an identified problem. These projects will be brief in nature and use a limited number of subjects. The basic intent is to determine such things as whether a design can be implemented, an instrument can be used, a coding system is reliable, etc.

4. **Project Proposals:** Project proposals will be submitted in the Annual Progress report or at other times during the year as appropriate. One management objective of the core developmental project concept is to insure that the development and submission of project proposals is a continuous process, rather than one in which ideas are "saved" for the Annual Progress report. The activities and products described above should insure the specific project proposals within this core area and will meet the following criteria: (1) specific relationship to programmatic research strategy, (2) adequate review of relevant literature, (3) clear definition of specific knowledge gap or problem, (4) adequate methodology for resolving knowledge gap/problem with pilot tests when necessary, (5) adequate utilization plan for findings by both rehabilitation in general and the Center.

FINDINGS TO DATE: Activities have been undertaken to define the areas of programmatic research, analyze issues, conduct pilot studies, and develop proposals.

Programmatic research. The Center's research activities can be classified on the basis of impact on the following categories of processes associated with handicapped individuals involved in the state-federal vocational rehabilitation system: (1) Service Delivery; (2) Role and Function of Rehabilitation Professionals; (3) Diagnostic and Assessment; and (4) Restoration and Training.
Issue Analysis. In the first year of the project, the issue analyses were confined largely to Vocational Evaluation. This year the issues related to the areas of programmatic research cited in the previous section which represents broad areas of functioning, but which are inter-related to one another.

In service delivery, the major issue centers around the measurement problem: How can we measure clients' functional capacities so that the impact of rehabilitation programs can be assessed?

Two other issues are being addressed in other projects. Counselors as gate-keeping decision-makers are being studied in a completing project (R-26).

In a second study (R-40), the issue of the impact of facility services on rehabilitation outcome is being investigated through tracking individual clients from intake to placement.

In the training of facility rehabiliation personnel, several recurrent issues have developed. These issues are being addressed in a completed project (R-25) and a proposed project (R-43).

The Center has begun a programmatic line of research in Adjustment programs centered around the examination of behavior change technology and Adjustment Specialist's competencies. The research now being conducted and proposed would provide a valuable data-base for developing and prioritizing the Center efforts in Adjustment Services.

Pilot Studies. Seven research pilot studies have been suported in one way or another by the Center. Two of these seven studies are completed doctoral dissertations at Michigan State University, two are doctoral dissertations now being conducted, another study is a proposed doctoral dissertation, and the remaining two studies are master's level research at the University of Wisconsin-Stout.

Project Proposals. The generation of research proposals is a complicated and lengthy process, but one which yields relevant projects of highest quality. The Advisory Council reviewed the four proposals and recommended submission in the current grant year. After RSA review, the projects will be reviewed by the University Committee on the Protection of Human Subjects Rights prior to the implementation.

APPLICABILITY: The products of this project can be generally used in rehabilitation in the following ways: (1) to identify significant issues and knowledge gaps related to the role and function of the facility-based vocational assessment and evaluation programs in client selection and rehabilitation planning; (2) to identify research priorities and to allocate resources to research on an orderly, systematic basis; (3) to resolve specific problems related to the design and instrumentation of research; and (4) to apply and implement new approaches and procedures which will enhance the use of facility-based services in client selection and planning.

As has been indicated above, the project is a developmental project which will serve to organize and integrate a series of programmatic research activities on vocational assessment and evaluation in client selection and planning. The Center will be a primary user of the products of this project in (1) selecting research priorities, (2) allocating research resources, and (3) applying research findings.

252 Study of the Vocational Decision-Making Skills of Vocational Evaluation Clients

Principal Investigator:	Thomas Czerlinsky, Ph.D.	
Status:	Continuing	
Dates:	July 1978-September 1981	
Cost:	Annual $27,041 RT Annual $19,783	Projected Total $97,737 RT % of Annual Total 73%
Annual Report Reference:	#8, Page 121, R-37	

OBJECTIVES: To conduct an exploratory study on the extent to which Vocational Evaluation clients experience vocational decision-making problems and compare the type of problems these clients experience to those experienced by clients at a different stage in the rehabilitation process as well as those experienced by a selected segment of the general population.

METHODOLOGY: To assess the vocational decision-making problems experienced by this group, a vocational Decision-Making Interview (DMI) was developed and administered. The DMI was constructed on the basis of the relevant research literature and the experiences of a number of rehabilitation professionals. Extensive content validation and item analysis procedures were utilized, and the final form of the DMI was an interview format made up of three scales—Employment Readiness Scale, Self-Appraisal Scale, and Decision-Making Readiness Scale. Reliability estimates for these three scales were .62, .63, and .79 respectively, and the reliability of the total DMI scale was .84. Inter-scale correlations ranged from .38 to .55, and the correlations of the scales with the total DMI score ranged from .70 to .88.

Two additional instruments were administered concurrently. A demographic questionnaire was used to gather information about the characteristics of the sample and the Career Maturity Inventory-Attitude Scale (CMI) was used as an indicator of the concurrent validity of the DMI. Three groups of 30 subjects each were used. The first group, vocational rehabilitation clients in vocational evaluation, was chosen to represent vocationally undecided clients. The second group was comprised of vocational rehabilitation clients in vocational training, selected to be representative of vocationally decided clients. The third group were seniors in high school, who should represent a mixture of vocationally decided and undecided individuals.

Each subject was administered the DMI and the demographic survey orally in an individual interview. The CMI was administered orally in a group at the end of the day.

FINDINGS TO DATE: **Concurrent Validity:** Correlational analyses were conducted to examine the degree of relationship between the DMI total (and the scales) and several independent indicators of decision-making. These indicators were (1) the CMI, Attitude Scale, a theoretical indicant of vocational maturity, (2) an item asking the subject to state three job goals, and (3) an item asking the subject to state three career goals. Result showed that the DMI obtained significant positive correlations with all three indicators. The Decision-Making Readiness scale was found to have a significant positive correlation with the item asking about job goals, and marginally significant correlations with the other two indicators. This overall pattern of correlations indicated a reasonable degree of concurrent validity for the DMI.

Discriminant Validity: Analyses of variance were conducted on both the total DMI scores and the three scales to see whether differences existed among the three groups, who were chosen to represent individuals who differ in the degree to which they have made (or are able to make) vocational decisions. The major results were that the mean differences of the three groups on the

DMI total score obtained marginal significance ($p < .07$) with the Training group > High School group > Evaluation group. The mean differences on the Decision-Making Readiness scale also obtained marginal significance ($p < .09$) again with the Training group > High School group > Evaluation group. The mean differences on the Employment Readiness scale and the Self-Appraisal scale were clearly not significant ($p < .15$ and $p < .19$ respectively). Thus, the analysis of the means suggested that, on the DMI total score and the Decision-Making Readiness scale, there was a tendency for those clients in vocational training to obtain a higher score than those clients in vocational evaluation, with the high school students falling at an intermediate point.

Neither of these findings, however, reached the typically accepted level of probability ($p < .05$) required to reject the hypothesis of no difference, so the above findings suggest a **trend** in the total score and the subscales, but do not statistically support this hypothesis.

To test whether there were significant differences in the variances (heterogeneity), Bartlett's tests of homogeneity were calculated on the data from the three groups of subjects, again using the DMI total and the subscales. The results showed that, on Employment Readiness, the Evaluation group > High School group > Training group ($p < .05$); on Decision-Making Readiness, the High School group > Evaluation group > Training group ($p < .01$); and on the total score, the Evaluation group > High School group > Training group ($p < .05$). No significant heterogeneity of variances was found on the Self Appraisal scale. These results appear to indicate that while the high school group was not consistent in terms of their variability, the Evaluation group of clients were more heterogeneous in their scores on the total DMI scale as well as on two of the three subscales.

Further analyses of the DMI results are currently being conducted. It is planned to use these results to modify and refine the instrument, and then to test the refined instrument in a further study. The aim is to assess whether the revisions in the DMI will lead to an instrument with satisfactory statistical properties, not only in terms of discriminant validity, but also in terms of predictive validity.

APPLICABILITY: This study examined the basic functional capacity of vocational rehabilitation clients to make decisions regarding their own vocational future. It was pointed out that the outcome of vocational evaluation services may depend on the client's ability to make such decisions. In this regard, it may be crucial to be able to assess a client's ability to make vocational decisions so that evaluators can maximize the benefits that clients are able to receive from the process of vocational rehabilitation.

253 Point Sampling Approach to Assessing and Monitoring Behavior in Adjustment Services

Principal Investigator:	Charles Coker, Ph.D.	
Status:	Continuing	
Dates:	July 1978-December 1980	
Cost:	Annual $26,086 RT Annual $19,085	Projected Total $87,100 RT % of Annual Total 73%
Annual Report Reference:	#8, Page 157, R-41	

OBJECTIVES: The purposes of this project are to develop a systematic behavioral observation system which is technically reliable and valid; refine the system to enhance its implementation in various rehabilitation program settings; and develop a curriculum package for training practitioners on the basic, but essential skills of observing and recording vocational behaviors in adjustment programs.

