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Safe Mobility for Older People
Notebook

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Model Driver Screening and Evaluation Program

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16. Abstract

The *Safe Mobility for Older People Notebook* is a research product of the "Model Driver Screening and Evaluation Program" project sponsored by NHTSA, and is intended as a resource to support program initiatives promoting the safe mobility of older persons across all States and Provinces. This document represents a snapshot of current knowledge and practices at the State and Provincial level. Topics include the identification of high-risk older drivers; the counseling and remediation of at-risk drivers; public information and educational tools to support program implementation; and mobility options and alternatives to transportation for seniors. Coverage of these topics is provided in 70 subtopic discussions, containing three sections each: (1) a summary of outcomes in relevant research studies and implementation efforts; (2) conclusions/preliminary recommendations pertinent to the development of a national Model Program; and (3) references identifying data sources. An *Annotated Research Compendium of Driver Assessment Techniques for Age-Related Functional Impairments* is also provided as further rationale and supporting evidence for conclusions and recommendations found in this document.

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SAFE MOBILITY FOR OLDER PEOPLE NOTEBOOK

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C. DEVELOP TOOLS NEEDED TO IMPLEMENT MODEL PROGRAMS

I. PROGRAM GOALS AND PROCEDURES

The singular objective of this work is to promote the safe mobility of older persons. Mobility is central to quality of life. There is a well-established link between restricted mobility among older persons and the onset or acceleration of diverse physical and mental health problems. Costs to society to provide care for seniors who lose their mobility also rise dramatically. To preserve independent functioning, to retain the dignity and self-esteem that result from providing for one's own mobility needs as long as it is possible to do so without unacceptable risk to oneself or to others— these are the overriding goals in a U.S.DOT policy initiative, *Safe Mobility for Life*, that provides the framework for application of material in this *Notebook*.

In our society personal mobility, to an overwhelming degree, is tied to the ability to drive a car. People who drive automobiles can exercise the freedom to choose where to work, live, and recreate; their social needs and maintenance requirements can be self-fulfilled; and they can travel virtually at any time they desire. These attributes of a contemporary lifestyle, and the means most often used to attain them, are perceived to be among the basic rights of every adult.

As people age, however, their ability to safely drive a car may be compromised by a variety of functional impairments. The functional abilities at issue include vision, attention, perceptual skills, memory, decision making, reaction time and different aspects of physical fitness and performance. With increasing age, the occurrence of disease and pathology are more common and, even in their absence, declines in functional abilities are to be expected as a normal consequence of aging. There is an accumulating body of evidence to show that impairments in one or more areas of functional capability significantly increase a driver's risk of a crash. And because of their higher vulnerability, older persons involved in an automobile crash are more likely than their younger counterparts to be seriously injured or killed. The leading cause of accidental death for older persons is a car crash.

The changing demographics in our society underscore the consequences of age-related driving impairments as an emerging public health issue. The population over age 65 will grow by 60 percent in the next 20 years; during the decade from 2020 to 2030, the proportion of Americans over the age of 65 will increase to more than 1 in 5. The development of screening procedures for license renewal and regulatory control that are fair, accurate, and which can be administered cost-effectively is therefore a clear priority. This was the premise behind a NHTSA research project, "Model Driver Screening and Evaluation Program;" the information presented in this *Notebook* was generated through performance of that project.

Improved practices for assessing drivers' abilities and driving skills are overdue. Through the decade of the 1990s and beyond, as people age 85 and older have emerged as the fastest growing segment of our driving population, the driving task itself has become characterized by ever-growing traffic volumes and congestion, plus novel highway features and vehicle technologies that demand greater attention by the driver. *Most* seniors are as capable of driving safely as their younger counterparts, and when they become aware that they have a problem they typically act responsibly by limiting or modifying their driving habits. Still, some diminished functional capabilities are more difficult to detect or may be denied, and the margin for 'human error' in many driving situations has become vanishingly small. Thus the payback for more accurate prediction of who is at greatest risk of causing a crash is substantial—both for the individual and for society.

The Model Program's first priority has accordingly been to identify the most useful tools for evaluation of drivers' functional capabilities. For many reasons, it is anticipated that functional screening will not be confined to Departments of Motor Vehicles, and that the DMV may not even be the most important setting for early screening to occur. Providing tools for self-evaluation by older drivers, and for screenings in various health care and social service settings in the community, is strongly emphasized in the *Notebook*. A need for multiple tiers of evaluation activities is also emphasized, such that results of early screening for gross impairments lead to more comprehensive, diagnostic testing by appropriate professionals whenever warranted.

While identifying and assessing the ability of older people to remain safely mobile receives the largest share of attention in the *Notebook*, other goals are also defined. When it has been determined that an individual has one or more functional limitations that are likely to produce driving impairments, the Model Program supports remediation of the problem if possible, and the provision of mobility counseling to inform the individual about local alternative transportation options and how to access available services. More broadly, the Model Program also includes a public information and education component to help meet the assessment, remediation, and counseling goals by informing senior citizens and care givers about the link between functional decline and driving safety, and about resources that exist to help preserve or extend their mobility as they grow older.

The procedures described and reported on in the *Notebook* will give readers an understanding of the current state-of-the-knowledge in a given topic area, and will identify the principal sources of information and evidence for the included conclusions and recommendations. At the same time, the conclusions stated in this *Notebook* are preliminary and current knowledge may derive from research-in-progress. Where readers note significant omissions in material or material that is out of date with current practices it is requested that they bring such items to the attention of the authors. This reference document is, and should remain, a work-in-progress as jurisdictions throughout North America prioritize local issues relating to seniors' mobility needs, and implement the best solutions that are feasible at the time.

I.A. IDENTIFY OLDER PEOPLE WHO ARE AT HIGH RISK OF CRASHES

I.A.1. Epidemiology

(a) Dementia
(b) Cataracts
(c) Diabetes and Associated Conditions
(d) Glaucoma
(e) Foot Abnormalities
(f) Falls
(g) Cardiac (and Cardiopulmonary) Conditions
(h) Feet or Legs Cold on Exposure to Cold
(I) Bursitis
(j) Renal Disease
(k) Seizure Disorders
(l) Back Pain
(m) Overview: Comparative Risk Tables

The NHTSA/AAMVA (1980) document entitled, Functional Aspects of Driver Impairment: A Guide for State Medical Advisory Boards states that "... there is evidence that, as a group, individuals with certain types of medical impairment constitute a greater risk on the highway than does the population at large." However, while researchers have been trying for decades to determine the extent to which medical impairments lead to increased crash risk, none of the commonly studied medical conditions (e.g., diabetes, heart disease, stroke, Parkinson's disease) have been consistently associated with a high vehicle crash rate in older drivers (Hu, 1997). In fact, it is not the mere presence of the disease, but instead the functional limitations caused by the disease, that is key to predicting driving impairment. Unfortunately, as noted by Janke (1994), the degree of severity of the medical condition has not been typically considered in past research studies. Also, as people age, they are likely to develop multiple medical conditions, which makes it difficult to determine which specific condition was most impairing to the driving task. The information provided in this section of the Notebook presents findings from recent studies conducted by physicians, occupational therapists, epidemiologists, and other researchers who have sought to control for many of the extraneous variables that so often cloud the investigations of medical conditions and driving performance in older persons. From these data, the Notebook attempts to summarize the associations between age-related diminished functional abilities and crash risk in Section IA2. Section IC2(b)v (Test Procedures: comprehensive physical examination), and Section IC3(b)i (Rehabilitation Procedures: physician/occupational therapist review) provide more information about how physicians can identify at-risk older drivers and specific diagnoses, their effects on driving, and potential remediation.

Summary:

Alzheimer's Disease (AD) is the most common cause of dementia, with a prevalence—based on correlation between autopsy data and the outcomes of strict clinical diagnostic procedures—estimated to be as high as 11.6 percent for those 65 and older and 47.8 percent for those over the age of 85 (Evans, Funkenstein, Albert, Scheer, Cook, Herbert, Hennekens, and Taylor, 1989). Drivers with dementia are less likely to report driving problems than cognitively unimpaired drivers, and their perception of their driving ability does not correspond either to that of their caregivers (as assessed by questionnaire) nor their actual driving performance (Cushman, 1992; Tallman, Tuokko, and Beattie, 1993). Thus, they are less likely to limit their exposure to high risk driving situations than are drivers who have diminished visual and physical capabilities, but intact cognitive capabilities. Throughout the first three years the crash rate for AD patients is only slightly higher than that for drivers of all ages in the United States, and remains well below that of young adults aged 16 to 24. Although the course of AD may vary considerably, study findings suggest that the increase in crash risk develops toward the end of the third year, and more than doubles in the fourth year (see Staplin, Lococo, McKnight, McKnight, and Odenheimer, *in press*, for a review of dementia and diminished driving skills).

A recent matched-pair, case-control study, with close (1-year) age matching was conducted in Sweden, using the Clinical Dementia Rating (CDR) scale to measure dementia severity. In this study, questionable dementia (CDR=0.5) and mild dementia (CDR=1) were found significantly more often in the case group (37 drivers age 65+ with license suspended due to crashes or moving violations) than in the matched control group (37 drivers age 65+ with no license suspensions in past 5 years). Dementia was found in 49 percent of the cases versus 11 percent of the controls. Comparison of the 23 case subjects with crashes and the 29 control subjects with no crashes in the past 5 years showed that the crashed drivers had more incidence of dementia/CDR>0 ($p<.001$), worse cube copying ($p<.015$), poorer 5-item recall ($p<.003$), a lower Mini-Mental Status Examination (MMSE) score ($p<.019$), and more EEG abnormalities. (see Johansson, Bronge, Lundberg, Persson, Seideman, and Viitanen, 1996; Johansson, 1997).

In a recent study to assess the reliability and stability of a standardized road test for healthy aging people and those with dementia of the Alzheimer type, a significant relationship between global rating on the road test and Clinical Dementia Rating (CDR) was found, such that most CDR-0 subjects (no dementia) were rated as "safe" drivers [78 percent (45/58) of CDR-0 subjects], compared to 67 percent (24/36) of CDR-0.5 subjects (very mild dementia) and 41 percent (12/29) of CDR-1 subjects (mild dementia)]. Only 3 percent of CDR-0 subjects were judged "unsafe," but 19 percent of CDR-0.5 and 41 percent of CDR-1 subjects were judged "unsafe." The remaining subjects in each CDR group were rated "marginal." (see Hunt, Murphy, Carr, Duchek, Buckles, and Morris, 1997a, and 1997b).

In a study of healthy elderly controls (n=13; mean age=73.5; CDR score=0); subjects with very mild dementia (n=12 ; mean age=72.5; CDR score=0.5), and subjects with mild dementia (n=13; mean age=73.4; CDR score=1.0), the correlation between the pass/fail outcome on the road test and performance on the Logical Memory test was significant at the $p<.0009$ level. Five subjects—all in the CDR-1 stage— "failed" the in-car on-road test. The Logical Memory subscale of the Wechsler Memory Scale assesses immediate or delayed recall of verbal ideas presented in two paragraphs, read aloud by the experimenter. (see Hunt, Morris, Edwards, and Wilson, 1993).

Most recently, Salzberg and Moffat (1998) evaluated the driving records of 46 older drivers who had psychiatric conditions (Alzheimer's, bipolar disorders, dementia, and confusion/memory loss) who were referred to the Washington State Special Examination Program (and passed), and 449 control group drivers. An additional 20 drivers with psychiatric conditions failed the special exam, and their licenses were canceled. This constituted 30 percent of the drivers with psychiatric conditions who underwent the special exam. This program is described in more detail in Section IA1(m) of the *Notebook*. A "special exam" includes an in-depth interview, and an extended or specialized on-road drive test, typically conducted near the driver's residence. The most common outcome of the "special exam" is to impose driving restrictions (time of day, area, equipment).

Crash and violation records of drivers with psychiatric conditions were compared with that of the control group, for a period of 1.75 years before the exam, and 3.25 years after the exam (a 5-year period). Crash and violation rates were calculated to describe the number of incidents per 100 subjects per year, since the pre- and post-observation periods differed in length. The crash and violation rates for the 46 drivers with psychiatric conditions who passed the "special exam" and the (entire) control group are presented below, for the pre-exam and post-exam period. For comparison purposes, in Washington State during 1996 there were 140,215 total collisions and 4,037,534 licensed drivers, yielding a rate of 3.47 collisions per 100 licensed drivers in a one-year period.

Group	Pre-Exam Collision Rate	Post-Exam Collision Rate	Pre-Exam Violation Rate	Post-Exam Violation Rate
Control (n=449)	3.8180	1.1650	7.5087	2.2614
Special-Exam Psychiatric Conditions (n=46)	12.4224	4.6823	23.6025	8.0268

Older drivers with psychiatric conditions who passed the "special exam" and received consequent driving restrictions showed a greatly reduced collision and violation rate. However, the rate reduction still resulted in a crash and violation risk that was approximately 4 times that of the control group of older drivers, who did not receive exams and consequent restrictions but also showed reductions in their crash and violation rates over the 5-year period. Of particular interest is that the post-exam collision rate of the psychiatric group (4.6823) was 1.35 times higher than the collision rate of the population of licensed drivers in the State (3.47). This point illustrates that restricting the driving privileges of drivers with psychiatric conditions brings their crash rate more in line (although still higher) with that of the general population of drivers, however, the rate is still much higher than that of a comparison group of older drivers without psychiatric conditions, who (probably) are practicing self-restriction.

Hunt (1994) describes the following situations in which demented drivers experience difficulty:

- Familiar routes are no longer well remembered, and the demented individual may become lost while driving.
- In an emergency, the driver may confuse the brake pedal with the gas pedal or press on both pedals simultaneously.