METHODOLOGY: The methodology has two main aspects: (1) a multi-stage Monte Carlo computer simulation model was developed to (a) generate a pattern of continuous behaviors which would be displayed by a client in a workshop setting and (b) to sample this continuous behavior pattern in a manner which replicates behavior observation schedules as desired; and (2) the implementation of the Point Sampling system by the staff of three rehabilitation centers. This methodology would enable Center staff to refine the system so that it would be more practical for use in rehabilitation programs, without losing the technical accuracy of a systematic observation schedule.

Cooperative research relationships were developed with three rehabilitation facilities in the Twin Cities area (Minneapolis-St. Paul) for the implementation of the Point Sampling approach in practical surroundings. Each of these facilities were selected because of diversities in philosophy; approach/environmental surroundings; program availability; clientele served; staff backgrounds; etc. Initial training in the basic Point Sampling approach was provided to select staff members. Each facility then implemented the approach for a two-week period with continuing follow-up by Center staff. Modifications to the procedures and testing of the revisions followed, as necessary due to variations in program objectives, needs and specific conditions evidenced in each setting.

Final revisions were made to each approach utilized in the various programs (evaluation, adjustment services, extended employment and work activity) with the facilities.

Alternative manners of implementation, programming considerations and technical aspects of each approach will be fully described in the final report. A training package, including supportive audiovisual materials, will be developed and implemented into on-going, in-service/short-term training activities.

FINDINGS TO DATE: The Point Sampling approach to behavior observation is based upon the gathering of frequency data on specific behaviors which are included in a behavioral hierarchy. This hierarchy can have several branches which represent behaviors expected in a work environment. Theoretically, the behavior observed can be coded into one and only one branch of this hierarchy, at any single point in time. The primary branches of this hierarchy include on-task and off-task behavior. Further branching, within each of these categories, allows for more specific behavioral information to be collected (e.g., On-task Behavior: Attending, Looking Around, Talking, and Other). The hierarchy is used as a method of organizing behavior for recording, analysis and interpretation. To implement the hierarchy approach into actual behavior observations, the practitioner establishes a periodic and systematic schedule for making individual observations. Each time an observation occurs, the practitioner looks at the client, codes the behavior observed, and records it on a data sheet. Additional information is collected with this approach, that relates to production quality and quantity, for later use in assessment of behavior on production output and prediction of performance levels after treatment.

The Point Sampling approach has also been employed in Vocational Adjustment, Vocational Evaluation and Extended (Sheltered) Employment settings to assess and monitor the behavior of individual clients. A formula was developed to estimate the potential production rate (PPR) of a client, given the elimination of off-task behaviors. The formula is as follows:

$$\text{Potential Production Rate \%} = 100 \times \frac{\text{Current Production Rate \%}}{\text{Current on-task\%}}$$

Such a formula could be utilized to give an estimate of the increase in production rate on an actual work task or work sample based on the theoretical assumption that every decrease in off-task behaviors would result in an equal increase in the production ability of the client. This application of the Point Sampling system has not been researched.

A two-level behavioral hierarchy code has been used with some success. Behavior is coded for on-task or off-task and then for four different types of behavior under on- or off-task. Two different intervals of Point Sampling have been used. In one approach, client behavior was observed every 5 minutes during the day over a two week period. In a second, client behavior was observed for periods of ten minutes throughout the day. Observations were recorded every 10 seconds during the 10 minute period. Both approaches are useful. In the first, more behavior of the client is observed over many different tasks. In the second, more specific behaviors in relation to one task are recorded.

This research study has several purposes that extend these initial investigations, which include (1) refinement of the technical aspects of the Point Sampling approach, to increase confidence and reduce error of measurement in the results of its implementation; (2) systematic examination of the validity and reliability of the observation system and its subcomponents; (3) determination of work performance; and (4) development of training materials on the use of Point Sampling in adjustment programs.

Initial results of data analysis indicate that:

1. Fixed block observation schedules, such as the 5 and 10 minute block approaches used in Point Sampling, allow the rater to obtain fairly accurate (above 90% accuracy) estimates of client behavior patterns in a limited number of observations (usually within the first 4 blocks of observations). Variation in accuracy does occur, however, particularly when the durations of behaviors increase beyond the length of the observation block used in the approach.

   At the completion of initial training on behavior discriminations, individual raters were found to achieve significant levels of accuracy on the first administration of a static, slide-tape presentation of behavior categories (78.6% of the raters achieved a 82% accuracy level or higher, with 100% of the raters achieving an accuracy level of 72% or higher). Raters were extremely accurate in distinguishing between 4 types of on-task behavior (85.7% achieving an accuracy level of 92% or higher) and satisfactory accuracy on 4 off-task behaviors (only 53.6% achieved a 92% accuracy level or higher; 100% achieving 72% of higher).

2. At the end of initial training, raters were found to agree in their assignment of behavior ratings as follows: On-task vs off-task behaviors = 970 level of agreement; On-task behavior (4 types) = 964. Off-task behaviors (4 types = .896; total agreement = 943).

3. Internal consistency of individual ratings during application phases of the project reached a level of 905 overall prior to correction for attenuation with a range of .688 to 952 for the 8 categories of behavior used in the behavioral hierarchy.

4. When behavioral ratings were correlated with external criterion, the following correlations were found prior to correction for attenuation: On-task with Production Rate = 380; On-task with Production Quality = 126; and On-task with Potential Production Rate = 072.

5. On-task attending was found to correlate the highest of the 8 categories with Production Rate at a .306 level prior to correction. Other On-task behaviors correlated with Production Rate as follows: Looking around = 061, Talking = 077; and Other = 003.

6. Individual subjects being observed by raters were found to have varying levels of correlation between On-task total Behavior and Production Rate, ranging from .159 to 566 over 8 subjects.

7. Based on type of service program, facility characteristics and clientele being served, numerous modifications to procedures were made to facilitate usage and implementation. Basic procedures of the Point Sampling approach were found to be of value to each facility. Modifications to data collection forms, scheduling and reporting were considerations for facilities and programs.

8. A need for a continuous behavior pattern to be utilized in training was found to be needed. A movie or video tape would give a better indication of rater competency at the end of training, during data collection, and at the end of data collection. Use of such an assessment device would aid in determining the on-going accuracy of raters as they continue to use the Point Sampling approach. Additional work is being undertaken to develop this training tool.

9. Raters and facility administrators found that the information provided was objective, useful, and timely. It confirmed or provided information which was utilizable in diagnostic and planning activities for meeting the needs of the client.

APPLICABILITY: The development of a behavioral observation system such as this not only provides a significant technique for conceptualizing client problems, but is also an excellent basis for building staff competencies in behavior identification and analysis.

This project attempts to improve the method by which individual client behavior can be observed and recorded. It is aimed at development of a behavioral observation system that is technically accurate in the way in which it is structured, practical in the ways in which it can be implemented, and easily learned by practitioners in order for them to become skilled in behavior observation and interpretation of behavior.

254 Client Referral Inventory for Service Delivery

Principal Investigator: Fredrick Menz, Ph.D.
Status: Continuing
Dates: July 1978-May 1982
Cost: Annual $16,840 — Projected Total $108,340
RT Annual $12,320 — RT % of Annual Total 73%
Annual Report Reference: #8, Page 29, R-39

OBJECTIVES: The Functional Capacities Inventory (FCI) was conceived as a tool which vocational rehabilitation counselors, evaluators, and adjustment specialists can commonly use in communicating and in planning and delivering vocational evaluation and work adjustment services. As the goal of this project is to develop a tool which will enhance appropriate utilization of diagnostic and adjustment services, the objectives are geared toward determining whether the FCI is sufficiently reliable and valid to be used in effective communications with individual clients or groups of clients. These objectives, therefore, are as follows:

1. To determine the content validity of the FCI for use in Vocational Evaluation and in the planning and delivery of Work Adjustment Services.
2. To determine the reliability of the FCI for use in Vocational Evaluation, in development of IWRP's, and in Work Adjustment Programming.
3. To determine the utility of the FCI for planning and communicating between counselors, evaluators, and work adjustment specialists.
4. To develop the necessary instructional or training materials for effective use of the FCI in service delivery by counselors and service personnel.

METHODOLOGY: **Subjects:** The primary subjects in the study are vocational rehabilitation counselors, evaluators, and work adjustment specialists representative of a diversity of clients, caseloads, and agency and facility settings. It is estimated that approximately 90 professionals will complete FCI's on approximately 465 clients representative of the dominant disability groups generally referred for evaluation and adjustment services.

Instruments: Respective to their roles, counselors, evaluators, and adjustment specialists will provide three types of responses to the stotements contained in the FCI: a summative judgment of capability; a focused analysis of capability; and a decision regarding service needs. Demographic and survey data on the professionals and the clients on whom FCIs are completed will also be gathered for descriptive purposes and to evaluate the utility of the FCI for professionals.

Procedures: Content Validity. A sample of approximately fifteen academic and practicing evaluators, adjustment specialists, and rehabilitation counselors will review the content and the instructions for the FCI to determine whether the statements are sufficiently inclusive, are clearly stated, and are commonly understood and to insure that assignments of statements to scales are appropriate.

Reliability. Estimates of the stability of responses and the equivalence with which the professionals respond to the FCI on clients will be sought in the two reliability studies. The first reliability study will focus on estimating test-retest and inter-judge reliability within each of the three groups of professionals (counselors, evaluators, and work adjustment specialists). The second reliability study will focus on estimating inter-judge reliability among the professional groups, i.e., the FCI's reliability in the context in which it is expected to be used.

Fifteen counselors, fifteen evaluators, and fifteen adjustment specialists will complete FCIs on three clients from their current caseload and adjustment specialists will independently complete the FCI on each of the three clients. Approximately one week later, the original fifteen counselors, fifteen evaluators and fifteen adjustment specialists will complete a second FCI on each of the clients. FCIs will be available from evaluators on ninety clients, from adjustment specialists on ninety clients, and from counselors on 135 clients. A criterion level $p < .01$ was set for the average rates of agreement or correlations across clients, to judge the FCI as a reliable tool for use with clients. The incomplete block design underlying the study will also allow secondary analyses to isolate sources of variability attributable to client, professional, and items in the FCI.

The second study will track clients from initial referral through adjustment to obtain estimates of the equivalence with which the professionals judge clients. Each of thirty counselors will complete FCIs on five clients as clients proceed through rehabilitation. Evaluators and adjustment specialists will also complete FCIs as each of the clients enter and complete their respective services, yielding a total of seven FCIs on each of 150 clients. Inter-judge (equivalency) reliability estimates (rates of agreement and correlation) will be computed among counselors, evaluators, and adjustment specialists at referral to evaluation, completion of evaluation/referral to adjustment, and completion of adjustment. If the FCI is a reliable tool for use in communicating client capacities, level of functioning, and priority needs, the average rates of agreement or correlations across clients are expected to exceed the .05 level of significance.

Utility. Counselors, evaluators, and adjustment specialists who participate in the reliability studies will be queried approximately three months after FCI data have been gathered via a survey or structured interview to solicit their perceptions of the FCI as a planning and communications tool. This survey/interview will be such that the FCI's utility can be estimated and to develop instructional or training materials needed for effective use of the FCI. Attention will be given to determining the degree to which the FCI is used beyond the experiment by participants and their colleagues, whether communications are enhanced; whether more specific referrals result; and whether services are more specifically designed to meet individual client needs.

FINDINGS TO DATE: Efforts to date have been directed at insuring content validity in the FCI. Re-examination and revision of the content and pool of statements for the FCI and revision of the FCI's structured response format were undertaken to increase the likelihood that the FCI will be an effective tool for summarizing vocationally relevant capacities of a client at critical points in his/her summarizing rehabilitation.

Revision and expansion of the content focused on the original pool of fifty-two statements and the five original vocationally relevant domains of capability: Personal-Social Capacities; Vocational Maturity and Planning Capacities; Job Seeking Capacities; Job Holding and Advancement Capacities; and Stability Capacities. Presently, 115 revised, restated and new statements have been written and the five capacity domains collapsed under three capacity themes: Personal Capacities; Vocational Capacities; and Independent Living Capacities. Revision of the structured response format was initiated so that counselors and service providers provide three types of analytic responses about a client to each statement: (1) Client's Capability is a broad screening of the client's capability and whether the counselor or service provider has sufficient knowledge of the client to judge capability. (2) Refined Analysis of Capability is a more diagnostic screening in which the respondent's uncertainty about the client's functioning is brought together with his/her estimates of both how well and how appropriately the client can do what is implied in each capability statement. (3) Priority is a decision-making response as to whether and what types of services are called for based upon the counselor's or service provider's summarization of the client's functioning. The response format allows the counselor or the service provider to quickly summarize his knowledge of the client and focus in on only those capacities for which his/her knowledge is incomplete or for which the client's functioning is in some way limited.

APPLICABILITY: If the FCI is found valid and useful for the purposes it is intended, then it should provide a much needed and effective tool for referral-planning and delivery of services to clients. Counselors might use it for identifying informational needs in eligibility determination, for establishing priorities among their referral questions, and in monitoring client progress toward employability as the client proceeds through the services. The evaluation and adjustment specialists should be more responsive to the expectations and priorities of the counselor's referral, more economically establish priorities in their service, directly plan and monitor delivery of the service, and more concisely and accurately communicate answers to referral questions.

The primary impact of this study, therefore, is expected to be on how rehabilitation is delivered to clients by counselors and service providers. As counselors, evaluators, and adjustment specialists are better equipped with systematic methods for planning referrals to services and for planning and delivery of those services, four contingent impacts may be expected: (1) the reasons for referral may be more concise/prescriptive and better articulated to service providers; (2) more clearly articulated referrals may result in shorter and lower cost diagnostic and treatment programs; (3) better sequencing of services and specifically directed services may make more opportunities for rehabilitation services available to greater numbers of disabled persons; and

(4) time and opportunity to devise innovative delivery methods particular to specific classifications of client functional capability might make a broader range of effective programming possibilities available than is currently provided through today's service programs.

255 Facility Services–A Tracking System

Principal Investigator:	**Fredrick Menz, Ph.D.**	
Status:	**Continuing**	
Dates:	**July 1979-July 1982**	
Cost:	**Annual $34,182** **RT Annual $25,007**	**Projected Total $158,000** **RT % of Annual Total 73%**
Annual Report Reference:	**#8, Page 47, R-40**	

OBJECTIVES:

1. To obtain a usable and accurate picture of how rehabiliation facility services in Wisconsin are delivered to clients.
2. To obtain a usable and accurate picture of how the rehabilitation system in Wisconsin is delivered to clients who receive vocational evaluation and work adjustment services as part of their rehabilitation program.
3. To develop a client tracking and data retrieval system which will allow the state of Wisconsin to update this picture in advance of the regular planning and redevelopment cycles.

METHODOLOGY: **Subjects:** The principal subjects in this study are state agency vocational rehabilitation clients. However, a consortium of vocational rehabilitation practitioners has also been drawn together to provide input at critical points in the project's development and dissemination. Wisconsin vocational rehabilitation clients receiving facility services between October 1, 1977 and September 30, 1978, will be included in a pilot study to determine the utility of Wisconsin's Facility Form (DVR-85) for tracking clients through facility services to closure. Clients entering the program on or after April 1, 1978 and before October 1, 1981, will be subjects of the longitudinal study of how services are delivered to clients.

Instruments: The initial instrument of concern will be Wisconsin's Facility Form (DVR-85). These are merged with the state's client service (DVR-2), fiscal (DVR-40) and follow-up data (DVR-52) to comprise data for both cross-sectional and longitudinal studies of clients in the rehabilitation program and receiving facility services.

Procedures: The four steps in this study involve identification of questions of concern to be asked of a client data tracking system, and implementation of a formal longitudinal study of clients with the client data tracking system.

Step 1. The practitioner consortium consists of representation of the state rehabilitation agency, rehabilitation facilities in Wisconsin and the RTC staff. It functions primarily (1) to pose questions of concern about the provision of facility services to the vocational rehabilitation client that could be addressed with a client data tracking system prior to the data analysis in the pilot study, and (2) to adequately answer their questions should analysis of the pilot data provide inadequate or only partial answers. The consortium has been selected and has identified a "laundry list" of concerns about clients and the effects of services on clients, both from the state agency and facility points of view. These concerns will form the basis to determine whether DVR-85 (in conjunction with client service, fiscal, and follow-up data) provide partial or full answers to the concerns phrased as research questions. Issues or concerns raised by the consortium fell into two topical areas: (1) Who is the client in the vocational rehabilitation system? (e.g., who is the vocational evaluation client?) and (2) How are facility services being provided (e.g., what is the probability of a client who receives vocational training becoming employed?).

Step 2. Analysis of DVR-85 data will provide both descriptive cross-sectional and longitudinal characterizations of clients going through rehabilitation. Cross-sectional analyses will be in terms of frequencies, percentages, and means and standard deviations relating DVR-85 data to significant client service, fiscal and follow-up variables also contained in the existing data system and pertinent to the concerns raised by the consortium. Descriptive longitudinal analyses will employ the Automatic Interaction Detection (AID) Program. AID is a multivariate analysis tech-

nique which is useful with categorical data, such as that on the DVR-85, has the major advantage of being useful in predicting outcomes at several points in the rehabilitation process, and has an additional advantage in that AID forms clusters of individuals having similar probabilities for a particular kind of outcome. Thus, analysis of data are focused on the interaction of client variables and the patterns of services for clients.

Step 3. Refinement of the client data tracking system will follow analysis of DVR-85 data and involves use of the consortium to determine the extent to which their concerns have been met through those analyses of existing data. Concerns and questions posed, but unanswerable, will provide the basis upon which refinement of the system is expected to take place. Three directions which might be expected could be (1) revision of DVR-85 to incorporate new data items, (2) development of a new system to collect needed data items, or (3) integration of DVR-85 with other existing but untapped formal sources of information in facilities or the state agency.