- Driving situations that demand complex or rapid cognitive processing and problem solving may cause a demented driver to stop in the middle of traffic or otherwise fail to negotiate traffic safely. To an observer, there may seem to be no apparent reason to stop.

- In making a left turn at an intersection, the driver may fail to yield the right-of-way or inappropriately attempt to proceed on a green light when the sign reads "left turn on arrow only."

- Verbal commands or suggestions from a passenger (i.e., directions; reminders to check traffic before making a lane change) are not interpreted correctly or in time for the proper action to occur.

The American Psychiatric Association's Position Statement on the Role of Psychiatrists in Assessing Driving Ability was drafted by the Council on Aging, approved by the Assembly in November 1993, and by the Board of Trustees in December 1993 (Council on Aging, 1995). It states that: (1) a mental disorder *per se* does not imply impaired driving capacity; (2) persons suffering from mental disorders may experience symptoms that can interfere with their ability to drive; (3) usually, accurate assessment of the impact of symptoms on functional abilities is not possible in an office or hospital setting because such an assessment typically requires specialized equipment or actual driving observation which goes beyond the scope of ordinary psychiatric care; and (4) since psychiatrists do not have special expertise in assessing patients' ability to drive, they should not be expected to make these assessments in the course of clinical practice. However, the position statement specifies that psychiatrists do have a role to play in advising patients about the potential impact of their illness and treatments on driving ability, as follows: (1) when appropriate, psychiatrists should discuss with their patients symptoms of their mental disorders that may be serious enough to substantially impair their driving ability; (2) psychiatrists should warn their patients about the possible effects of prescribed psychotropic medications on alertness and coordination, and about the possibility that such medications could magnify the effects of alcohol; and (3) when clinically appropriate, medication with a low potential to impair ability should be chosen preferentially, depending on the patient's driving requirements and habits. Finally, the statement mentions that given the importance of maintaining confidentially in psychiatrist-patient relationships, psychiatrists should not be required to report information on a patient's driving ability to state departments of motor vehicles. However, a statute that allows, but does not require, reporting when there is clear-cut evidence of substantial driving impairment (e.g., a family's statement that a moderately demented patient has had several recent minor crashes) is socially desirable and can be clinically useful. The position is that ultimate responsibility for assessment of patients' driving ability should lie with the DMVs. Reports made in good faith, however, should be accompanied by immunity for psychiatrists from subsequent liability.

Conclusions/Preliminary Recommendations:
Diagnosis is not an adequate predictor of function, since there is great heterogeneity in the rate of progress as well as the cognitive strengths and weaknesses among patients with dementing disorders. Diagnosis could thus be important as a way to identify persons for tracking, with decisions on whether driver status should be terminated then based on functional assessments.

Mental status evaluations may be useful in identifying older drivers who are beginning to show evidence of cognitive decline, but on-road or off-road tests, especially those requiring the driver to follow sequential directions, are more likely to measure the skills required for driving. Cutoff scores (MMSE) must be considered as being relative, forming a small part of the basis of making decisions about driving, and secondary to a clinical evaluation; however, MMSE score ≤ 10, accompanied by a diagnosis of dementia, indicates a sufficiently low level of cognitive functioning to justify recommending immediate cessation of driving (Lundberg, Johansson, Ball, Bjerre, Blomqvist, Braekhus, Brouwer, Blysma, Carr, Englund, Friedland, Hakamies-Blomqvist, Klemetz, O'Neill, Odenheimer, Rizzo, Schelin, Seideman, Tallman, Viitanen, Waller, and Winblad, 1997).

It is important to note that MMSE scores are influenced by race and level of education, so some adjustment of cutoffs may be necessary.

Patients who have had AD for more than two years should have their driving ability closely monitored if they are to continue driving, as the overall risk to society during the first two years is well within the accepted range for other drivers. This is dependent upon whether AD is defined as early stage (CDR = 0.5) or later stage (CDR >1.0) however.

References:

• Council on Aging (1995)
• Evans, Funkenstein, Albert, Scheer, Cook, Herbert, Hennekens, and Taylor (1989)
• Hunt (1994)
• Staplin, Lococo, McKnight, McKnight, and Odenheimer (*in press*)
• Excerpts from *Annotated Research Compendium of Driver Assessment Techniques for Age-Related Functional Impairments* (Hunt, Morris, Edwards, and Wilson, 1993; Tallman, Tuokko, and Beattie, 1993; Cushman, 1992; Odenheimer, Beaudet, Jette, Albert, Grande, and Minaker, 1994; Johansson, 1997; Lundberg, Johansson, Ball, Bjerre, et al., 1997; Keyl, Rebok, Bylsma, et al., manuscript under review; Duchek, Hunt, Ball, Buckles, and Morris, 1997; Rizzo and Dingus, 1996; Rizzo, Reinach, McGehee, and Dawson, 1997; Hunt, Murphy, Carr, Duchek, Buckles, and Morris, 1997a, and 1997b; Janke and Eberhard, 1998; Staplin, Gish, Decina, Lococo, and McKnight, 1998; DriveAble Testing, March 1997; Dobbs, 1997)

IA1(b). Cataracts

Summary:

Owsley, Stalvey, Wells, and Sloane (1999) conducted a study that included 279 drivers with cataract (mean age = 71) and 67 drivers with no cataract (mean age = 67). This on-going project is an intervention evaluation study to determine how improvement in vision impacts crashes and driving habits. Crash data from 5 years prior to enrollment and 3 years following enrollment were obtained from Alabama Dept. of Public Safety. Findings are as follows:

- Subjects in the cataract group averaged 20/60 and 20/40 in the worst and best eye respectively, compared to the no cataract group who averaged 20/25 and 20/20 respectively. This difference was significant ($p < .001$).
- Contrast sensitivity was significantly worse in both eyes for subjects with cataracts ($p < .001$). Age adjusted log CS for cataract group was 1.39 (best eye) and 1.19 (worst eye) compared to 1.61 (best eye) and 1.52 (worst eye) for no cataract group.
- Cataract subjects detected fewer points in their visual field than the no cataract subjects.
- Proportionately more cataract subjects preferred to have someone else drive when they traveled in a car, drove slower than the general traffic flow, and received advice that they limit or stop driving (self-reports on driving habits questionnaire).
- Cataract was associated with reduced number of days driving per week and a reduced number of destinations. (Cataract drivers 2 times more likely to reduce driving).
- Subjects with cataracts were (2 times) less likely to drive beyond their neighboring towns than subjects without cataracts.
- Cataract was significantly associated with driving difficulty in the rain, driving alone, making left turns across traffic, driving on interstates, in high traffic, in rush hour, and at night (Cataract drivers 4 times more likely to report these difficulties).
- After adjusting for driving exposure, the association between cataract and at-fault crash involvement was defined as relative risk equal to 2.48, (95% CI = 1.0-6.14).
- When adjusted for impaired health, the association between cataract and crash involvement was defined as relative risk = 2.49, (95% CI = 1.0-6.27).

Salzberg and Moffat (1998) evaluated the driving records of 45 older drivers with cataracts who were referred to the Washington State Special Examination Program (and passed), and 449 control group drivers. This program is described in more detail in Section IA1(m) of the *Notebook*. A "special exam" includes an in-depth interview, and an extended or specialized on-road drive test, typically conducted near the driver's residence. The most common outcome of the "special exam" is to impose driving restrictions (time of day, area, equipment).

Crash and violation records of drivers with cataracts were compared with that of the control group, for a period of 1.75 years before the exam, and 3.25 years after the exam (a 5-year period). Crash and violation rates were calculated to describe the number of incidents per 100 subjects per year, since the pre- and post-observation periods differed in length. The crash and violation rates for the 46 drivers with cataracts who passed the "special exam" and the (entire) control group are presented below, for the pre-exam and post-exam period. For comparison purposes, in Washington State during 1996 there were 140,215 total collisions and 4,037,534 licensed drivers, yielding a rate of 3.47 collisions per 100 licensed drivers in a one-year period.

Washington State Special Exam Program Analysis				
Group	**Pre-Exam Collision Rate**	**Post-Exam Collision Rate**	**Pre-Exam Violation Rate**	**Post-Exam Violation Rate**
Control (n=449)	3.8180	1.1650	7.5087	2.2614
Special-Exam Cataracts (n=45)	5.0794	2.0513	15.2381	2.0513

Older drivers with cataracts had a pre-exam crash risk that was 1.33 times that of a control group of older drivers without medical conditions, and 1.46 times higher than the population of licensed drivers in Washington State. After taking and passing a special exam and receiving license restrictions, their risk dropped substantially, to a level below that of the general population, but still higher than that of the older drivers comprising the control group. The authors explain the drop in crash and violation rate shown by the control group as the result of lower driving exposure with increasing age, which is a trend that has been demonstrated in many studies employing older drivers. It is unknown to what degree the cataract group would self-restrict in the absence of the special exam and its formal license restrictions, however, the drop in violation rate for the cataract group as a function of having taken the exam was over twice the reduction shown for the control group. Thus, the special exam program (an on-road test in a driver's home area, plus the tailoring of license restrictions) showed a beneficial effect in reducing crash and violation risk for older drivers with cataracts.

Conclusions/Preliminary Recommendations:

Older drivers with a cataract experience a restriction in their driving mobility and a decrease in their safety on the road. Vision impairment from cataract is now largely reversible due to technological advances in surgical techniques and interocular lens design, with over 85 percent of cases reaching 20/40 acuity or better post-surgery. Cataract surgery is the most common surgical procedure performed on medicare beneficiaries representing 12 percent of the overall Medicare budget.

Owsley et al.'s in-progress study will determine whether improvement in vision following cataract surgery expands driving habits and improves safety. Cataracts are related to increased crash frequency; however, drivers with cataracts are candidates for remediation through eye surgery. Study findings may provide the basis for recommending earlier surgery to remove cataracts. Optometrists and ophthalmologists should counsel patients regarding the dangers associated with driving with cataracts, and suggest driving restrictions (e.g., at night/dusk, in reduced visibility conditions such as rain, fog, etc.) for their cataract patients. The findings from Washington State (Salzberg and Moffat, 1998) indicate that such licensing restrictions reduce the crash and violation risk of older drivers with cataracts to a level that is lower than that posed by the general population of licensed drivers.

References:

- Owsley, Stalvey, Wells, and Sloane (1999)
- Salzberg and Moffat (1998)

IA1(c). Diabetes and Associated Conditions

Summary:

Hu, Young, and Lu (1993) state that 26 out of 1,000 persons are diagnosed as having diabetes, based on the 1998 National Health Interview Survey, and that the prevalence rate increases with age. Diabetes Mellitus is the most prevalent metabolic disease that may have implications for driving (NHTSA, 1980). Hu et al. (1993) provide the following brief description of the disease. Diabetes Mellitus describes a variety of related medical conditions that affect the body's ability to produce appropriate levels of insulin. Insulin regulates blood sugar levels that provide nutrients to the brain; blood sugar levels that are too high (hyperglycemia) or too low (hypoglycemia) may lead to unconsciousness. Diabetes affects other parts of the body, including the circulatory system and vision. Diabetes in all age groups is associated with thickening of the arteries that can lead to faintness or unconsciousness. The longer a person has diabetes, the more likely that retinal damage (vision impairment) will occur. Approximately 60 percent of patients having diabetes for 15 years or more have some blood vessel damage in their eyes (American Academy of Ophthalmology, 1984). Diabetes Mellitus can be controlled by diet alone, by a combination of diet and oral medication, or by injection of insulin. NHTSA (1980) states that since the level of successfully controlling the disease varies, the following factors should be considered in determining whether a patient should be considered for driver licensing: (1) whether an individual is under regular medical supervision;
(2) whether insulin is required; (3) whether the individual is in compliance with the prescribed medical/dietary regimen; (4) whether a warning is experienced before onset of any symptoms; and
(5) whether the disease is under control.

A study by Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998) included 294 older drivers, ages 56-90 years at enrollment, drawn from the population of licensed drivers in Jefferson County over age 55. They were divided into three groups as follows: 33 percent had 0 crashes on record; 49 percent had 1 to 3 crashes over the prior 5-year period; and 18 percent had 4 or more crashes over the prior 5-year period. A significant, independent association with crash risk in 3-year follow-up was found for subjects with a diagnosis of diabetic retinopathy (5 times greater risk, 95% CI = 1.13 - 21.8).[1]

Koepsell, Wolf, McCloskey, Buchner, Louie, Wagner, and Thompson (1994) conducted a case-control study of 234 older drivers (age 65+) who were injured in a crash during the previous 3-year period, and 446 older drivers who had no injury crashes during the same period. Injury risk was 2.6 times higher in older diabetic drivers, and higher for those treated with insulin (odds ratio = 5.8), or oral hypoglycemic agents (OR=3.1), or those having diabetes for more than 5 years (OR= 3.9), or those with both diabetes and coronary heart disease (OR=8.0).

Diller, Cook, Leonard, Reading, Dean, and Vernon (*in press*) analyzed citation rates and crash rates (all crashes and at-fault crashes) for 10,069 drivers reporting diabetes mellitus and other metabolic

[1]Correction. The finding reported above for diabetic retinopathy was cited from a manuscript under review, but not yet published. Due to concerns with small sample size, the analysis supporting this finding was subsequently excluded from the final, published manuscript (Owsley et al., 1998). The reported relationship must therefore be regarded as tentative and should not be further cited. (February 2004).

conditions (including thyroid, parathyroid, pituitary) who had unrestricted licenses, and 358 drivers reporting diabetes and other metabolic conditions with restricted licenses [see *Notebook* section IA1(m) for further details regarding methodology]. Drivers with multiple medical conditions were excluded from these analyses, which significantly reduced the number of drivers with only diabetes, whose operating privileges were restricted in some way. Their crash and citation rates were compared to a control group of drivers (selected randomly from all licensed drivers without medical conditions), matched on age, gender, and county of residence. Accordingly, different control groups were established for restricted drivers and for unrestricted drivers with this medical condition.