Step 4. Implementation of a longitudinal study of the rehabilitation client and delivery of facility services to clients will formally commence after refinement of the client data tracking system. This phase of the project is expected to be a demonstration of the applicability of a research data base for answering specific administrative questions and for estimating existing or predicted effects of service delivery on clients which are needed for planning, development and operation of an effective and dynamic state vocational rehabilitation program. A 10% random sample of all clients entering the state rehabilitation program on or after 1978 and up to October 1981 are being selected as the subjects of this research and demonstration phase of the project.

FINDINGS TO DATE: The five primary activities accomplished or undertaken to date are activities critical to accomplishing this research. First, issues and concerns have been collected from the project's consortium and phrased into research questions related to client, professional and program variables. A second major accomplishment has been in obtaining complete tape copies of all data in the state's administrative computing systems (IBM) and translation of that data for use with a Univac computer. The third accomplishment appears to be development of an effective method for creating and maintaining a "queriable" master data base using the Unified Data Handler and Miser Data Base system at the Madison area computing center. If it is as effective as expected, this accomplishment will be unique in that this master data base is capable of merging original client service data (DVR-2) fiscal data (DVR-40) follow-up data (DVR-52) and DVR-85 data from four different sources; regularly updating with new information on existing clients; updating with new data on new clients entered; and is susceptible to analysis with such standard statistical packages as SPSS and BMD.

The fourth accomplishment has been to establish a continuing relationship with the state agency to receive new and updated copies of 10% random samples of all clients entering and continuing through the system between April 1, 1978 and October 1, 1981 for the longitudinal study. The last activity under the project has been to formally initiate cross-sectional analyses of all data gathered for the pilot study.

APPLICABILITY: This project is expected to provide state agency and facility administrators with longitudinal data for planning in relation to clients served. It is further anticipated that the data will provide the field with an understanding of the vocational rehabilitation client and his service patterns and outcomes. With respect to rehabilitation personnel, the findings should identify staff needs for training and agency needs for staffing.

While this project will provide longitudinal information about the vocational rehabilitation client for the state agency and rehabilitation facilities in Wisconsin, it is possible that the project findings will be relevant to other states as well when they plan for clients and especially clients who will receive services in facilities. In particular, though, the method for creating and using a client data tracking system in planning and program development might be expected to have high utility for state programs.

256 Use of a Microprocessing System to Predict Practiced Performance Levels From Initial Task Acquisition Measures

Principal Investigator: Thomas Blakemore
Status: New
Dates: July 1979-June 1981
Cost: Annual $22,423 — Projected Total $59,811
RT Annual $16,941 — RT % of Annual Total 76%
Annual Report Reference: #8, Page 187, R-42

OBJECTIVES:

1. To develop and test the utility of using a microcomputer as a data collector which monitors work-sample performance on tasks involving motor skills.
2. To determine the accuracy with which client performance on a psycho-motor task (work sample) can be predicted using learning curves based upon his/her initial task acquisition data.
3. To determine which of several alternative learning curve formulas is most accurate in predicting client performance.

METHODOLOGY: **Phase 1:** The initial phase of this study consisted of the selection, purchase, modification, and programming of a microcomputer (an Ohio Scientific, model C4P) to be used in collecting client performance data on a repetitious work sample involving motor skills. This microcomputer is also being used in data analysis.

Phase 2: Data was collected on the work sample performance of twenty (10 males, 10 females) non-severely disabled rehabilitation clients who were undergoing vocational rehabilitation. Each client performed 50 repetitions of the Stout-Eye-Hand-Foot-Coorination work Sample each day for 5 consecutive work days. The data (time per repetition) from the early acquisition trials will be used to compute learning curves for each client using a variety of computation formulas. The learning curves will then be used to predict client performance on the final day of practice at the task.

Phase 3: The final phase of this project will involve field testing both the microprocessor and the learning curve-assessment approach in three rehabilitation facilities. The microprocessor will be tested in terms of its reliability and utility to vocational evaluators. The learning-curve-assessment technique will be examined in terms of the reliability of the techniaue.

FINDINGS TO DATE: Phase 2 data collection has just been completed. Preliminary analysis of this data suggests that the use of time scores for each repetition of the task does not result in accurate predictions of subsequent performance. The use of blocked data, however, does appear to be a viable technique, resulting in reasonably accurate prediction (mean error 10%) of performance on day 5. Also, it is clear that microcomputers can be reliable and very accurate tools for use in the collection of data in the vocational evaluation setting.

APPLICABILITY: This project deals with two aspects of vocational evaluation: (1) it investigates the feasibility of using a microcomputer to collect data on client work sample performance on repetitious tasks involving a motor skill and (2) it investigates the utility of using learning curves as a tool for predicting client potential on a specific task. The technique under investigation might also be useful in work adjustment and skill training programs.

257 Resources for Competency-based Training of Adjustment Personnel: A Joint Research and Training Project

Principal Investigator: Fredrick Menz, Ph.D.

Status: New

Dates: July 1979-July 1981

Cost: Annual $19,241 — Projected Total $49,192
RT Annual $14,077 — RT % of Annual Total 73%

Annual Report Reference: #8, Page 203, R-43

OBJECTIVES: The goal of this project is to provide trainers and educators with resources for use in the design, development, and implementation of competency-based training for adjustment personnel. Two research and development objectives are to be pursued in light of this goal.

1. To determine the needs and audiences of adjustment training.
2. To organize existing resources (literature and training materials) for competency-based training of adjustment personnel.

METHODOLOGY: Subjects in this project are the 1384 respondents to the national survey of adjustment personnel conducted between January and February of 1978. Need, competency and demographic data in this project were gathered with the "Questionnaire on the Abilities, Skills, and Knowledges of the Entry Level Work Adjustment Specialist."

Three steps which are being followed to accomplish objective needs and audiences of adjustment training are:

1 To identify training audiences by examining professional, educational, and vocational characteristics of adjustment personnel. Clustering algorithms (Hartigan, 1975; Wishart, 1970) will be applied to the nominal data obtained from the demographic section of the Questionnaire to identify dominant audiences along with standard analysis of variance techniques.

2. To determine the differential perceptions of roles and functions among those audiences. Dominant groups (i.e., the audiences) identified in Step 1 will be the independent variable in these analyses to partition factor score data for the 19 competencies extracted by Menz and Ellien (1979) The 19 dependent variables, partitioned on the basis of audiences, will first be submitted to discriminant function analysis (Roulon and Brooks, 1968; Tatsuoka, 1970, 1971a) to determine whether there are systematic differences in perceptions of the competencies among the audiences.

3. Patterns of similar and dissimilar training needs among the audiences will be identified in the third step. Statistical procedures in this step will parallel those used in Step 2. However, the 19 dependent variables in the analyses will be respondent's estimated need for training under each competency.

Subsequent to the statistical analyses of differences and similarities of training needs among the audiences, patterns of training needs will be examined by the Research and Training staff to identify resources potentially in need of development, and to relate them to present training resources, and appropriate instructional formats.

Activities under objective 2, Resources for Competency-based Training of Aajustment Personnel, involve a major search and review of literature and training materials. The literature search is expected to rely heavily upon resources presently available within the Center's training division, documents held in the Materials Development Center, the conference proceedings, and documents available through such sources as Educational Research and Instructional Centers (ERIC), the National Clearing House of Rehabilitation Training Materials, and inter-library loan systems. These literature searches will be guided by key words contained in the names and definitions of the 19 competencies of the adjustment specialist. Specific documents will be reviewed for their applicability as instructional resources in training or teaching of each of the 19 competencies.

With further aid of other members of the training staff, specific tentative curriculum model(s) will be advanced. Particular attention will be given to identify learner objectives for the 19

competencies. Each objective will be classified by appropriate taxonomic level of cognition, tentative level of mastery, and relative career level (e.g., entry level). To serve as an appropriate example for curriculum development, the literature and instructional resources corresponding to one or more of the competencies (and contained in the Bibliography), will be reexamined, annotated, and cross-referenced to each of the learner objectives, and a tentative training format(s) developed.

FINDINGS TO DATE: Preparation of a bibliography of training relevant materials catalogued under the 19 competencies required development of a procedure for systematically screening and classifying the vast literature of rehabilitation, education, psychology, and sociology. A "keyword" approach was selected as the procedure which will be most efficient in isolating the relevant literature and/or training aides. Computer, phone, and/or direct searches through the Materials Development Center, NARIC, ERIC, the National Clearing House of Rehabilitation Materials, Auburn University, Southern Illinois University, University of Wisconsin-Stout, New York University, City College of New York, Michigan State University, and the Publication and Audiovisual Aides Directory were conducted as part of this early search process. Close to 800 sources were reviewed in developing bibliographies for each of these four competencies: Individual Client Programming; General Client Programming; Behavior Modification/Change; and Principles of Human Behavior/Behavior Change.

Analyses of training needs data have been initiated to identify audiences to which training programs focusing on specific competencies can be targeted. These five analyses examined differences in respondent intensity of needs over all nineteen areas in terms of (1) their personal characteristics (VEWAA Membership, sex, age); (2) their professional preparation (amount of education and source of training in adjustment); (3) their work experience (amount of work experience in and outside rehabilitation and with clients); (4) the characteristics of their facility (their principal role, volume of clients and accreditation of the facility); and (5) the location of their employment (VEWAA region and size of city).

Generally, none of the personal variables revealed any statistical differences in the intensity of the respondents' needs for training. The one exception was that female members of VEWAA, between the ages of 31 and 40, perceive themselves to have lower overall general need for training (average need about 45% vs 51% for all respondents)

While, where one received their training in adjustment does not make much of a difference, whether one has a college degree does, regardless of discipline. The most intense general need for training (average about 60%) is felt by those who have not acquired a college degree.

The respondent's work history, too, seems to have little effect on their perceptions of their general need for training in adjustment, except greater need (average about 54%) for training is felt by those who have less than 1 year's work experience in rehabilitation. Neither amount of work experience outside rehabilitation nor amount of experience working directly with clients appears to make a difference in the intensity of their needs for training.

What one does in a facility and where one works appears to reflect statistical differences in the intensity of one's training needs. Practitioners perceive themselves as having less intense needs for training than do administrators (50 vs 53%), and particularly if they are working in an accredited facility (48%). Further, administrators in facilities with an average caseload less than 31 clients see their staff as having more intense needs (57%) than do administrators in facilities with an average caseload of 31 to 70 clients (54%), or administrators of larger facilities (70-100 or 100+ clients) and practitioners, regardless of the size of the facility (50%). Greater need for training, though, is seen in non-accredited facilities (about 53%), than in the medium sized (31-100 clients) accredited facilities (about 47%).

Differences in training needs are identifiable for different geographic locales and for cities of different sizes, independent of whether those cities are located in a given part of the United States. The most intense needs for training found among respondents in different parts of the country are expressed by people in the Southwest (57%) and followed by persons in the Mid-Atlantic or Southeastern states (53%). Finally, persons in relatively small cities (less than 15,000) report a more intense need for training (56%) than do persons in more urban areas (49%).

APPLICABILITY: The quality of rehabilitation provided to persons with handicapping conditions is the fundamental concern of the entire rehabilitation professional community, the state-federal vocational rehabilitation program, and all consumer groups. A major determining factor

affecting such quality is the competence of personnel (professional, paraprofessional, and administrative) working with persons with handicaps.

Well accepted vehicles for providing the rehabilitation program with appropriately equipped personnel are the programs funded by RSA to provide pre-service, in-service, and short-term training. While such wide acceptance is based upon the general effectiveness of these programs, continued development of appropriate training and materials has rarely proceeded from a consistent base of systematically gathered and analyzed data. Such data now appears to exist, however, at a national level, this project intends to optimize the utility of those data and through systematic analysis and extrapolation, provide timely resources useful to educators and trainers for designing, redesigning, and implementing increasingly effective rehabilitation training programs.

Given a knowledge of those presently providing adjustment services; a knowledge of the overall domains in which they must be competent to adequately serve their clients, respective to expected roles and functions; a knowledge of the areas in which they are presently in need of training; and a knowledge of the differential training needs of practitioners around the country, a cohesive competency-based curriculum model may be outlined which accounts for both immediate and long-term concerns in the training of competent personnel. Around such a model, appropriate educational and training materials and resources can be aligned and direct training applications can be devised to produce increasingly effective pre-service, in-service, and short-term training of adjustment personnel.

The long-term effects of this project are expected to be reflected in the practice and delivery of Adjustment Services to individual clients. The short-term effects are expected to be seen in the content and manner in which adjustment personnel are trained.

258 Vocational Evaluation Services: A Systems Approach

Principal Investigator: Thomas Czerlinsky, Ph.D.

Status: New

Dates: July 1979-August 1982

Cost: Annual $16,651 — Projected Total $129,260
RT Annual $19,498 — RT % of Annual Total 73%

Annual Report Reference: #8, Page 225, R-44

OBJECTIVES: This project is directed toward three questions: (1) What constitutes vocational/work evaluation, as practiced in the field today?; (2) How are these activities, technologies, or components arranged and related?; and (3) What are the alternative approaches to the delivery of vocational/work evaluation services to the disabled? The project focuses on the following four objectives:

1. To identify critical characteristics of rehabilitation facilities providing services to rehabilitation clients nationally.
2. To determine whether, and if so, what differences exist between facilities that offer vocational/work evaluation services and programs, and those facilities that do not.
3. To observe and identify at selected "model" research sites the variables of evaluation programs that relate to input, process, and outcome information.
4. Employ a systems approach, to describe the process(es) practiced at these facilities, as this provides a framework within which vocational/work evaluation services can be defined in terms of components, sequences, activities, and relationships.

METHODOLOGY: There are two phases to this study. Phase 1 is addressed at Objectives 1 and 2, and Phase 2 encompasses Objectives 3 and 4.

Phase 1. Subjects: Individuals will not be focused upon. Rather, accredited rehabilitation facilities, some of which provide vocational/work evaluation services, will be the primary participants. Each facility surveyed will be asked to complete a questionnaire. The results of this questionnaire will be used to select 20 representative facilities offering vocational/work evaluation services for further in-depth investigation, including site visits.

Instruments: The primary instrument used in this phase will be a national survey. It will tap a list of variables deemed important for selection of facilities to serve as research sites. It will seek information with respect to (1) overall facility characteristics; (2) client characteristics; (3) client flow patterns; (4) descriptions of evaluation conducted; (5) interaction of facility services; (6) identification of program and client outcomes; (7) identification of evaluation objectives; and (8) willingness to participate in Phase 2 of the research project.

Procedures: Accredited rehabilitation facilities will be surveyed with the above instrument. Then, based on the returns, facilities which offer vocational/work evaluation services and which represent various organizational and program variables will be identified and designated as research sites. Selection criteria will include, but not be limited to, the following:

1. Urban and rural programs and representatives from different areas of the country.
2. Facilities serving diverse types of handicapping conditions.
3. Facilities serving selected minority groups.
4. Facilities representing a range of size and funding levels.
5. Facilities representing various vocational/work evaluation styles.

Twenty such facilities will be selected.

Phase 2. Subjects: The participants in this phase will be the twenty selected facilities. Interviews will be conducted with key persons including administrators, evaluators, counselors, and other appropriate rehabilitation professionals.

Instrument: An instrument will be developed for site reviews to systematically collect the information. The information will be obtained from records of the facility and personal interviews with appropriate key persons. Information will be collected relative to input variables, process variables, and outcome variables, as well as goals and objectives of the evaluation programs. evaluation programs.

Procedures: The exact procedure for gathering the data will be determined on an individual basis, as a function of the needs and demands of each facility, as well as the data requirements. interviewees will know what information needs to be gathered, and will arrange with each facility on an individual basis for the best way of collecting the data.

FINDINGS TO DATE: Efforts to date have been directed toward identifying the data needed from each facility for Phase 1, and toward designing a suitable questionnaire to collect this data. A questionnaire was developed and piloted in a number of facilities of various sizes. Revisions from this pilot phase resulted in a final questionnaire. It taps the following areas:

1. General Facility Characteristics
    a. Clients Served
    b. Referral Sources
    c. Fiscal Resources
    d. General Staffing
    e. Accreditations and Records
2. Vocational/Work Evaluation Programs/Services
    a. Client Intake
    b. Staffing of Service Programs
    c. Technology Used in Evaluation
    d. Service Characteristics
    e. Client Exit and Recommendations
3. Reactions to Survey

    Includes consent for follow-up

This questionnaire is currently being mailed to facilities nationwide, and it will provide the database for Phase 1 and thus, for the selection of facilities in Phase 2.

APPLICABILITY: The ultimate goal of this study will be to indicate alternative conceptual models of vocational/work evaluation services that currently exist in the country, and these will be viewed in light of the objectives of evaluation services that will also be determined by the study. Knowledge of what variables contribute most to adequately serving specific client characteristics will aid in improving services to clients. This information, in turn, should provide rehabilitation personnel with information on the relationships of separate components, processes, and the total program in attaining the program's intended effects upon clients, to the betterment of program management, and to the improvement of the quality of evaluation services. Thus, the project will provide guidance in determining which overall evaluation components need additional study or consideration. The empirical models derived from this project may serve as a basis of comparison with other rehabilitation programs, or for the development of new evaluation programs.

259 Analysis of Self-Monitoring on Work Skills of Vocational Adjustment Clients

Principal Investigator: Charles C. Coker, Ph.D.