Rates for drivers with diabetes (and other metabolic conditions) and their control groups per 10,000 license days for citations, for all crashes, and for at-fault crashes, are presented in the following table, by license status (not restricted and restricted). Also presented are the relative risk ratios (case rate/control rate).

Utah Rates and Relative Risk Ratios of Adverse Driving Events Per 10,000 Days of Driving			
License Status	**Adverse Driving Event**		
Not Restricted	**Citation**	**All Crashes**	**At-Fault Crashes**
Drivers with Diabetes	2.61	1.70	1.02
Matched Controls	2.52	1.20	0.64
Rate Ratio	1.04	1.41*	1.58*
Restricted	**Citation**	**All Crashes**	**At-Fault Crashes**
Drivers with Diabetes	4.43	2.03	1.48
Matched Controls	3.16	1.42	0.82
Rate Ratio	1.40	1.43	1.79

* The rate for drivers with diabetes is significantly higher than the rate for their matched controls who have no reported medical conditions.

Drivers with diabetes (both restricted and unrestricted) had a higher risk of adverse driving events than control drivers without a medical condition. Drivers with diabetes whose operating privileges were restricted showed *higher* rates of adverse driving events than drivers with diabetes licensed without restrictions. This is noteworthy even though their rates were not statistically different than the rates of their control group. This may be the result of the small number of cases with restricted licenses (n=358) and the lower number of days of driving available to this group (54,199), as well as different population characteristics.

Salzberg and Moffat (1998) evaluated the driving records of 14 older drivers with diabetic retinopathy and 27 older drivers with diabetes mellitus who were referred to the Washington State Special Examination Program (and passed), and 449 control group drivers. This program is described in more detail in Section IA1(m) of the *Notebook*. A "special exam" includes an in-depth interview, and an extended or specialized on-road drive test, typically conducted near the driver's residence. The most common outcome of the "special exam" is to impose driving restrictions (time of day, area, equipment).

Crash and violation records of drivers with diabetic retinopathy and diabetes mellitus were compared with that of the control group, for a period of 1.75 years before the exam, and 3.25 years after the exam (a 5-year period). Crash and violation rates were calculated to describe the number of incidents per 100 subjects per year, since the pre- and post-observation periods differed in length. The crash and violation rates for the drivers with diabetes and related conditions who passed the "special exam" and the (entire) control group are presented below, for the pre-exam and post-exam period. For comparison purposes, in Washington State during 1996 there were 140,215 total collisions and 4,037,534 licensed drivers, yielding a rate of 3.47 collisions per 100 licensed drivers in a one-year period.

Washington State Special Exam Program Analysis				
Group	**Pre-Exam Collision Rate**	**Post-Exam Collision Rate**	**Pre-Exam Violation Rate**	**Post-Exam Violation Rate**
Control (n=449)	3.8180	1.1650	7.5087	2.2614
Special Exam Diabetic Retinopathy (n=14)	12.2449	.0000	8.1633	2.1978
Special Exam Diabetes Mellitus (n=27)	6.3492	1.1396	8.4656	2.2792

Older drivers with diabetic retinopathy had a pre-exam crash risk that was 3.2 times that of a control group of older drivers without medical conditions, and 3.5 times higher than the population of licensed drivers in Washington State. The pre-exam crash risk for drivers with diabetes mellitus was 1.67 times higher than the control group of older drivers. After taking and passing a special exam and receiving license restrictions, their risk dropped below that of the control group. The authors explain the drop in crash and violation rate shown by the control group as the result of lower driving exposure with increasing age, which is a trend that has been demonstrated in many studies employing older drivers. Since the drop in crash and violation rates was greater for drivers with diabetes and related conditions than that demonstrated by the control group of older drivers over the 5-year period, it may be concluded that the Special Exam Program (on-road driving exam and license restrictions) was effective in reducing crash risk without eliminating mobility for these drivers. What is not known is the actual driving exposure of these groups of drivers and the severity of disease in the exam group. Thus, the drop in rates for the special exam group could have resulted from being too sick to drive for some period of time during the study.

Finally, in the recently completed pre-pilot study conducted in Salisbury, Maryland for the NHTSA "Model Driver Screening and Evaluation Program" project, the present *Notebook* authors found that older drivers who reported having diabetes were slightly more likely to be involved in a crash (OR=1.34). For female subjects only (n=163), the odds ratio was 2.13. Subjects ranged in age from 68 to 89 (mean age = 75.7); 131 of the 363 subjects were involved in at least 1 crash in the previous 6-year period (1991-1997).

Conclusions/Preliminary Recommendations:

Diller et al. (*in press*) and Salzberg and Moffat (1998) found that drivers licensed with diabetes and other metabolic conditions have a higher rate of crashes than the general population of drivers. In the Owsley et al. study, the association between crash rate and diabetic retinopathy was independent of visual functional problems, since these variables were addressed separately in the modeling. The authors state that this implies that features of eye conditions unrelated to the visual functions assessed in the study (Letter Acuity - ETDRS chart; Contrast Sensitivity - Pelli-Robson chart; Stereoacuity - TNO Test; Disability Glare - MCT-8000 (VisTech); Visual Field Sensitivity) may be associated with crash involvement; factors such as medication usage and other systemic and functional complications. The authors also state that diabetic retinopathy is relatively common in the elderly and is treatable (ophthalmologic laser surgery to seal or photocoagulate the leaking blood vessels or a surgical procedure called a vitrectomy, which is the removal of the blood-filled vitreous from the eye and replacement with a clear artificial solution). If elevated crash rate is independent of visual function, diabetes (not diabetic retinopathy) may actually be responsible for the elevation in crash rate. Physicians and ophthalmologists should counsel their patients with diabetes regarding the importance of complying with treatment recommendations (diet and medications) for maintaining safe driving, and recommend driving restrictions/cessation on an individual basis, depending on the extent and severity of the symptoms.

Regarding the effectiveness of restricting the licenses of drivers with diabetes, results are mixed. This is because actual exposure data have not been available. Diller et al. *(in press)* attempted to control for the effects of exposure, but only used available days (as opposed to actual miles driven). The reduction in crash and violation rates shown in the Salzberg and Moffat (1998) study are noteworthy; however, caution needs to be taken in generalizing the results. Older drivers with medical conditions may either choose to restrict their driving because they know that they are at an increased crash risk, or they may not feel well enough to drive as often as healthy older drivers. Lower exposure leads to a lower crash risk. Also, the sample size of drivers with diabetes in this study was small. But the crash and violation rate reductions reported above indicate that restricting the driving privileges has promise in improving safety while maintaining mobility.

References:

- American Academy of Ophthalmology (1984)
- Diller, Cook, Leonard, Reading, Dean, and Vernon (*in press*)
- Hu, Young, and Lu (1993)
- Koepsell, Wolf, McCloskey, Buchner, Louie, Wagner, and Thompson (1994)
- National Center for Health Statistics(1989)
- NHTSA (1980)
- Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998)
- Salzberg and Moffat (1998)

IA1(d). Glaucoma

Summary:

Glaucoma is one of the leading causes of blindness in the U.S., affecting 2 out of every 100 persons over age 35 (American Academy of Ophthalmology, 1983).

A study by Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998) included 294 older drivers, ages 56-90 years at enrollment, drawn from the population of licensed drivers in Jefferson County over age 55. They were divided into three groups as follows:

- 33% had 0 crashes on record.
- 49% had 1 to 3 crashes over the prior 5-year period.
- 18% had 4 or more crashes over the prior 5-year period.

A significant, independent association with crash risk in a 3-year follow-up was found for subjects with a diagnosis of glaucoma: (Relative Risk =5.20, 95% Confidence Interval = 1.19-22.72). The relationship for glaucoma and crashes was stronger for males (RR=9.81) than for females (RR=5.14). The association between crash rate and glaucoma was independent of visual functional problems, since these variables were addressed separately in the modeling. The authors state that this implies that features of eye conditions unrelated to the visual functions assessed in the study may be associated with crash involvement (such as medication usage and other systemic and functional complications).[2]

In another study of 193 older drivers between age 55-87 (mean = 71 years), identified through Alabama Department of Public Safety Files, 78 drivers (cases) had at least 1 crash in the prior 5-year period that resulted in an injury to anyone in the involved vehicles, and 115 drivers (controls) had no crashes in the same 5-year period. Glaucoma was independently associated with crash risk in the multivariate analyses: cases were 3.6 times more likely to report glaucoma than were controls (Owsley, McGwin, and Ball, 1998).

In a panel data analysis of remaining eligible drivers in 1993 (507 female drivers and 375 male drivers) who participated in the Iowa 65+ Rural Health Study from 1981-1993, none of the commonly studied medical conditions (e.g., diabetes, heart disease, stroke, Parkinson's Disease) were associated with crashes. The only medical condition that increased crash risk in older drivers was glaucoma. And, the association between glaucoma and highway crashes was evident only among older male drivers (odds ratio = 1.7) (Hu, Trumble, Foley, Eberhard, and Wallace, 1998).

Stewart, Moore, Marks, May, and Hale (1993) found *no association* between glaucoma and increased crash risk, in a sample of 1,431 older drivers. Both independent and dependent variables, however, were comprised of self-reports (of medical conditions and crashes, respectively).

Conclusions/Preliminary Recommendations:

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[2] Correction. The finding reported above for glaucoma was cited from a manuscript for review, but not yet published. Due to concerns with small small sample size, the analysis supporting this finding was subsequently excluded from the final, published manuscript (Owsley et al., 1998). The reported relationship must therefore be regarded as tentative and should not be further cited. (February 2004).

Glaucoma is relatively common in the elderly and is associated with an increased crash risk. In multiple studies, the risk of an older driver being involved in a crash is 1.7 to 5.2 times higher if glaucoma is present. Two studies showed that the risk appears to be higher for males than for females. The American Optometric Association (AOA) recommends that people ages 10 to 40 see an optometrist every 2 to 3 years; people ages 41-60 every two years; and people age 61+ every year. Individuals age 61+ have an increasing risk for the development of cataracts, glaucoma, and macular degeneration and other sight threatening or visually disabling eye conditions as well as systematic health conditions. The American Academy of Ophthalmology recommends that persons over age 35 be checked for glaucoma every 2 or 3 years. Glaucoma is treatable (eye drops, pills to decrease pressure either by assisting outflow of fluid from the eye or by decreasing the amount of fluid entering the eye, or surgery to perform a new drainage canal).

References:

- American Academy of Ophthalmology (1983): Glaucoma
- Hu, Trumble, Foley, Eberhard, and Wallace (1998)
- Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998)
- Owsley, McGwin, and Ball (1998)
- Stewart, Moore, Marks, May, and Hale (1993)

IA1(e). Foot Abnormalities

Summary:

Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994) studied 283 community-dwelling individuals age 72 to 92 (mean age = 77.8) from the Project Safety cohort living in New Haven, CT who drove between 1990 and 1991. Fifty-seven percent of the sample were males.

The number of the following foot abnormalities was noted in addition to the ability to stand on toes and heels: toenail irregularities, calluses, bunions, and toe deformities such as hammer toes. Analyses were conducted contrasting driving outcomes for patients with 0 to 2 foot abnormalities versus 3 to 8 foot abnormalities.

The outcome variable was self-reported involvement in automobile crashes, moving violations, or being stopped by police in the year following administration of the test battery.

Persons with 3 or more foot abnormalities were more likely to have adverse events (23 percent had adverse events) compared to persons with 0-2 foot abnormalities (10 percent had adverse events). The difference was significant at $p<0.01$ level (relative risk = 2.0, 95% CI=1.0 to 3.8).

A multivariate analysis adjusting for driving frequency and housing type found the following factors to be associated with the occurrence of adverse events: poor design copying on the MMSE (relative risk=2.3, 95% CI=1.5 to 5.0), fewer blocks walked--0 versus $\geq$ 1 (relative risk=2.3, 95% CI=1.3 to 4.0) and more foot abnormalities--3 to 8 versus 0 to 2 (relative risk=1.9, 95% CI=1.1 to 3.3).

Combining these 3 factors to assess their ability to predict adverse driving events showed that if no factors were present, 6 percent of drivers had adverse events; if 1 factor was present, 12 percent had events; if 2 factors were present, 26 percent had events; and if all 3 factors were present, 47 percent had events.

Conclusions/Preliminary Recommendations:

There is a significant relationship between foot abnormalities in the elderly and increased crash risk. The association between foot abnormalities and crashes is logical, because such abnormalities may affect the ability to maneuver between the brake and accelerator. Physicians should take notice of foot abnormalities in older patients and include driving history-taking and counseling as part of routine exams.

References:

• Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)

IA1(f). Falls

Summary:

Sims, Owsley, Allman, Ball, and Smoot (1998) conducted a study to explore associations between a history of at-fault vehicle crashing in older subjects (between 1985-1991) and several medical and functional variables collected on them in 1991. Seven questionnaires and 10 physical examination/ performance measures were employed to assess medical and functional domains. Lists of drivers and number of crashes for each driver were made available by the AL Dept. of Public Safety.

Subjects included 174 drivers ages 55-90 (mean age 71.1), residing in Jefferson County, AL. Case drivers has at least 1 state-recorded at-fault crash in the 6 years preceding the assessment (n=99). Controls had no state-recorded at-fault crashes in the prior 6 years (n=75).

At the univariate level, crash-involvement was significantly associated with falling in the prior two years (p=0.004). All non-collinear variables that were significant at the univariate level were entered into logistic regression models; these included falling, reduction of 40 percent or more in the useful field of view, and not taking a beta-blocking drug. The logistic regression model indicated that having fallen in the prior two years was related to crash involvement with an odds ratio of 2.6 (CI=1.1-6.1, p=0.025).