Status: New

Dates: Not Specified

Cost: Annual $6,363 — Projected Total $36,461
RT Annual $4,656 — RT % of Annual Total 73%

Annual Report Reference: #8, Page 243, R-45

OBJECTIVES. The modification of one's own behavior can be accomplished through what is termed self-control procedures. Since a goal of adjustment services is to increase the probability that behavior change is long lasting, the feasibility of training clients in self-control procedures seems a worthwhile pursuit. The purpose of this research will be to examine self-control procedures and assess the efficiency of one such procedure: Self-Monitoring on work and work related skills of vocational adjustment clients. The objectives of the research are:

1. To determine the feasibility of teaching self-monitoring techniques to vocational adjustment clients.
2. To compare the effects of self-monitoring procedures with staff-monitoring on the maintenance of clients' work skills during adjustment services.
3. To examine the transferability of self-monitoring procedures to different tasks and different settings.
4. To explore the relationship between self-control procedures and locus of control.
5. To develop training module(s) as dictated by research findings.

METHODOLOGY: The initial research will utilize the following design:

1. Independent variable: Self-control technique(s), client demographic characteristics, and Rotter pre-test data.
2. Dependent variable:
   a. number of clients and time required for each client to successfully acquire the self-control technique
   b. time and efficiency with which clients used self-control procedure in new tasks and new settings
   c. on-task time, production rate, and production quality of tasks (initial task, new task, and new task in different settings) by staff and by clients if self-monitoring is used
   d. Rotter's internal/external locus of control on a post-experimental basis

3. Controlled variables:

    a. subject differences. demographic characteristics and skill level on the self-control technique and performance level on tasks prior to intervention

    b. task differences

    c. staff differences

    d. peer pressure difference (e.g., assembly line operation vs isolated performance of task)

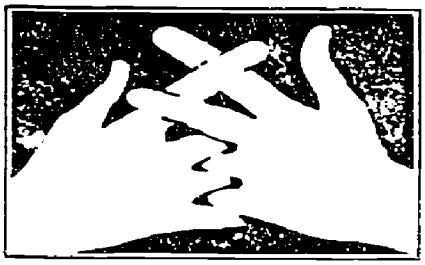
    e. facility characteristics

    f. other variables as further investigation reveals (e.g., effect of Center staff and training of facility staff).

The statistical analysis will primarily determine (a) to what extent clients are capable of learning the self-control procedure and with what reliability. (b) to what extent does the self-control technique affect task permanance variables and the transferability (i.e., generalization) of the changes. (c) and to what extent the self-control procedure affects a more general concept of locus of control and/or other less empirical, but more general characteristics of individual (i.e., consistency, supervisor ratings. etc.).

FINDINGS TO DATE: No data is available at this time.

APPLICABILITY: This project's major impact would be on practice changes in vocational adjustment programs. Through a currently completed workshop on adjustment specialist's competencies. the major conclusion was that these specialists should have behavior change techniques as one of their primary. basic skills. This project will add to the repertoire of adjustment specialists by adding a workable skill. The secondary and more general impact is that of emphasizing the necessity of clients being taught to assume control over their lives and over their own rehabilitation.



University of California/San Francisco (RT-23)
Research and Training Center in Deafness and Mental Health

CORE AREAS

Work Adjustment as a Function of Self-Image and Mental Health

Studies which will allow the Center to make predictions about the vocational adjustment of deaf people and to test the predictions with follow-up data on actual vocational performance. Results of this research will provide rehabilitation counselors and administrators with information that should lead to better understanding and more effective treatment of their clients.

Improving Clinical Training of Personnel Working with Deaf

Development of measures of the trainee counselors' knowledge of deafness, their knowledge of clinical principles and their behavioral effectiveness. These measures will be used to assess changes as a result of the training program.

Communication as it Affects the Vocational Rehabilitation Process for the Deaf

Investigating the contribution of the communicative competence of clients and counselors; as well as investigating the effect of introducing interpreters into the rehabilitation setting.

Evaluation of Therapeutic Intervention for the Deaf

Investigation into the use of skilled interpreters in the therapeutic process—crisis intervention, family therapy and psychosocial testing—which may open up pathways for professionals new to the field of deafness; and exploring the feasibility and optimal timing of developmental compensation.

Evaluation of the Mental Health Needs of the Multiple-Handicapped Deaf

Research to (1) provide for further evaluation of the needs of severely disabled deaf and (2) develop ways to best meet those needs through the available clinical services or through the creation of specialized services within the Center.

Special Problems of Members of Deaf Minority Groups

Research in similarities between the deaf and racial/ethnic minority groups and the personal and social consequences of the combined stigma. Anthropological research among the general deaf community, and cross-cultural investigations of the treatment and rehabilitation of deaf persons in the various subgroups would add a significant dimension to the Center's research program.

Development of Guidelines for Clinical Histories and Appropriate Clinical Forms

Studies aimed at determining background variables which are inappropriate for other groups but which are essential for an accurate assessment of deaf clients (e.g., degree, onset, and etiology of loss; and educational and audiological history). Such a description would be useful to other centers in planning services for deaf clients and in the development of clinically and vocationally oriented forms.

UNIVERSITY OF CALIFORNIA/SAN FRANCISCO

Hilde S. Schlesinger, M.D., Director
Deafness and Mental Health
Rehabilitation Research and Training Center
1474 Fifth Avenue
San Francisco, California 94143

CONTINUING

NEW

PROPOSED

Behavior Problems in Deaf Adolescents: A Comparison of Rubella and Nonrubella Etiologies

Evaluation of a Cohort of Rehabilitation Clients on a Continuum of Psychological Health to Psychiatric Illness

260 Longitudinal Study of Self-Image and Work Adjustment of Young Deaf Adults

Principal Investigator:	Hilde Schlesinger, M.D.	
Status:	Continuing	
Dates:	October 1977-September 1981	
Cost:	Annual $65,049 RT Annual $48,325	Projected Total $225,000 RT % of Annual Total 74%
Annual Report Reference:	#3, Page 9, R-1	

OBJECTIVES: To describe the vocational success and general well-being of a group of young deaf adults who are still in relatively early career stages.

To relate earlier obtained measures of self-image, psychosocial adjustment, communication skills, academic achievement, family climate and history to vocational success.

To use relationships as a guide to the possible modification of earlier experiences so that the deaf student will have a better probability of achieving vocational success.

METHODOLOGY: A population of young deaf adults have been interviewed and administered scales that provide information regarding their social and vocational adjustment. These individuals had been studied previously when they were between the ages of six and eighteen. At that time deaf children of deaf parents scaled higher on measures relating to social adjustment such as intellectual functioning, academic standing, adjustment to deafness, self esteem, maturity and independence. All these variables are expected to be related to subsequent social and vocational adjustment. A major focus of this project is to relate these previously measured variables to current social and vocational adjustment.

FINDINGS TO DATE: Of the original 116 subjects, sixty-two have been contacted and have participated in this study. Testing the major hypothesis cannot be accomplished until the characteristics of this population, as related to the previous sample, have been clearly defined. The results reported here represent a brief report of data that is currently being analyzed.

1. **Brief Demographic Description of the Population**

   The average age of our population is 26.38 years. Of this group 26 have hearing parents, while 36 have deaf parents. In the original population the hearing status of parents was equally divided between the total subject population. In terms of education, 94 percent completed high school and 90 percent have had some college education. Of the total, 20 of the 62 have received college degrees. Using the Hollinghead and Redlick occupational status system, our population tends to fall in categories 4 and 6, reflecting a general distribution in the lower occupational status. However, generally, our subjects tend to rate overall satisfaction with their employment as good. Mean average income is $5,500 per year. This figure is extremely low, especially in the context of a population that has received so much college education. As a group, the self-reported mental health adjustment of these individuals is good.

2. **Vocational Adjustment**

   Initial analysis of this data indicates that individuals with longer intervals of employment generally have a higher income and better occupational status than others. Longer intervals of employment and holding college degrees also are significantly related; having a college degree tended to be significantly related to income level as well.

3. **Communication Skills**

   Correlation analysis based on these 62 subjects has as yet failed to establish any relationship between communication skill (as measured by our profile) and variables related to vocational adjustment. Further analysis of this data is needed.

   Analysis of the hearing status of parents, and scores from the Communication Skills Profile, show a consistent relationship between these two variables. Deaf adults whose parents were also deaf demonstrate greater skill in communication, as measured by our profile, than do those deaf adults with hearing parents.

4. **Self-Concept Scale**

The current research reported here represents an ongoing effort to establish this instrument as a suitable scale to measure self-concept of the deaf population. Test-retest data on the Self-Concept Scale indicate that, except for the Physical Self and Self Identity subscales, the test-retest correlation is significant.

APPLICABILITY: The data from this study will be made available to schools and rehabilitation personnel enabling them to modify their practices in such ways as to improve the chances of vocational success for their deaf clients.

261 Improving the Effectiveness of Psychotherapy for the Deaf

Principal Investigator:	**Hilde S. Schlesinger, M.D.**	
Status:	**Continuing**	
Dates:	**October 1977-September 1981**	
Cost:	**Annual $35,273** **RT Annual $22,186**	**Projected Total $194,000** **RT % of Annual Total 63%**
Annual Report Reference:	**#3, Page 31, R-2**	

OBJECTIVES: To review literature on psychotherapy with the disadvantaged and with impulsive characters to note similarities with psychotherapy with the deaf.

To conduct an "experience survey" to learn about common features of psychotherapy with the deaf.

To survey a number of deaf adults about their views on psychotherapy and mental health with a view ultimately to making a film to orient deaf adults to psychotherapy and mental health principles.

Eventually, based on the above, to produce a film that will help deaf adults understand when psychotherapy is useful, what its aims and methods are, and to educate them about some elementary notions of mental health.

METHODOLOGY: As a first step, surveys of the literature were conducted on (a) the effect of psychotherapy training, (b) psychotherapy with several different groups, i.e., the deaf, the impulsive, and the underprivileged. Previous research suggests that impulsiveness and low verbal skills are frequently found among deaf persons.

As a second step, the literature on orienting lower-class and nontraditional patients to psychotherapy was reviewed, and on the basis of this review, an interview schedule was constructed and all ten therapists on the staff of our Center were interviewed in depth about their experience and attitudes in working with deaf patients.

Based on the findings of these interviews and on the literature search, we are constructing a questionnaire to administer to deaf adults. The findings from both sets of respondents will eventually be used to form the basis for a film to orient deaf adults to the nature of psychotherapy.

FINDINGS TO DATE: An article on "Special Issues Regarding Psychotherapy with the Deaf" which grew out of the experience survey with therapists has been accepted for publication by **The American Journal of Psychiatry**, pending minor revisions.

A treatment of the film on "Psychotherapy with the Deaf" has been produced by the Golden Door Production company in collaboration with RT-23 Center staff. The production costs were not funded by the National Institute of Handicapped Research. RT-23 intends to resubmit it for funding to other potential funding sources.

APPLICABILITY: Since RT-23 is the only RT Center specifically mandated to focus on mental health problems of the deaf, it has an obligation to other centers, to the deaf community, and most immediately, to deaf patients to help make that therapy as effective as possible. It has been observed that many deaf people fail to seek therapy because they have fears about it and believe that going into psychotherapy is only for people who are severely disturbed. As a result, some of the people who could most benefit from treatment do not get seen. Furthermore, among those who do come, there is a relatively poor attendance rate, along with frequent tardiness, early drop-out. Both the deaf community at large and those particularly at risk need to have psychotherapy "demystified" for them so that the prospect will be less threatening, and so that problems are presented in earlier stages before they become disabling and thus even further compound the disability of deafness itself.

262 Precursors of Vocational Adjustment: Adolescent Follow-Up Study

Principal Investigator:	**Hilde S. Schlesinger, M.D.**	
Status:	**New**	
Dates:	**October 1979-September 1982**	
Cost:	**Annual $64,777** **RT Annual $48,087**	**Projected Total $200,000** **RT % of Annual Total 74%**
Annual Report Reference:	**#3, Page 75, R-4**	

OBJECTIVES: To examine a group of young profoundly deaf adolescents who have been followed longitudinally since toddlerhood in order to identify factors which contribute to emotional-social, cognitive and language development

To explore the relationships among contemporary measures of the following variables: language competence; reading level and comprehension; intelligence; cognitive development; self-esteem; social maturity; quality of interaction with mother.

To explore the relationships among these measures across development; i.e., to compare the contemporary measures to those taken in the four previous rounds of this longitudinal study. Especially of interest is the relationship between early communication competence and mother-child reciprocity on the one hand and adolescent social, cognitive and language development on the other.

METHODOLOGY: The 40 adolescents (ages 13½-15) who were originally assessed at ages 2½-4 will be assessed on the following measures: a) interviews to assess communication competence, b) reading comprehension component of the Stanford Achievement Test; c) WISC-R; d) a problem-solving task to assess reasoning ability; e) questionnaires assessing self-esteem and locus of control; f) structural interactions with their mother.

FINDINGS TO DATE: Thirty-eight of the original subjects have been contacted to date and have agreed to participate in this follow-up. The measures of self-esteem and locus of control have been selected and piloted. The measures of mother-adolescent interaction, communication competence, and cognitive development are being piloted and refined. The actual interviewing of the subjects should begin in January, 1981.

APPLICABILITY: The findings of this study will help to understand what the major factors contributing to healthy and adjusted development for deaf people are. This should greatly contribute to the development of future intervention programs.

263 The Earliest Antecedents of Communicative Competence—An Intervention Study

Principal Investigator:	Hilde S. Schlesinger, M.D.	
Status:	New	
Dates:	October 1980-September 1984	
Cost:	Annual $121,389 RT Annual $100,665	Projected Total $350,000 RT % of Annual Total 83%
Annual Report Reference:	#3, Page 160, R-6	

OBJECTIVES: To determine intervention strategies which will improve mother-deaf infant interaction of communication within the first year of life. Through the microanalysis of early mother-infant interchanges, the factors which are crucial to the establishment of optimal early reciprocity of communication will be identified. The relationship between mother-infant attachment and language development will also be explored.

METHODOLOGY: Six profoundly deaf infants identified before their seventh month of life, with either hearing or deaf parent, will be studied longitudinally, until they reach the age of 3. Dyadic engagements between infant and mother (or primary attachment figure) will be videotaped every two weeks through infancy and subjected to microanalysis. Assessments will be made of the child's social, cognitive and linguistic development and of the mother's response and handling of her child's deafness. Also, the quality of attachment between infant and mother will be assessed with Ainsworth's "Strange Situation" when each child reaches one year of age. The visual and auditory preferences of the toddlers over time will also be assessed.

FINDINGS TO DATE: (This project is just now getting started.) The literature on attachment, early mother-infant interactions and the relationship between language acquisition and early social experience is now being reviewed. These have been active areas of research for hearing infants, but as yet, there has been little reported for deaf infants.

APPLICABILITY: The development of interaction strategies on the basis of the suggested analyses of mother-infant interchange will make possible the systematic development of programs to help deaf children and their mothers from the earliest possible moment. Evidence suggesting that the first year of a child's life is critical in language development, is increasing. Appropriate intervention here may effectively improve communication abilities across a lifetime.

University of North Carolina at Chapel Hill (RT-24) Blindness Rehabilitation Research and Training Center*

CORE AREAS

Job Identification and Selective Placement

Investigations of the major problems encountered in successful placement of blind and visually impaired persons and methods of identifying the unique capacities of each person so that appropriate training, education, and placement objectives may be specified.

Residual Vision

Research into methods to permit visually impaired persons to make maximum use of residual vision in employment settings.

Advanced Technology

Research dealing with utilization and evaluation of technological aids for visually handicapped persons.

*Funding for RT-24 was terminated July 31, 1980.

University of North Carolina at Chapel Hill

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Completed

Preparation of the Blindness Portion of the NIHR Long-Range Plan

Discontinued

Employment and Benefits Choices: Personal, Familial, Financial and Social Forces Affecting the Employment Histories of a Random Sample of Totally Blind Adults

Improving Job Opportunities for Persons with Residual Vision

Systematic Program of Job Development and Placement for Blind and Visually Impaired

RT-25

Boston University (RT-25)
Mental Health Research and Training Center

CORE AREAS

Personnel

Studies to identify the critical knowledge, skills, and attitudinal variables which affect the process and outcome of rehabilitation interventions of persons handicapped by mental health problems.

Program

Research to identify specific program dimensions (such as skills training, predictive and evaluative models, and rehabilitative interventions) which affect rehabilitation outcome.

BOSTON UNIVERSITY

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Rehabilitation Research and Training Center
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NEW **ACCESSION NO.**

PROPOSED

Study of the Service Needs of People with Combined Severe Physical and Psychiatric Disability

Examination of Predictive Variables of Outcomes for the Psychiatrically Disabled in Vocational Rehabilitation Services

Families as a Central Resource in the Rehabilitation of the Severely Psychiatrically Disabled

Model Monitoring and Evaluation System for a Mental Health Center

Development of a Comprehensive, Standardized, Program Evaluation Model for Community-Based Alternative Living Arrangements (ALAs) for the Psychiatrically Disabled

Long-Term Follow-Up of Psychiatrically Disabled Clients: A Client Function Referenced Approach

Development of Vocational Assessment Instruments for the Psychiatrically Disabled

264 Effects of Training Psychiatric Staff in Human Relations and Programming Skills: Developing a Rehabilitation Model for Chronic Patients During Deinstitutionalization

Principal Investigators: Donald Dellario, Ph.D.
Marianne Farkas

Status: New

Dates: February 1979-September 1980

Cost: Annual $5,198 — Projected Total $5,198
RT Annual $4,477 — RT % of Annual Total 86%

Annual Report Reference: #1, Page 5, R-1

OBJECTIVES:

1. To assess the effect of skills training of staff upon skill changes in staff, staff perceptions of their wards and staff satisfaction with training.
2. To assess a skills training approach to preparing patients for transition in terms of its effect over time on patient behaviors and levels of skills.
3. To assess a skills training approach to preparing patients for transition in terms of its effect on patient satisfaction and view of the quality of their life.