Note: In another study by Owsley, McGwin, and Ball (1998), subjects with crashes were 3.6 times more likely to report a diagnosis of glaucoma compared to controls. These authors cited Glynn et al. (1991). Although medication information was not collected, Glynn et al. (1991) reported that the use of topical eye medications in elderly patients with glaucoma increased their risk of falling (an adverse mobility outcome).

Koepsell, Wolf, McCloskey, Buchner, Louie, Wagner, and Thompson (1994) conducted a case-control study of 234 older drivers (age 65+) who were injured in a crash during the previous 3-year period, and 446 older drivers who had no injury crashes during the same period. Injury risk was 1.4 times higher in older drivers who had fallen in the previous year. The authors caution that this association could have arisen by chance.

In the recently completed pre-pilot study conducted in Salisbury, Maryland for the NHTSA "Model Driver Screening and Evaluation Program" project, the present *Notebook* authors found that self-reported falls in the past two years was related to crashing (Odds Ratio for all subjects=1.53; OR for females only=1.38; OR for males only=1.61). Subjects ranged in age from 68 to 89 (mean age=75.7); 131 of the 363 subjects were involved in at least 1 crash in the previous 6-year period (1991-1997).

Conclusions/Preliminary Recommendations:

Crash involvement in the elderly is significantly related to having fallen in the past two years. Professionals conducting geriatric assessments should include a question about falling as part of history-taking, and DMVs should include a question about falling on license renewal applications for tracking of associations between falling and automobile crashes.

References:

- Glynn, Seddon, Krug, Sahagian, Chiavelli, and Campion (1991)
- Koepsell, Wolf, McCloskey, Buchner, Louie, Wagner, and Thompson (1994)
- Owsley, McGwin, and Ball (1998)
- Sims, Owsley, Allman, Ball, and Smoot (1998)

Summary:

Stewart, Moore, Marks, May, and Hale (1993) studied 1,431 participants in the Florida Geriatric Research Program (Dunedin, FL), for whom 8 years of longitudinal data were available (1975-1987). Subjects included 874 females (mean age = 77.8 years, s.d. = 4.6) and 596 males (mean age = 78.6 years, s.d. =4.5).

The dependent variable was self-reported crashes. Independent variables included self-reported information on 31 diseases, 26 symptoms, 34 clinical and laboratory values, number of drugs reported, number of symptoms reported, number of diseases reported. Subjects completed a questionnaire containing 180 questions and a form listing prescribed and nonprescribed medications used on a regular basis. Biochemical profile includes hemogram, red cell indices, and SMAC-23. Clinical assessment includes electrocardiogram and carotid auscultation, plus MMSE and Beck Depression Inventory at 8th visit.

The correlation between irregular heartbeat (palpitations) and crashes is significant (p=0.0017, Odds ratio = 1.83, 95% CI = 1.25-2.68). No other cardiovascular symptoms or diseases investigated in the present study were predictive of crashes.

No other signs or symptoms were of significance in crashes (paroxysmal nocturnal dyspnea, temporary loss of limb, dizziness/spinning, lightheadedness, syncope, tinnitus, dysphagia, amaurosis fugax, pain in abdomen, swollen feet/ankles, headache, paresthesia, diarrhea, recurrent cough, hematuria, incontinence (urine), aphasia, dysphonia, dyspnea, orthopnea, nocturia, claudication, dysuria, memory loss, feel awkward, effort angina, angina with tension, hemoptysis, constipation, thin bowel movements, blood in stools, melena, swollen joints, ache/painful joints, urinary hesitancy, and carotid bruits).

Diller, Cook, Leonard, Reading, Dean, and Vernon (*in press*) analyzed citation rates and crash rates (all crashes and at-fault crashes) for 18,990 drivers with cardiovascular conditions (including heart disease, rhythm disturbances, or history of myocardial infarctions, heart surgery, or hypertension) who had unrestricted licenses, and 160 drivers with cardiovascular conditions with restricted licenses [see *Notebook* section IA1(m) for further details regarding methodology]. Drivers with multiple medical conditions were excluded from these analyses, which significantly reduced the number of drivers with only cardiovascular conditions, whose operating privileges were restricted in some way. Their crash and citation rates were compared to a control group of drivers (selected randomly from all licensed drivers without medical conditions), matched on age, gender, and county of residence. Accordingly, different control groups were established for restricted drivers and for unrestricted drivers with this medical condition.

Rates for drivers with cardiovascular conditions and their control groups per 10,000 license days for citations, for all crashes, and for at-fault crashes, are presented in the following table, by license status (not restricted and restricted). Also presented are the relative risk ratios (case rate/control rate).

The data indicate that unrestricted drivers with cardiovascular disease have significantly higher crash rates (all crashes and at-fault crashes) than their matched controls without a medical condition. Drivers with cardiovascular disease whose driving privileges are restricted, also have a higher rate of adverse events than their matched control group, although the differences are not statistically significant. The higher rate may be explained by the small sample size (n= 160) and resulting number of eligible licensed driving days (22,290). In the time period under analysis (1992-1996), these restricted drivers experienced only 7 citations, 3 crashes, and 2 at-fault crashes.

Utah Rates and Relative Risk Ratios of Adverse Driving Events Per 10,000 Days of Driving			
License Status	**Adverse Driving Event**		
Not Restricted	**Citation**	**All Crashes**	**At-Fault Crashes**
Drivers with Cardiovascular Conditions	1.23	1.04	0.55
Matched Controls	1.60	0.91	0.47
Rate Ratio	0.77**	1.14*	1.15*
Restricted	**Citation**	**All Crashes**	**At-Fault Crashes**
Drivers with Cardiovascular Conditions	3.14	1.35	0.90
Matched Controls	2.0	0.83	0.52
Rate Ratio	1.57	1.61	1.72

* The rate for drivers with cardiovascular conditions is significantly higher than the rate for their matched controls who have no reported medical conditions.
** Differences in rates between medical conditions and control groups are statistically significant, with higher rates for control group.

Salzberg and Moffat (1998) evaluated the driving records of 47 older drivers with cardiovascular conditions who were referred to the Washington State Special Examination Program (and passed), and 449 control group drivers. This program is described in more detail in Section IA1(m) of the *Notebook*. A "special exam" includes an in-depth interview, and an extended or specialized on-road drive test, typically conducted near the driver's residence. The most common outcome of the "special exam" is to impose driving restrictions (time of day, area, equipment).

Crash and violation records of drivers with cardiovascular conditions were compared with that of the control group, for a period of 1.75 years before the exam, and 3.25 years after the exam (a 5-year period). Crash and violation rates were calculated to describe the number of incidents per 100 subjects per year, since the pre- and post-observation periods differed in length. The crash and violation rates for the drivers with cardiovascular conditions who passed the "special exam" and the (entire) control group are presented below, for the pre-exam and post-exam period. For comparison purposes, in Washington State during 1996 there were 140,215 total collisions and 4,037,534 licensed drivers, yielding a rate of 3.47 collisions per 100 licensed drivers in a one-year period.

Washington State Special Exam Program Analysis				
Group	**Pre-Exam Collision Rate**	**Post-Exam Collision Rate**	**Pre-Exam Violation Rate**	**Post-Exam Violation Rate**
Control (n=449)	3.8180	1.1650	7.5087	2.2614
Special Exam Cardiovascular Conditions (n=47)	7.2948	1.9640	20.6687	2.6187

Older drivers with cardiovascular conditions had a crash rate almost twice as high as that of the control group of older drivers prior to taking the special exam and receiving driving restrictions, and a violation rate over 2.5 times higher than control group drivers, during the pre-exam period. After undergoing the special exam process, their crash and violation rates fell significantly, to almost the level of that shown by the control group, which is less than the crash rate of the population of licensed drivers in the State of Washington. Thus, it appears that appropriate license restrictions (e.g., driving only within a specific radius of residence, daylight driving only, driving only between the hours of 10 a.m. to 3 p.m., no freeway driving, and/or driving within city limits only) are effective in reducing the risk posed by older drivers, without unduly restricting their mobility.

In Janke's (1994) review of cardiovascular conditions and driving, it is concluded that increased societal risk due to the driving of patients (in personal vehicles) with cardiovascular disease has not been shown. There is evidence that cardiac patients cut down on their mileage considerably and reduce long-distance driving, driving in bad weather, driving alone, driving after dark, and driving in heavy traffic (Waller, 1981, 1987; Potvin, Guibert, Philibert, and Loiselle, 1990, Potvin, Guibert, and Loiselle, 1993: in Janke, 1994). Potvin, Guibert and Loiselle, 1993 (in Janke, 1994) note methodological problems in the studies they review, including low occurrence of crashes, difficulty in defining a suitable comparison group, classification difficulties (e.g., healthy controls may develop a cardiovascular condition in the course of the study, unknown to the experimenter), and uncontrolled variations in exposure to crash risk.

Diller et al. (*in press*) also analyzed citation rates and crash rates (all crashes and at-fault crashes) for 2,615 drivers with pulmonary conditions (including pulmonary disease or symptoms, impaired function, or severe respiratory difficulties) who had unrestricted licenses, and 244 drivers with pulmonary conditions and whose licenses were restricted. Drivers with multiple medical conditions were excluded from these analyses, which significantly reduced the number of drivers with only pulmonary conditions, whose operating privileges were restricted in some way. Their crash and citation rates were compared to a control group of drivers (selected randomly from all licensed drivers without medical conditions), matched on age, gender, and county of residence. As mentioned earlier, different control groups were established for restricted drivers and for unrestricted drivers with this medical condition.

Rates for drivers with pulmonary conditions and their control groups per 10,000 license days for citations, for all crashes, and for at-fault crashes, are presented in the following table, by license status (not restricted and restricted). Also presented are the relative risk ratios (case rate/control rate).

The relative risk ratios for all events between drivers with pulmonary conditions who drove with *unrestricted* licenses and their matched controls are significantly different (at alpha = 0.05). This finding suggests that drivers who have pulmonary conditions and unrestricted driving privileges have a higher risk of crash events than drivers in the general population who do not report medical conditions. For citations, pulmonary conditions appear to have a protective effect, possibly due to self-restriction (a factor which was not taken into account in the data collection), or to other differing population characteristics. However, the differences between drivers with medical conditions who were *restricted* in their driving privileges and their corresponding control groups were not significantly different.

Utah Rates and Relative Risk Ratios of Adverse Driving Events Per 10,000 Days of Driving			
License Status	**Adverse Driving Event**		
Not Restricted	**Citation**	**All Crashes**	**At-Fault Crashes**
Drivers with Pulmonary Conditions	2.24	1.52	0.85
Matched Controls	2.54	1.22	0.63
Rate Ratio	0.88**	1.25*	1.35*
Restricted	**Citation**	**All Crashes**	**At-Fault Crashes**
Drivers with Pulmonary Conditions	0.69	1.04	1.04
Matched Controls	1.39	1.11	0.64
Rate Ratio	0.50	0.93	1.63

* The rate for drivers with pulmonary conditions is significantly higher than the rate for their matched controls who have no reported medical conditions.
** The rate for drivers with pulmonary conditions is significantly lower than the rate for their matched controls who have no reported medical conditions.

Conclusions and Preliminary Recommendations:

The correlation between irregular heartbeat and crashes in the elderly was significant in a study that used self-reporting both of crash occurrence and of medical conditions. Another study found that drivers with cardiovascular conditions and drivers with pulmonary conditions who drive without restrictions on their licenses have a significantly higher citation and crash risk than drivers without these medical conditions. Restricted drivers in Utah have either a 3-month interval for review (cardiovascular conditions) or a 6-month interval for review (pulmonary conditions), and generally have the following restrictions placed on their driving privileges: speed limitations (profile level 6); speed and area limitations (level 7); speed, area, and time of day (level 8); and speed, area, time of day, and must be accompanied by licensed passenger (levels 9-10). Thus, it appears that restricting the driving privileges of persons with cardiovascular conditions and those with pulmonary conditions reduces citation and crash risk to the level of risk posed by the general population without these medical conditions. One limitation to the methodology in the Diller et al. study was that no actual measure of exposure was collected; therefore, it is unknown to what degree the restricted drivers (whose impairments were more severe than unrestricted drivers) reduced their own risk by lowering their exposure.

Larsen et al, 1994 (in Janke, 1994) recommended that doctors should advise their arrhythmia patients not to drive for 7 months after discharge from the hospital.

References:

- Diller, Cook, Leonard, Reading, Dean, and Vernon (*in press*)
- Janke (1994)
- Stewart, Moore, Marks, May, and Hale (1993)

IA1(h). Feet or Legs Cold on Exposure to Cold

Summary:

Stewart, Moore, Marks, May, and Hale (1993) studied 1,431 participants in the Florida Geriatric Research Program (Dunedin, FL), for whom 8 years of longitudinal data were available (1975-1987). Subjects included 874 females (mean age = 77.8 years, s.d. = 4.6) and 596 males (mean age = 78.6 years, s.d. =4.5).

The dependent variable was self-reported crashes. Independent variables included self-reported information on 31 diseases, 26 symptoms, 34 clinical and laboratory values, number of drugs reported, number of symptoms reported, number of diseases reported.

Subjects completed a questionnaire containing 180 questions and a form listing prescribed and nonprescribed medications used on a regular basis. Biochemical profile includes hemogram, red cell indices, and SMAC-23. Clinical assessment includes electrocardiogram and carotid auscultation, plus MMSE and Beck Depression Inventory at 8th visit.

The correlation between feet or legs cold upon exposure to cold and traffic crashes is significant (p=.0074, odds ratio = 1.82, 95% confidence interval = 1.17 - 2.82).

Conclusions/Preliminary Recommendations:

One study has found that older drivers who indicate that their feet/legs feel cold upon exposure to cold are at increased crash risk. Professionals conducting geriatric assessments should include a question about these symptoms as part of history-taking, and important data may be obtained if DMVs included a similar question on license renewal applications for tracking of associations between feet/legs becoming cold upon exposure to cold and automobile crashes.

References:

- Stewart, Moore, Marks, May, and Hale (1993)

Summary:

Stewart, Moore, Marks, May, and Hale (1993) studied 1,431 participants in the Florida Geriatric Research Program (Dunedin, FL), for whom 8 years of longitudinal data were available (1975-1987). Subjects included 874 females (mean age = 77.8 years, s.d. = 4.6) and 596 males (mean age = 78.6 years, s.d. =4.5).

The dependent variable was self-reported crashes. Independent variables included self-reported information on 31 diseases, 26 symptoms, 34 clinical and laboratory values, number of drugs reported, number of symptoms reported, number of diseases reported. Subjects completed a questionnaire containing 180 questions and a form listing prescribed and nonprescribed medications used on a regular basis. Biochemical profile includes hemogram, red cell indices, and SMAC-23. Clinical assessment includes electrocardiogram and carotid auscultation, plus MMSE and Beck Depression Inventory at 8th visit.

Bursitis is an inflammation of a bursa, especially of the shoulder or elbow. Bursae are closed synovial spaces located at the site of friction between skin, ligaments, tendons, muscles and bones; the most common site of bursitis is in the shoulder. Bursitis may cause severe pain and limitation of mobility. The correlation between bursitis and traffic crashes was significant (p=.0005, odds ratio = 2.18, 95% confidence interval = 1.41 - 3.38).

In the recently completed pre-pilot study conducted in Salisbury, Maryland for the NHTSA "Model Driver Screening and Evaluation Program" project, the present *Notebook* authors found that self-reported bursitis was related to crashing for females only (Odds Ratio = 1.57). Subjects ranged in age from 68 to 89 (mean age = 75.7); 131 of the 363 subjects were involved in at least 1 crash in the previous 6-year period (1991-1997). Only 13 of the 146 females who responded to this health question reported having bursitis.

Conclusions/Preliminary Recommendations:

Older drivers with bursitis are at increased crash risk. Professionals conducting geriatric assessments should include a question about bursitis as part of history-taking (and note its presence during the assessment), and DMVs should include a similar question on license renewal applications for tracking of associations between bursitis and automobile crashes.

References:

• Stewart, Moore, Marks, May, and Hale (1993)

IA1(j). Renal Disease

Protein in Urine

Summary:

Stewart, Moore, Marks, May, and Hale (1993) studied 1,431 participants in the Florida Geriatric Research Program (Dunedin, FL), for whom 8 years of longitudinal data were available (1975-1987). Subjects included 874 females (mean age = 77.8 years, s.d. = 4.6) and 596 males (mean age = 78.6 years, s.d. =4.5).

The dependent variable was self-reported crashes. Independent variables included self-reported information on 31 diseases, 26 symptoms, 34 clinical and laboratory values, number of drugs reported, number of symptoms reported, number of diseases reported.

Subjects completed a questionnaire containing 180 questions and a form listing prescribed and nonprescribed medications used on a regular basis. Biochemical profile includes hemogram, red cell indices, and SMAC-23. Clinical assessment includes electrocardiogram and carotid auscultation, plus MMSE and Beck Depression Inventory at 8th visit.

The correlation between protein in the urine and traffic crashes was significant (p=.0021, odds ratio = 1.84, 95% confidence interval = 1.25 - 2.72).

Conclusions/Preliminary Recommendations:

Increased urinary excretion of protein is a common sign of renal disease, and is significantly related to older driver crashes. Urinalysis should be a part of a physical examination for older persons.

References:

• Stewart, Moore, Marks, May, and Hale (1993)

IA1(k). Seizure Disorders

Summary:

Hu, Young, and Lu (1983) state that epilepsy may cause sudden loss of consciousness, muscular convulsions or spasms, or it may only cause a slight temporary change in a person's conscious awareness. They report that although the actual number of Americans who have epilepsy is unknown, the National Center for Health Statistics (NCHS, 1989) estimated a rate of 3.8 in every 1,000 persons.

Diller, Cook, Leonard, Reading, Dean, and Vernon (*in press*) analyzed citation rates and crash rates (all crashes and at-fault crashes) for 2,620 drivers with epilepsy who had unrestricted licenses and 775 drivers with epilepsy with restricted licenses [see *Notebook* section IA1(m) for further details regarding methodology]. These groups were not mutually exclusive, as during the study period, a number of drivers may have fluctuated between restricted and nonrestricted licensing privileges. Their crash and citation rates were compared to a control group of drivers (selected randomly from all licensed drivers without medical conditions), matched on age, gender, and county of residence. Accordingly, different control groups were established for restricted drivers and for unrestricted drivers with this medical condition.

This category of medical condition (epilepsy and other episodic conditions) is defined as follows in Utah's *Guidelines and Standards for Health Care Professionals*), included as Appendix A in Diller et al.: "Epilepsy includes any recurrent loss of consciousness or conscious control arising from intermittent changes in brain function. Because of the similarity of consequences, other disorders affecting consciousness or control such as syncope, cataplexy, narcolepsy, hypoglycemia, episodic vertigo interfering with function, etc., have been included in this section, to be considered in a similar fashion."

Rates for drivers with epilepsy and their control groups per 10,000 license days for citations, for all crashes, and for at-fault crashes, are presented in the following table, by license status (not restricted and restricted). Also presented are the relative risk ratios (case rate/control rate).

Utah Rates and Relative Risk Ratios of Adverse Driving Events Per 10,000 Days of Driving			
License Status	**Adverse Driving Event**		
Not Restricted	**Citation**	**All Crashes**	**At-Fault Crashes**
Drivers with Epilepsy	4.06	2.69	1.76
Matched Controls	3.96	1.49	0.84
Rate Ratio	1.03	1.81*	2.11*
Restricted	**Citation**	**All Crashes**	**At-Fault Crashes**
Drivers with Epilepsy	4.13	2.67	2.40
Matched Controls	3.94	1.73	0.97
Rate Ratio	1.05	1.55*	2.47*

* The rate for drivers with epilepsy is significantly higher than the rate for their matched controls who have no reported medical conditions.

Drivers with epilepsy (both those with restrictions and those without restrictions) have a higher risk of crashing than their matched control groups.

Conclusions/Preliminary Recommendations:

The data analysis conducted by Diller et al. (*in press*) indicates that licensed drivers with epilepsy/episodic conditions (both those who have restricted operating privileges and those without license restrictions) are at a significantly higher risk of a crash than the general population of drivers.

The American Academy of Neurology, American Epilepsy Society, and Epilepsy Foundation of America (1994) have drafted consensus statements on driver licensing and epilepsy, based on a Consensus Workshop held in 1991. These groups agree that a seizure-free interval should be stated, and that 3 months is preferred, starting from the date of the seizure. Both favorable and unfavorable modifiers could alter the interval. The groups also agree that "restricted licenses may be appropriate under certain circumstances in which such restrictions will allow driving with an acceptable risk of seizure occurrence." They further state that physician and/or medical advisory board input should be obtained for individualized determination of the terms of each restricted license. There is unanimous agreement among the groups that physicians should not be required to report their patients to the DMV; they should, however, advise patients about the medical risks involved, about DMV requirements, about self-reporting obligations, and should tell the patient the physician's own recommendation about driving. The patient should be responsible to self-report the condition initially to the DMV and to report recurrent seizures. However, the group stated that if the physician believes the patient has not self-reported and is endangering the public by driving, the physician should have the right to report the patient, with immunity. The participants of the Consensus Workshop determined that medical criteria for licensing are best handled in the form of medical guidelines or regulations. Sample statutory language is provided in the document; many are based on Wisconsin Statutes.

References:

- American Academy of Neurology, American Epilepsy Society, and Epilepsy Foundation of America (1994)
- Diller, Cook, Leonard, Reading, Dean, and Vernon (*in press*)
- Hu, Young, and Lu (1993)
- National Center for Health Statistics (1989)

IA1(l). Back Pain

Summary:

Hu, Trumble, Foley, Eberhard, and Wallace (1998) conducted a panel data analysis of the remaining eligible drivers in 1993 (507 female drivers and 375 male drivers) who participated in the Iowa 65+ Rural Health Study from 1981-1993. The study included all noninstitutionalized individuals in two counties age 65+. The resulting sample was 6,553 female person-years and 5,414 male person-years. The survey data were obtained from in-home and telephone interviews, and included demographic attributes, onset of medical conditions, symptoms and ailments, functional status, physical functioning, physical activities, vision, drug use, cognitive abilities, and annual miles driven. The survey data were linked to crash files maintained by the Iowa DMV. The association between crash risk and persistent back pain was significant for combined gender (6,553 female person-years and 5,414 male person-years). The risk ratios (RR) are as follows, for the specified mileage levels: RR=1.25 for 3,000; 6,000, and 12,000 miles driven annually; RR = 1.54 for 9,000 and 18,000 annual miles.

Foley, Wallace, and Eberhard (1995) interviewed 1,791 of the Rural Health Study participants in 1989. Between the period of 1985 and 1989, 206 drivers were involved in 245 state-recorded crashes. They found that a large proportion of drivers with existing back pain or an episode of back pain in the previous year (42%) had a significantly increased risk of crashing. Interestingly, none of the other disease histories obtained were related to crashing (heart disease, cancer, stroke, hypertension, diabetes, asthma, arthritis, osteoporosis, and emphysema). The crash involvement rate (number of drivers involved in crashes per 1,000 estimated person-years of driving) for older drivers with back pain in the past 12 months was 33. The relative risk was 1.5, with a confidence interval ranging from 1.2 to 2.0.

Conclusions/Preliminary Recommendations:

Foley et al. (1995) stated that the association of back pain with crash risk corroborates concern over the impact of musculoskeletal dysfunction on driving. Reasons for this association may include decreased motor function in driving tasks because of pain or underlying neurologic deficit in the lower extremities, as well as a dysfunction resulting from more generalized arthritic conditions.

Since the presence of self-reported arthritis did not correlate with crashes it seems reasonable to conclude that license renewal forms should specifically cite symptoms, as opposed to diagnoses alone, to query drivers about health risks that may be related to crashes.

References:

- Hu, Trumble, Foley, Eberhard, and Wallace (1998)
- Foley, Wallace, and Eberhard (1995)

IA1(m). Overview: Comparative Risk Tables

Summary:

Tables permitting comparison of the risk associated with each of the conditions addressed in this section are presented below. First, the results of a recent and ongoing analysis of Utah's medical conditions database are presented, summarized in the form of relative risk values for all of the included conditions compared to matched control groups of drivers (Diller, Cook, Leonard, Reading, Dean, and Vernon, *in press*). These values are presented on page 36; a synopsis of the methodology used to derive these values is also given. Next, data from Washington State are presented in a table on page 37, along with a description of the study methodology (Salzberg and Moffat, 1998). Immediately following the relative risk table for the Utah and Washington data is another table labeled "Risk Ratios for Identified Medical Conditions." This table, shown on page 38, extracts risk ratios and odds ratios for crash involvement for various conditions as they could be extracted from the studies cited in each area, i.e., *Notebook* sections IA1(a) - IA1(l).

In Utah, driver license applicants must complete a general questionnaire designed to identify medical conditions related to physical, mental, and emotional health. Applicants who report a medical condition are placed into at least one of 12 functional ability categories (diabetes mellitus and other metabolic conditions; cardiovascular; pulmonary; neurologic; epilepsy and other episodic conditions; learning/memory/communications; psychiatric or emotional conditions; alcohol and other drugs; visual acuity; musculoskeletal abnormalities/chronic medical debilities; functional motor ability; and hearing) and further by functional ability level (1-12) within the functional category. Passenger vehicle drivers in functional ability profile levels 1-5 may drive without restrictions (speed, area, time of day, licensed passenger). Although severity of impairments increase with increases in assigned functional profile level, drivers in levels 4 and 5 are deemed safe to drive without license restriction, but may be required for reexam/medical review at intervals shorter than the standard renewal period, depending on their functional (medical) category. Drivers assigned to functional ability profile level 6 have a speed restriction placed on their licenses. A profile level of 7 indicates that the driving risk posed by the functional impairment justifies a speed and area limitation. A profile level of 8 indicates a speed, area, and time of day limitation. Drivers in profile level 9 must be accompanied by a licensed driver, and may have speed, area, and/or time of day limitations as recommended by their health care professional. Levels 10 and 11 are associated with special driving limitations recommended by health care providers or the Director of Licensing. A person assigned to level 12 may not drive until ability improves and functional ability can be assigned at a lower level.

Utah's *Guidelines and Standards for Health Care Professionals* (provided as Appendix A to Diller et al., *in press*) contains descriptions of basic concepts, definitions, and ground rules for each functional ability category. A brief description of conditions, symptoms, impairments, etc., that are subsumed under each category is presented next.

Diabetes Mellitus and Other Metabolic Conditions: Disturbances in the function of the endocrine glands cause many symptoms from generalized asthenia, muscle weakness, and spasm or tetany to sudden episodes of dizziness or unconsciousness. This category includes diabetes mellitus, parathyroid disorders, thyroid disorders, and hypoglycemia.

Cardiovascular: Cardiovascular disease may affect a driver's ability in a variety of ways, and therefore profile guidelines and standards are provided for four of the most common circumstances: general heart disease; rhythm; after myocardial infarction or cardiac surgery; and hypertension. The 12 profile levels are determined by the history and severity of these four circumstances. General heart disease, for example, is divided into four classes based on the functional classification of the American Heart Association, with Class I containing patients with heart disease but with no limitations of physical ability (ordinary physical activity causes no undue dyspnea, anginal pain, fatigue, or palpitation) and Class IV containing patients with inability to carry on any physical activity without discomfort (symptoms of cardiac insufficiency or of the anginal syndrome may be present, even at rest, and are intensified by activity).