METHODOLOGY: This study involves a non-randomized, control group pre-post test design (Campbell and Stanley, 1966; Isaac and Michael, 1974). A follow-up assessment was added to the design. The primary sample consists of professional and non-professional staff normally assigned to two chronic wards of a State Hospital. The secondary sample consisted of all patients admitted to the designated Chronic Wards as of February, 1979. Several instruments were utilized to gather information on skill changes and satisfaction for both staff and patients.

Skills training in human relations and programming skills was conducted by two professional consultants hired by the experimental ward. Regular in-service workshops were conducted by professional staff hired by the comparison ward.

Data was gathered pre-training, post-training and at a 6 month follow-up period through observation, independent assessment, and paper-pencil measures for both staff and patients. Pre-training assessments were done in February of 1979. Post-training assessments were completed in June of 1979. Follow-up assessments were completed in December of 1979. Data was analyzed by means of several parametric and non-parametric statistical techniques.

FINDINGS TO DATE: The major findings were that State mental institution ward staff can learn skills associated with rehabilitation counseling in a relatively short period of time, that experienced State staff can be retrained to be as effective in these skills as new staff hired from outside the system, that attitudinally, experienced staff saw less of a need for the Rehabilitation Skills Training approach than did newer staff, although State staff were not against recommending the workshop. Most State staff were reserving opinions about the manner in which patients were being deinstitutionalized. In terms of treatment of staff, however, those who took training felt more involved in the whole deinstitutionalization process than did those who did not.

In terms of patients, those in community residences at follow-up were more sedentary than those who had remained on the in-patient wards, even though the overall rate of behavior activity was higher for the experimental ward residents than for the same ward's in-patients. Community residents performed better in terms of critical skills than did in-patients particularly in the area of controlling physical abuse. 22% of the total population of 54 patients achieved eligibility for Mass. Rehabilitation Commission services. In simple linear regressions, it was determined that the following variables were associated with skill outcomes: being in a locked ward (negative relationship), being in a vocational program at MRC (Personal Adjustment Training) and having a general diagnosis of schizophrenia or mental retardation and schizophrenia. Being in settings other than locked wards, being in other vocational programs at MRC, having diagnoses other than the two mentioned, or length of hospitalization did not have a significant relationship to the levels of skill scores achieved by patients.

APPLICABILITY: The increasing focus in the field on rehabilitation of the severely disabled makes the question of the effectiveness of skills training of the chronically psychiatrically disabled a crucial one. An initial exploratory study in this area can set the stage to identify more specifically the variables that should be investigated further in developing an effective training program to increase the skill repertoire of the chronically disabled.

265 Effects of a Systematic Skills Training Program on Clients and Their Significant Others on Selected Rehabilitation Outcome Variables

Principal Investigator: Donald Dellario, Ph.D.

Status: New

Dates: December 1979-July 1980

Cost: Annual $5,474 — Projected Total $5,474
RT Annual $3,002 — RT % of Annual Total 55%

Annual Report Reference: #1, Page 14, R-2

OBJECTIVES:

1. To compare the outcome rates of out-patient female alcoholic clients participating in systematic skills training programs with out-patient female alcoholic clients participating in non-skills programs.
2. To compare the outcome rates of out-patient female alcoholic clients participating in skills training with their significant others to out-patient female alcoholic clients participating by themselves.
3. To assess the ability of psychiatric instruments to measure the effects of skills training.
4. To assess the ability of out-patient female clients to obtain and maintain skills by participating in a systematic skills training program.

METHODOLOGY: This study consisted of a pre-test post-test control group design with random assignment to one of three groups. Experimental group 1 consisted of females participating in skills training; experimental group 2 consisted of females participating in skill training with significant others; the control group consisted of females participating in non-skills out-patient treatment. All subjects were interviewed prior to training, post training and at a three month follow-up period. Training consisted of a 12 session (6 week) program followed by monthly booster groups. Outcome variables consisted of skill level, employment status, employment functioning, employment satisfaction, community adjustment (PARS), personal adjustment (PAL), level of abstinence, and A.A. participation. Data was analyzed by several statistical techniques.

FINDINGS TO DATE: The present research study demonstrated the difficulty of involving the significant others of out-patient female clients in a systematic skills training program. Twelve subjects had been assigned to each of the three groups. At the completion of training, only two female-significant other dyads remained. Two dyads did not participate in any training sessions; two dyads discontinued participation after erratic attendance for several sessions. Six females assigned to group 2 refused to participate with their significant other, though five of them completed training in a separate group. The dyads completing the skills training program were husband-wife dyads, both husbands admitting to alcohol problems of their own and encouraging their wives' participation.

Females participating in skill training made significantly greater skills gains than females participating in non-skills out-patient treatment and continued to demonstrate these gains at a three month follow-up period. Gains existed for all skills: problem solving ($p = .01$), program development ($p = .05$), and interpersonal ($p = .01$)—though the training focused on problem solving and program development skills.

Significantly greater A.A. participation was observed for skills trained clients at a three month follow-up period than non-skills clients. More clients receiving skills training were abstinent than non-skills clients at post test (70% of skills clients, 30% of controls). These differences were less at follow-up, consisting of 52% of skills clients and 40% of the controls.

No differences on employment status, employment functioning, and employment satisfaction were found between trained and non-trained clients. Though skills training resulted in skill gains for participants, these gains were not observed on either instrument at post test or follow-up. Comparisons of the female only skills group and the female-significant other skills group indicated no significant differences on skill level, abstinence or A.A. participation. Females trained with significant others did as well as, but no better than, females trained alone. When the PARS was examined, females participating with significant others tended to receive more positive ratings than females trained alone or untrained females ($p = .08$). A similar difference was not observed on the PAL, a measure of personal functioning.

The results of this study indicate that out-patient skills training provides female alcoholics with greater skills than traditional out-patient services. Additionally, skills training resulted in greater A.A. participation and abstinence than non-skills treatment.

Females trained with significant others fared as well as, but no better than, females trained by themselves. The two standard psychiatric instruments (PARS, PAL) were unable to detect differences between skills and non-skills groups.

APPLICABILITY: The findings of the present study were applicable to practitioners working in the field of alcoholism rehabilitation as well as family therapists. The contributions of skills groups have direct implications for program developers in the field of rehabilitation. Developing alternative strategies to enlist the participation of significant others is indicated as well as examining the differential effectiveness of types of significant other involvement.

266 Burn-out in Occupational Therapists

Principal Investigator: LeRoy Spaniol, Ph.D.

Status: New

Dates: April 1980-July 1980

Cost: Annual $2,279 — Projected Total $2,279
RT Annual $2,279 — RT % of Annual Total 100%

Annual Report Reference: #1, Page 20, R-3

OBJECTIVES:

1. To determine the symptoms occupational therapists identify as indicators of their stress.
2. To determine the specific personal and job related stress factors that are cited as causes of burn-out.
3. To identify ways in which occupational therapists contribute to their own burn-out.
4. To identify ways therapists have found to deal with or decrease the symptoms they are feeling.

METHODOLOGY: Burn-out has become an increasingly important issue among helping professionals in contemporary society. A burnt-out worker is one who temporarily or permanently experiences physical and mental exhaustion plus diminished motivation and productivity as a result of excessive commitments of energy and resources.

This study explored the question of whether Registered Occupational Therapists (OTRs) perceived themselves as experiencing burn-out, and identified the personal and organizational sources that amplify their perceived level of burn-out. Two hundred and ninety-eight OTRs residing in New England participated in this study by completing a six page mail questionnaire. Information regarding the respondent's biographical data, his symptoms and perceived sources of job-related stress, and methods for dealing with this stress were gathered. This information was then compared to the respondent's perceived level of burn-out using stepwise multiple regression, Chi Square, and Pearson correlation.

FINDINGS TO DATE: The major findings of this study were that burn-out is perceived to be present in Occupational Therapists, that it is amplified by certain managerial practices and organizational structures, that burn-out symptoms increase in frequency as severity of burn-out increases, with the most severe burn-out state in OTRs being a doubting of one's own ability to perform.

APPLICABILITY: Information will be useful in developing curriculum for pre-service and in-service training for occupational therapists and related professionals.

This year the National Institute of Handicapped Research designated four new Rehabilitation Research and Training Centers to focus on specific priority areas. The first two listed are funded jointly by the NIHR and the National Institute of Mental Health.

University of California (RT-26)

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CORE AREA

The development and evaluation of assessment and treatment techniques for the social, community, and vocational rehabilitation of schizophrenic individuals.

University of Pennsylvania (RT-27)

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CORE AREA

Stroke, psychotherapy, and incontinence studies with the impaired elderly in the rehabilitation process.

Rancho Los Amigos Hospital (RT-28)

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CORE AREA

Multidisciplinary research and rehabilitation assessment and treatment needs of elderly handicapped.

University of Kansas (RT-29)

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CORE AREA

Research on advocacy, interagency coordination, organization and administration of Centers for Independent Living.

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*Accurate January 1981