Pulmonary: Although impaired pulmonary function is seldom the cause of sudden death, it may seriously affect operators of vehicles in the following ways: (1) sudden severe coughing while driving may result in a crash; (2) cough syncope may occur while driving; (3) impaired cerebral oxygenation caused by impaired pulmonary function may result in mental confusion and/or impaired judgment. In assessing the severity of pulmonary impairment, effort is made to limit the tests to those found in most medical offices, although occasionally, more sophisticated studies may be needed (e.g., arterial blood gases, maximal voluntary ventilation, etc.). The basic function tests (FVC and FEV) are the principal guidelines and standards currently recommended.

Neurologic: A wide variety of neurologic conditions may affect driving safety, that includes (but is not limited to) strokes; head injuries; Cerebral Palsy; Multiple Sclerosis; Parkinson's Disease; progressive conditions such as muscular atrophies and dystrophies; myasthenia gravis; and other spinal cord and brain diseases. The common element in all of these is the disturbance of sensory, motor, or coordinating functions sufficient to effect driving.

Epilepsy and Other Episodic Conditions: Epilepsy includes any recurrent loss of consciousness or conscious control arising from intermittent changes in brain function. Because of the similarity of consequences, other disorders affecting consciousness or control such as syncope, cataplexy, narcolepsy, hypoglycemia, episodic vertigo interfering with function, etc., have been included in this section, to be considered in a similar fashion.

Learning, Memory, and Communication: This broad category includes retardation; learning problems related to general intelligence; impairments relating to the recovery of head injuries; closed head injuries (resulting in diffuse cognitive deficits such as impaired judgment, impulsiveness, distractibility, impaired attention, neglect, slowed reaction time, or impaired cognitive endurance); Alzheimer's Disease; aphasia, and inadequate language skills.

Psychiatric or Emotional Conditions: Psychiatric history and medications determine the functional levels under this category. There are a variety of behavioral conditions, extremes of mood, and impairments in thinking associated with psychiatric disorders which may correlate with accident proneness or driver risk. These include: inattentiveness which may accompany even minor disturbances; impulsivity, explosive anger, and impaired social judgment characteristic of personality disorders, especially antisocial personality; and suicidality, perceptual distortions, psychomotor retardation or frank irrationality in addition to the previously described symptoms which are common features of major psychiatric illnesses such as schizophrenia, major depressive disorder, bipolar (manic depressive) disorder, and organic brain syndromes.

Alcohol and Other Drugs: This category includes chronic use of alcohol; use of mood altering and hallucinogenic drugs (amphetamines, LSD, antihistamines, barbiturates, benzodiazepines, and anti-psychotics such as phenothiazine, haloperidol, and sleeping pills of all types); marijuana; and excessive or inappropriate use of drugs for the purpose of intoxication or stimulation (including prescription, nonprescription, legal, and illegal drugs). Users of alcohol and other drugs are well known for their tendency to under-report amounts used, and there is wide individual variation in the effects of such substances; therefore, the only valid basis for evaluating a person's probable safety as a driver is careful appraisal of the person's history including, but not limited to, the past effect on driving.

Visual Acuity: Guidelines for placing drivers in functional ability categories are based on acuity and visual fields. Correction must be less than 10 diopters to qualify for profile level 1 (20/25 vision in each eye; monocular visual fields 120° in each eye; binocular visual fields 70° to the right and to the left in the horizontal meridian). Other eye conditions that require special consideration, but which have no set standards, include: color vision; dark adaptation; heterophoria; stereopsis; monocular vision; refractive states; telescopic lenses; and chronic and recurrent disease.

Musculoskeletal Abnormality or Chronic Medical Debility: Includes chronic conditions not listed elsewhere, including osteoporosis, HIV, amputations, congenital abnormalities (unless compensatory devices are used as outlined in the Functional Motor Ability Category), that according to medical judgment may be of primary importance in determining limitations on driving.

Functional Motor Ability: Evaluations of this ability consist of an appraisal of an individual's ability to operate a vehicle with reference to muscular strength, coordination, range of motion of joints, spinal movement and stability, amputations or the absence of body parts, and/or other abnormalities affecting motor skill. The health care professional should indicate in their best judgment a provisional profile level without and with compensating devices. This will help the driver examiner who tests the applicant in the vehicle using compensatory devices, and makes the final determination of the functional motor ability profile.

Hearing: No hearing requirements have been formulated for drivers of private vehicles. For Meniere's Disease, see Episodic Disorders.

Recently, Diller et al. (*in press*) evaluated the medical conditions program by comparing the crash and citation rates per eligible licensed days for restricted and unrestricted drivers who had single medical conditions, by functional ability category (levels 3-5 vs 6-11) to the rates of control drivers (drivers licensed without a medical condition) matched on age group, gender, and county of residence. The relative risk ratios are shown in the table presented on page 36.

Salzberg and Moffat (1998) evaluated the Washington State Department of Licensing's Special Examination Program. A "special exam" includes an in-depth interview, and an extended or specialized on-road drive test, typically conducted near the driver's residence. The requirements of the "special" on-road exam are dependant of the Licensing Service Representative's (LSRs) assessment of the driver during the interview. The "special" drive test may be limited to specific roads or routes (e.g., form home to the doctor's office). Drivers come to the "special exam" program by being referred to the Department by law enforcement, physicians, family, or by LSRs who observe an impairment or disability when the driver comes in for license renewal. These drivers must undergo and pass a drive test (a "re-exam") and possibly a knowledge test. Drivers who fail the "re-exam" or those with medical/vision certificates who do not meet Department of Licensing standards have their license canceled. However, they may request a "special exam" that more completely assesses their driving ability. The most common outcome of the "special exam" is to impose driving restrictions, such as time of day (e.g., 10 a.m. to 3 p.m., daylight only); area (e.g., within an x-mile radius of residence, within city limits only, no freeway driving); and equipment (e.g., corrective lenses, hand controls,

outside vehicle mirrors, power steering, power brakes). In some cases, drivers who retain their licenses must submit periodic medical or visual reports.
The study included 380 older drivers who were required to undergo a "special examination" (and passed) in 1994, and 449 control drivers matched on age, gender, and city of residence. Sixty-nine drivers failed the "special exam" and are not included in this analysis, because they have no post-exam driving exposure (97 percent had their licenses canceled and 3 percent voluntarily surrendered their licenses). Control group drivers averaged 75.6 years of age, and drivers who passed the "special exam" averaged 75.2 years of age. Documents retrieved to describe the medical conditions and driving performance of the subjects included medical certificates, vision certificates, driver license status and restrictions, and traffic violations and convictions. The most common reasons that drivers were given "special exams" were because of failing a re-exam (36 percent), a vision certificate being filed with the Department of Licensing (30 percent), or a medical certificate being filed (15 percent). Law enforcement accounted for 4 percent of the referrals, physicians for 6 percent, Licensing Service Representative for 7 percent, and family/friend/self for 3 percent of the referrals.

The following visual and medical conditions were represented among the "special exam" group: cataracts, diabetic retinopathy, macular degeneration, diabetes mellitus, cardiovascular conditions, neurological conditions, psychiatric conditions, and stroke/cerebral vascular conditions. The primary medical condition for a subject listed on the Department of Licensing record is the condition that was associated with a particular subject for this study.

Crash and violation records of drivers who underwent the "special exam" were compared with that of the control group, for a period of 1.75 years before the exam, and 3.25 years after the exam (a 5-year period). Since control group drivers did not undergo a special exam (by definition), an arbitrary date that was the same as the date for the matched exam group drivers was chosen to measure driving performance. Crash and violation rates were calculated to describe the number of incidents per 100 subjects per year, since the pre- and post-observation periods differed in length. For comparison purposes, in Washington State during 1996 there were 140,215 total collisions and 4,037,534 licensed drivers, yielding a rate of 3.47 collisions per 100 licensed drivers in a one-year period. Driving records for the "special exam" (passing) and control groups are shown below.

Washington State Special Exam Program Analysis

Group	Pre-Exam Collision Rate	Post-Exam Collision Rate	Pre-Exam Violation Rate	Post-Exam Violation Rate
Control (n=449)	3.8180	1.1650	7.5087	2.2614
Passed Special-Exam (n=380)	7.0677	3.2389	13.3835	5.2632

Control group drivers (who did not receive exams and consequent restrictions) showed reductions in their crash and violation rates over the 5-year period. The authors explain this phenomenon by noting that a normal trend exists among older drivers that as they age, they tend to reduce their driving, or to stop altogether. Although the exam group drivers also showed a reduction in crash and violation rate after passing the exam and receiving restrictions, their rates were significantly higher than the control group during the post-exam period. Comparing the post-exam collision rates of the "special exam" drivers (3.24 per 100 licensed drivers) with collision rates for the entire licensed population in

Washington State over a 1-year period (3.47 per 100 licensed drivers) shows that drivers who pass special exams and receive driving restrictions are no larger a threat to the public than the population of drivers across all age groups. Rates for control- and exam-group drivers by medical condition are presented on page 37.

A discussion of the results found for drivers with neurological conditions and stroke/cerebral vascular conditions is provided here, instead of in a separate sub-section for several reasons. First, the sample sizes are rather small (~20). Second, the type of neurological condition is not specified (e.g., epilepsy, cerebral palsy, muscular dystrophy, poliomyelitis, multiple sclerosis, Parkinson's Disease, myasthenia gravis, tumors of the brain, etc.). Third, there is not a separate section under epidemiology in this *Notebook* that deals with strokes, because, depending on what area of the brain is affected, a stroke could have minimal, moderate, or severe effects that are either temporary or permanent. Also, a stroke may affect any of the following capabilities needed for driving: vision, perception, physical functionality, reaction time, and cognitive skills needed for decision making and judgment.

What is interesting about the drivers with neurological and stroke/cerebral vascular conditions in Salzberg and Moffat's study is that their post-exam crash and violation rates remained among the highest of all exam-group drivers with medical conditions, and these rates were well above (2.6 to 3.8 times) the post-exam rates of the control group of older drivers. In addition, drivers with strokes/cerebral vascular conditions had a post-exam crash rate that was 1.27 times that of the population of licensed drivers in the State of Washington. Therefore, restricting the licenses of drivers with these medical conditions was not sufficient to reduce their crash risk to the level posed by drivers across all age groups, nor did these drivers appear to reduce their exposure to the level of their age peers in the control group, who showed a reduction in crash risk over the 5-year period without any intervention. It is possible that drivers with these medical conditions are unaware of the risks they pose while driving, and demonstrate poor judgment and impulse control leading to adverse driving events. The number of incidents per year per 100 drivers in each group is presented below.

Washington State Special Exam Program Analysis				
Group	**Pre-Exam Collision Rate**	**Post-Exam Collision Rate**	**Pre-Exam Violation Rate**	**Post-Exam Violation Rate**
Control (n=449)	3.8180	1.1650	7.5087	2.2614
Special Exam Neurological Conditions (n=20)	8.5714	3.0769	17.1429	7.6923
Special Exam Stroke/Cerebral Vascular Conditions (n=21)	5.4422	4.3956	8.1633	7.3260

Note: For comparison purposes, in Washington State during 1996, there were 140,215 total collisions and 4,037,543 licensed drivers, yielding a rate of 3.47 collisions per 100 licensed drivers during this one-year period.

Conclusions/Preliminary Recommendations:

Study findings from Diller et al. are currently in press; it is expected that a report will be submitted to NHTSA later in 1999. Based on the preliminary findings cited in this *Notebook*, the Utah report is expected to present evidence to indicate which medical conditions are associated with a higher rate of at-fault crashes and citations for licensed drivers who have full privileges than for the general population of drivers. With this information, health care professionals will be better equipped to counsel their patients who have medical conditions about the effects of their conditions on driving, and will have the knowledge to support suggestions about potential restrictions on when and where they should drive to remain as safe as possible. Health care professionals should also emphasize to their patients the importance of informing the DMV of medical conditions that effect driving performance, for their own safety.

The following caveats regarding epidemiology data collection methods also apply. First, eligible driving days was the exposure measure; actual or estimated miles driven data were not obtained in this analysis. Next, the results are dependent upon the drivers who reported their medical conditions during the study period and not on all drivers who have medical conditions. The proportion of drivers with medical conditions who report them to the Utah Driver License Division is unknown. Also, the extent to which health care professionals assign functional ability levels according to the Medical Conditions program specifications is unknown. For example, a driver who has been assigned a functional ability rating that requires a restriction may shop around for a professional who will assign a more favorable rating, thus allowing him or her to drive unrestricted. Finally, the compliance rates for restricted drivers were not obtained at the time of crash or citation, nor did the analysis take into account the number of drivers who are repeat offenders.

Notwithstanding these methodological limitations, this pending publication represents the most comprehensive analysis to date of the relationship between type and severity of medical conditions and associated risks of adverse driving events.

Based on the Salzberg and Moffat (1998) findings, it appears that the process used by Washington State to identify older drivers who are at an increased crash risk (e.g., referral by physicians, law enforcement, family/friends, and licensing personnel) does in fact detect individuals who have significantly poorer driving records than their age-matched peers. Also, the requirement to undergo a re-exam in a familiar area and the consequent tailoring of restrictions serves to (generally) lower their crash risk to a level that does not pose any more of a safety hazard to the public than that of the general driving population. But, the program has differential effects for differing medical conditions. Positive outcomes are shown for drivers with diabetic retinopathy, cataracts, cardiovascular conditions and diabetes mellitus. On the other hand, licensing restrictions did not lower the crash risk of drivers with macular degeneration; and, for drivers with neurological, psychiatric, or stroke/cerebral vascular conditions, the obtained reductions in crash risk still left these drivers at a 3- to 4-fold greater risk level when compared to the control group drivers. Finally, drivers with psychiatric and stroke/cerebral vascular conditions continued to have a crash risk higher than that of the overall population of licensed drivers.

Two points should be considered in generalizing the results of the Washington State study to other populations. First, there are no actual measures of driving exposure. Second, comparisons are made between drivers with certain medical conditions (a subset of the special exam group) and the control group *as a whole*. Since the overall age distribution for all study subjects was 12.5 percent under age 60, 40.4 percent between ages 60 and 80, and 47.3 percent over age 80, and since the incidence of many medical conditions increases as age increases, it is possible that the control group of drivers could be younger than any given subset of drivers who were selected for the analysis because they presented a particular medical condition.

References:

- Diller, Cook, Leonard, Reading, Dean, and Vernon (*in press*)
- Foley, Wallace, and Eberhard (1995)
- Hemmelgarn, Suissa, Huang, Boivin, and Pinard (1997)
- Hu, Trumble, Foley, Eberhard, and Wallace (1998)
- Koepsell, Wolf, McCloskey et al. (1994)
- Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)
- Owsley, Allman, Ball, and Smoot (1998)
- Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998)
- Owsley, McGwin, and Ball (1998)
- Owsley, Stalvey, Wells, and Sloane (1999)
- Salzberg and Moffat (1998)
- Sims, Owsley, Allman, Ball and Smoot (1998)
- Stewart, Moore, Marks, May, and Hale (1993)

Preliminary Analysis of Drivers with Medical Conditions Compared to Control Group Drivers, Presented as Relative Risk (per 10,000 eligible licensed days) for Specified Driving Events (Citation, All Crashes, At-Fault Crashes).

Excerpted from: Diller, E., Cook, L., Leonard, D., Reading, J., Dean, J.M., and Vernon, D (*in press*). *Evaluating Drivers with Medical Conditions in Utah, 1992-1996*. NHTSA Tech. Report, Contract DTNH22-96-H-59017. *Preliminary Report, Utah CODES Project.*

Functional Ability Category	License Restriction Status and Number of Drivers in Each Group: Not Restricted (FA Levels 3,4,5) vs Restricted (FA Levels 6-11)	Citations	All Crashes	At-Fault Crashes
Diabetes & Other Metabolic Conditions	Not Restricted (n=10,069)	1.04	1.41*	1.58*
	Restricted (n=358)	1.40	1.43	1.79
Cardiovascular	Not Restricted (n=18,990)	0.77**	1.14*	1.15*
	Restricted (n=160)	1.57	1.61	1.72
Pulmonary	Not Restricted (n=2,615)	0.88**	1.25*	1.35*
	Restricted (n=244)	0.50	0.93	1.63
Neurologic	Not Restricted (n=887)	0.93	1.67*	2.27*
	Restricted (n=194)	0.77	1.40	1.51
Epilepsy & Other Episodic Conditions	Not Restricted (n=2,620)	1.03	1.81*	2.11*
	Restricted (n=775)	1.05	1.55*	2.47*
Learning, Memory, & Communication	Not Restricted (n=107)	1.31	2.49*	3.57*
	Restricted (n=6)	11.76*	zero rate	zero rate
Psychiatric or Emotional Conditions	Not Restricted (n=6,763)	1.24*	1.65*	1.96*
	Restricted (n=305)	0.83	1.97*	2.97*
Alcohol & Other Drugs	Not Restricted (n=143)	2.37*	1.88*	2.33*
	Restricted (n=24)	5.83*	4.21*	5.75*
Visual Acuity	Not Restricted (n=10,363)	1.37*	1.49*	1.70*
	Restricted (n=1,535)	1.37*	1.39*	1.72*
Musculoskeletal Abnormality or Chronic Medical Debility	Not Restricted (n=370)	1.23	1.66*	1.92*
	Restricted (n=32)	zero rate	4.25	10.63*
Functional Motor Impairment	Not Restricted (n=214)	1.42*	1.18	1.87*
	Restricted (n=13)	zero rate	zero rate	zero rate

* Differences in rates between medical conditions and control groups are statistically significant, with higher rates for medical conditions group.

* *Differences in rates between medical conditions and control groups are statistically significant, with higher rates for control group.

zero rate: there were no adverse driving events in one of the driver groups, so a rate could not be calculated.

Driving Records (number of incidents per 100 drivers per year) for Control Group Drivers and Drivers with Medical Conditions Who Were Required to Take a Special Driving Exam.
(Excerpted from: Salzberg and Moffat, 1998: Washington State Department of Licensing Special Exam Program - An Evaluation.)

Group	Pre-Exam Collision Rate	Post-Exam Collision Rate	Pre-Exam Violation Rate	Post-Exam Violation Rate
Control (n=449)	3.8180	1.1650	7.5087	2.2614
All Conditions: Failed Exam (n=69)	12.4224	.0000 (license canceled)	15.7350	.0000 (license canceled)
All Conditions: Passed Exam (n=380)	7.0677	3.2389	13.3835	5.2632
Cataracts (passed exam: n=45)	5.0794	2.0513	15.2381	2.0513
Diabetic Retinopathy (passed exam: n=14)	12.2449	.0000	8.1633	2.1978
Macular Degeneration (passed exam: n=71)	3.2193	3.4670	6.4386	5.2004
Diabetes Mellitus (passed exam: n=27)	6.3492	1.1396	8.4656	2.2792
Cardiovascular Conditions (passed exam: n=47)	7.2948	1.9640	20.6687	2.6187
Neurological Conditions (passed exam: 20)	8.5714	3.0769	17.1429	7.6923
Psychiatric Conditions (passed exam: n=46)	12.4224	4.6823	23.6025	8.0268
Stroke/Cerebral Vascular Conditions (passed exam: n=21)	5.4422	4.3956	8.1633	7.3260

Note: For comparison purposes, in Washington State during 1996, there were 140,215 total collisions and 4,037,543 licensed drivers, yielding a rate of 3.47 collisions per 100 licensed drivers during this one-year period.

Risk Ratios for Identified Medical Conditions [ref. *Notebook* sections IA1(a) through IA1(l)]

Condition	Study	Results
Cataracts	Owsley, Stalvey, Wells, and Sloane (1999)	Significant association between cataract and crash involvement: • Adjusted for driving exposure...RR=2.48, 95% CI=1.0-6.14* • Adjusted for impaired health...RR=2.49, 95% CI=1.0-6.27
Diabetic Retinopathy/ Diabetes	Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998) Koepsell, Wolf, McCloskey et al. (1994)	Crash risk 5 times greater with diagnosis of diabetic retinopathy.... 95% CI = 1.13-21.8 Injury-crash risk odds ratios (OR) for older drivers = 2.6 for diabetes mellitus (any); 5.8 for diabetics treated with insulin; 3.1 for diabetics treated with oral hypoglycemic agents; 8.0 for diabetes and coronary heart disease together.
Glaucoma	Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998)	Significant association between glaucoma and crash risk....RR=5.20, 95% CI = 1.19-22.72 • Males- RR=9.81 • Females-RR=5.14
	Owsley, McGwin, and Ball (1998)	Crash risk cases 3.6 times more likely to report glaucoma than controls
	Hu, Trumble, Foley, Eberhard, and Wallace (1998)	Association between highway crashes and glaucoma significant only for older males (OR=1.7)
Foot Abnormalities	Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)	Association between 3+ foot abnormalities and adverse driving events RR=2.0, 95% CI = 1.0-3.8
Falls	Sims, Owsley, Allman, Ball and Smoot (1998)	Significant association between crash involvement and having fallen in the past two years: OR=2.6, 95% CI=1.1-6.1*
Persistent Back Pain	Hu, Trumble, Foley, Eberhard, and Wallace (1998) Foley, Wallace, and Eberhard (1995).	Association between crash risk and persistent back pain significant for combined gender (6,553 female person-years and 5,414 male person-years); RR=1.25 for 3,000; 6,000, and 12,000 miles driven annually. RR = 1.54 for 9,000 and 18,000 annual miles. Significant association between episodes of back pain and increased risk for crashes in a sample of 1,791 drivers age 68+ (RR=1.4, p<.05)
Cardiac Conditions (Irreg. Heartbeat)	Stewart, Moore, Marks, May and Hale (1993)	Significant correlation between irregular heartbeat and crashes: OR=1.83, 95% CI=1.25-2.68
Feet/Legs Cold on Exposure to Cold	Stewart, Moore, Marks, May and Hale (1993)	Significant correlation between feet or legs cold on exposure to cold and traffic crashes: OR = 1.82, 95% CI = 1.17-2.82
Bursitis	Stewart, Moore, Marks, May and Hale (1993)	Significant correlation between bursitis and traffic crashes: OR = 2.18, 95% CI = 1.41-3.38
Renal Disease (Protein in urine)	Stewart, Moore, Marks, May and Hale (1993)	Significant correlation between protein in urine and traffic crashes: OR = 1.84, 95% CI = 1.25-2.72
Use of Antidepressant/ Antianxiety drugs	Hu, Trumble, Foley, Eberhard, and Wallace (1998); Hemmelgarn, Suissa, Huang, Boivin, Pinard (1997)	Significant association between antidepressant use and crash risk (males only). RR= 1.98 Significant association between half-life benzodiazepine use (within 1st week of use) and crash risk (RR=1.45, CI=1.04-2.03) . RR for continuous use up to 1 yr significant (RR=1.26, CI=1.09-1.45). In contrast, no increased risk within first week of short-half-life benzodiazepines (RR=1.04, CI = 0.81-1.34) or with continued use (RR=0.91, CI=0.82-1.01)

*RR=Relative Risk; OR= Odds Ratio; CI=Confidence Interval

I.A. IDENTIFY OLDER PEOPLE WHO ARE AT HIGH RISK OF CRASHES

I.A.2. Driving and/or Functional Assessment Outcomes

(a) Physical Performance Deficits
(b) Sensory (Vision) Deficits
(c) Deficits in Visual Attention/Speed of Processing
(d) Perceptual Skills
(e) Memory/Cognition Deficits
(f) Navigation Errors on Road Test
(g) Discriminating Maneuver Errors on Road Test
(h) Decision-Making and Response Selection in Driving Simulators

1A2(a). Physical Performance Deficits

Summary:

Lower Limb Mobility: In a sample of 283 community-dwelling individuals age 72 to 92 (mean age=77.8), Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994) found that the timed performance test most strongly associated with adverse events (traffic crash, violation, stopped by police) in the year following testing was the rapid-pace walk ($>$ 7 seconds versus $\leq$ 7 seconds [relative risk=2.0, 95% confidence interval=1.0-3.8]). Nine percent of the faster walkers had adverse driving events, compared to 17 percent of the slow walkers. This difference was significant at the $p<.05$ level. In the activity domain, walking less than 1 block per day was associated with adverse events (relative risk [RR]=1.9, 95% confidence interval [CI]=1.1-3.5). Twenty-one percent of the subjects who walked less than 1 block per day had adverse driving events, compared to 11 percent of the subjects who walked 1 block or more each day. This difference was significant at the $p< .05$ level. Foot tap time showed a trend toward association with adverse events in the study, and is face valid as a measure of ability to move leg/foot from gas to brake pedal.

In the recently completed pre-pilot study conducted in Salisbury, Maryland for the NHTSA "Model Driver Screening and Evaluation Program" project, the present *Notebook* authors found that subjects who took longer than 7 seconds to complete the rapid-pace walk (walk 10 ft, turn around, walk 10 ft back) were 1.25 times more likely to be involved in a crash compared to subjects who could complete the walk in 7 seconds or less. The mean walk time for the crash-free drivers was 6.78 seconds, and the mean walk time for the crash-involved drivers was 7.12 seconds. Also, subjects whose alternating foot-tap time was 10 seconds or more were 2.61 times more likely to be in a crash, compared to subjects whose foot tap times were less than 10 seconds. The mean foot-tap time for the crash-free subjects was 6.6 seconds, and the mean foot-tap time for the crash-involved subjects was 7.1 seconds. This difference was significant at the 0.04 level. Subjects ranged in age from 68 to 89 (mean age=75.7); 131 of the 363 subjects were involved in at least 1 crash in the previous 6-year period (1991-1997).

Upper Limb Mobility: In a panel data analysis of remaining eligible drivers in 1993 (507 female drivers and 375 male drivers) who participated in the Iowa 65+ Rural Health Study from 1981-1993, older females who had difficulty extending their arms above their shoulders had an increased probability of being involved in a crash (Hu, Trumble, Foley, Eberhard, and Wallace, 1998). In other words, an older female with difficulty extending her arms above shoulder height is more than twice as likely to be crash involved than another female with no difficulty, given that both drive 6,000 mi/yr.

Sims, Owsley, Allman, Ball, and Smoot (1998) conducted a study of 174 drivers ages 55-90 (mean age 71.1). Case drivers had at least 1 state-recorded at-fault crash in the 6 years preceding the assessment (n=99) and controls had no state-recorded at-fault crashes in the prior 6 years (n=75). Results at the univariate level indicated that crash-involvement was significantly associated with difficulty reaching out ($p=.042$).

In the pre-pilot study conducted in Salisbury, Maryland for the NHTSA "Model Driver Screening and Evaluation Program" project, the present *Notebook* authors found that subjects who could not raise their arms above shoulder height were 1.91 times more likely to be involved in a crash, compared to subjects who could perform this action.

Head/Neck Range of Motion: The behavior of drivers at simulated T-intersections was investigated to determine the relationships between the range of movement of the head and neck, the visual field, and the decision time for a simulated traffic maneuver (Hunter-Zaworski, 1990). Impairment was defined by a combined static range of movement of the head/neck and visual field of less than 285 degrees. Younger (ages 30-50) impaired drivers were able to compensate for their impairment (their decision times were not affected by their reduced head/neck flexibility), but older impaired drivers (ages 60-80) were not.

In a study of 125 community-living cohort of older persons who were active drivers (ages 77+), limited neck range of motion (RR = 6.1, CI = 1.7-22.0) was one of the factors independently associated with (self-reported) adverse driving events (crash, moving violation, being stopped by police during previous 5.75 years) in multivariate analyses adjusting for driving frequency (Marottoli, Richardson, Stowe, Miller, Brass, Cooney, and Tinetti, 1998). Range of motion of the neck was measured by having the subject stand against a wall, and turn his or her head to identify a number placed behind either shoulder.

In the pre-pilot study conducted in Salisbury, Maryland for the NHTSA "Model Driver Screening and Evaluation Program" project, the present *Notebook* authors found that subjects who could not turn their heads (including upper torso) to view the time on a clock placed directly behind them were 1.38 times more likely to be involved in a crash compared to subjects who could perform this action.

Conclusions/Preliminary Recommendations:

Older drivers with reductions in physical flexibility and range of motion of arms, legs, and neck are at increased crash risk. Physicians and other health care providers should include physical performance measures in their assessments of geriatric patients, ask questions to determine driving habits and problems, and counsel older drivers about the consequences of limited mobility/flexibility on driving performance. In addition, they should recommend exercises to help improve strength and flexibility, make suggestions about where and when patients should drive, and refer patients to occupational/physical therapists for remediation or fitting with adaptive equipment, when appropriate. In addition, increasing the public's awareness about the effects of diminishing physical capabilities on driving performance should enable drivers to make their own responsible decisions.

References:

- Hu, Trumble, Foley, Eberhard, and Wallace (1998)
- Hunter-Zaworski (1990)
- Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)
- Marottoli, Richardson, Stowe, Miller, Brass, Cooney, and Tinetti (1998)
- Sims, Owsley, Allman, Ball, and Smoot (1998)

IA2(b). Sensory (Vision) Deficits

Summary:

Static Acuity. With respect to driving, static visual acuity has consistently been found to have weak relationships to traffic crashes and convictions. For example, in a large sample study investigating the relationship between visual function and crash rate, Burg (1967) reported that the three static visual tests evaluated in their protocol had the second strongest relationship with crashes, with dynamic acuity having the strongest relationship. These three correlations, ranging from -0.053 to -0.129, were small but significant given the large sample size (n > 17,000). In Marottoli, Richardson, Stowe, Miller, Brass, Cooney, and Tinetti's (1998) study of 125 community-living older persons who were active drivers (ages 77+), corrected near visual acuity worse than 20/40 (Risk Ratio = 11.9; 95% Confidence Interval 1.3 - 109.1) was one of the factors independently associated with (self-reported) adverse driving events (crash, moving violation, being stopped by police during previous 5.75 years) in multivariate analyses adjusting for driving frequency.

Meta-analysis across studies investigating acuity and crash risk confirms that there is a weak, but consistent relationship between these variables (Staplin, Ball, Park, Decina, Lococo, Gish, and Kotwal, 1997). While the overall comparison of effect sizes is significant (χ^2=19.79, p=0.00054) these differences are largely due to the level of significance that varies with sample size. There are several reasons why one might not expect to find a strong relationship between acuity and crash rate. Good acuity is probably beneficial to driving in instances where the vehicle is stopped or moving at a slow rate, such as at an intersection or in a parking lot. It is of less benefit while driving at normal speeds. Furthermore, unlike real visual scenes that vary in complexity, contrast, and illumination, the stimuli used to measure static visual acuity are small, of high contrast, and of low complexity. Therefore, many have argued that this type of measure bears little resemblance to the visual requirements of driving, and should not be expected to be strongly tied to crash involvement. Studies that have correlated the on-road driving performance of older subjects and static acuity are described below.

In a study of 82 drivers (age 60-91) referred to CA DMV, correlations between static acuity score (20/20, 20/80, and 20/200) measured with *MultiCAD* (square wave gratings with vertical bars were used), and weighted errors on driving test were not significant. However, correlations between static acuity response time at each level of acuity and weighted error scores on driving exam were as follows: 20/40 time: r=.3395 (p<.004); 20/80 time: r=.4230 (p<.000); 20/200 time: r=.1970 (p<.090) (Janke and Eberhard, 1998; Janke and Hersch, 1997; Staplin, Gish, Decina, Lococo, and McKnight, 1998).

In McKnight and McKnight's (1998) study of 360 drivers age 62+, correlations between static visual acuity (measured with Automated Psychophysical Test [APT]) and observed driving performance were relatively low but significant; correlations between on-the-road performance and time to respond to the acuity stimuli (r=.30) were higher than acuity errors (r=.18).

Salzberg and Moffat (1998) evaluated the driving records of 380 older drivers who were referred to the Washington State Special Examination Program (and passed), and 449 control group drivers. This program is described in more detail in Section IA1(m) of the *Notebook*. Static acuity readings were available for 357 of these drivers. A "special exam" includes an in-depth interview, and an extended or specialized on-road drive test, typically conducted near the driver's residence. The most common outcome of the "special exam" is to impose driving restrictions (time of day, area, equipment).

Crash and violation records of special exam group drivers were compared with that of the control group, for a period of 1.75 years before the exam, and 3.25 years after the exam (a 5-year period). Crash and violation rates were calculated to describe the number of incidents per 100 subjects per year, since the pre- and post-observation periods differed in length. The crash and violation rates for the exam group drivers by acuity score (20/20+, 20/40+, 20/100+, and 20/200+) who passed the "special exam" and the (entire) control group are presented below, for the pre-exam and post-exam period. For comparison purposes, in Washington State during 1996 there were 140,215 total collisions and 4,037,534 licensed drivers, yielding a rate of 3.47 collisions per 100 licensed drivers in a one-year period. It is important to note that approximately 60 percent of exam group drivers had other medical conditions; only 123 of the 380 drivers (32%) were referred to the program because a vision certificate was filed with the Department of Licensing. Other reasons for referral included: law enforcement noting signs of unsafe driving (3%); Licensing Service Representative noticing diminished capabilities (6%); medical certificate filed with Department of Licensing (15%); physician referral (5%); and because a driver failed the initial re-exam test (35%). Therefore visual acuity is confounded with other medical conditions, and no direct relationship with crashes or violations can be drawn.

Group	Pre-Exam Collision Rate	Post-Exam Collision Rate	Pre-Exam Violation Rate	Post-Exam Violation Rate
Control (n=449)	3.8180	1.1650	7.5087	2.2614
Special Exam No vision info. available (n=23)	4.9689	6.6890	22.3602	4.0134
Special Exam 20/20+ (n=44)	10.3896	1.3986	24.6753	3.4965
Special Exam 20/40+ (n=219)	7.8278	2.5290	12.0026	4.3555
Special Exam 20/100+ (n=45)	7.6190	2.0513	16.5079	6.1538
Special Exam 20/200+ (n=49)	1.1662	7.5353	2.3324	10.6750

What is interesting to note about the pre-exam crash rates is that the drivers with the best acuity (20/20) had the highest rates, and that drivers with the poorest vision (20/200) had the lowest crash rates. Obviously, drivers with 20/20 vision were not part of the special program because of poor vision. It is instructive to look just at drivers with 20/40-20/100 acuity, whose crash rates are about double that of the control group during the pre-exam period. The requirement to undergo a special exam and the consequent licensing restrictions had the effect (at least on the surface) of lowering their crash rates to a level that does not pose any more risk than the population of licensed drivers in the State of Washington. But the reduction still puts these drivers at twice the risk of control group (older) drivers. The authors explain the decline in crash risk for the control group (who did not have any intervention) as decreased driving exposure through increased self-restriction over the 5-year study period. The significant increase in the 20/200 group from the pre-exam to the post-exam period could be the result of increased exposure by these drivers who possibly misinterpreted the decision to allow them to retain driving privileges as positive feedback about their ability to drive safely.

Dynamic Acuity. Dynamic visual acuity (DVA), like static acuity, also declines with age (Burg, 1967; 1968; 1971), with some suggestion that the age-related declines in DVA are larger than for static visual acuity (Burg, 1966). Dynamic acuity reflects the ability to resolve the details of a moving target, and therefore it has been proposed that this measure of acuity should be more relevant to driving. Some activities that appear to rely on dynamic acuity are reading street signs while in motion, locating road boundaries when negotiating a turn, and making lateral lane changes. In these situations, greater speeds are associated with poorer DVA. The earlier studies on driving and the elderly that have assessed both static and dynamic acuity have indeed found that DVA is more strongly associated with crash risk than static acuity. However, the statistically significant correlations between dynamic visual acuity and crash rate have also been consistently weak (Staplin et al, 1998). For example, the correlation between DVA and crash rate for the older drivers, as reported by Hills and Burg (1977), was too low (r=0.054) to be of any practical significance for identifying at-risk drivers. As stated earlier, dynamic visual acuity has been found to be weakly associated with crash involvement in several correlational studies (Burg, 1968; Shinar, McDowell, and Rockwell, 1977; Laux and Brelsford, 1990). In a study of professional drivers over age 50, the top 10 percent with respect to dynamic acuity were found to have lower than average crash rates. The bottom 10 percent with respect to dynamic acuity were found to have higher than average crash rates (Henderson and Burg, 1974). In other studies, Shinar, Mayer and Treat (1975) noted that drivers found recently to be at fault in a crash had poorer dynamic visual acuity than a group of persons who had not been in a crash for 2 years. As with static acuity, however, the strength of the relationships is generally weak, and meta-analysis confirms the consistency of these findings that differ primarily due to sample size discrepancies (Staplin et al., 1998). Studies that have correlated the on-road driving performance of older subjects and dynamic acuity are described below.

In a study of 82 drivers (age 60-91) referred to CA DMV, correlations between dynamic acuity score (20/20, 20/80, and 20/200) measured with MultiCAD (square wave gratings with vertical bars were used, with a rate of movement across the screen of 12 degrees per second) and weighted errors on driving test were not significant. However, correlations between dynamic acuity response time at each level of acuity and weighted error scores on driving exam were as follows: 20/40 time: $r=.3092$ ($p<.010$); 20/80 time: $r=.3256$ ($p<.005$); 20/200 time: $r=.3297$ ($p<.004$). (See Janke and Eberhard; Staplin, Gish, Decina, Lococo, and McKnight, 1998).

In a study of 360 drivers age 62 and older, correlations between dynamic visual acuity (measured with APT) and observed driving performance were relatively low but significant; correlation between on-the-road performance and time to respond to the acuity stimuli was $r=.24$; correlation between on-road performance and acuity errors was $r=.21$ (McKnight and McKnight, 1998).

Static Contrast Sensitivity. Contrast sensitivity tests measure both the response to sharply-defined, black-on-white targets and those with grayer, less-distinct edges. Recent studies that have included contrast sensitivity as a predictor of driving crashes have shown that, while it is a slightly better predictor than acuity, the strength of the relationship is still relatively weak ($r<0.25$) (Ball and Owsley, 1991; Owsley et al., 1991; Ball et al., 1993). More recently, Hennessy (1995) studied 3,669 randomly-selected Class C license renewal applicants who were licensed in California for at least 12 years. Four driver age groups were studied: 26-39, 40-51, 52-69, and 70+. The 48-letter test designed by Pelli, Robson, and Wilkins, 1988, of contrast sensitivity at one spatial frequency was one of the independent measures examined. In this test, the contrast between letters and background decreases as one moves down and toward the right of wall-mounted chart, viewed at distance of 2 meters under normal room illumination. The letters from left to right and from top to bottom progressively fade out as if they must be read in thicker and thicker fog. Letters (in groups of 3) range from 90 percent contrast (upper left) to 0.5 percent contrast (lower right). Testing requires no more than 3 minutes. The dependent measure was the crash frequency during the previous 3-year period, extracted from the DMV database. Results showed that for all age groups combined, the contrast sensitivity test score was not significantly associated with total prior 3-year crash involvement when considered in isolation. There was a very small percentage of drivers age 70+ with good low-contrast acuity. Using a pass-fail criterion of 36 or more correctly identified letters as pass and less than 36 letters fail, Pelli-Robson specificity was 53 percent and sensitivity was 29 percent in predicting citations for age 70+ drivers; accuracy of predicting citation occurrence was 6.5 percent. For subjects ages 52-69, specificity was 65 percent, sensitivity was 19 percent, and positive prediction was 7 percent. Studies that have correlated older drivers on-road performance with static contrast sensitivity are described below.

In a study of 82 drivers (ages 60-91) referred to CA DMV, static contrast sensitivity response time for the high contrast 20/80 target measured with *MultiCAD* was significantly correlated with weighted error score on the driving test ($r = .3884$, $p < .001$). (See Janke and Eberhard, 1998; Janke and Hersch, 1997; Staplin, Gish, Decina, Lococo, and McKnight, 1998).

In Janke and Eberhard's (1998) study of 102 "referred" subjects aged 60-91 (34 of which were identified as probably being cognitively impaired to some degree) and 33 paid "volunteers" ages 56-85, the correlation between Pelli-Robson errors and weighted error score on a road test was significant ($r=.4009$, $p<.0001$) for combined referrals and volunteers ($n=135$). For the referral group only ($n=102$), the correlation between Pelli-Robson errors and weighted error score on the road test was also significant ($r= .2069$, $p<.044$).

In Brown, Greaney, Mitchel, and Lee's (1993) study of 1,475 ITT Hartford Insurance Co. policyholders (age 50-80+) divided into two groups based on the presence or absence of recent at-fault crashes, the Pelli-Robson Letter Sensitivity Chart consistently yielded the highest correlation to crashes in the sample during 1989-1991 ($r=-0.11$, $p < 0.05$).

In a study of 12,400 drivers ages 16 to 75+ in Pennsylvania, who came to Photo ID centers for license renewal, failure on the combined criteria that incorporates the current PennDOT standard (binocular acuity of 20/40 and horizontal visual field of 140 degrees) <u>and</u> a broadly defined contrast sensitivity criterion (scores below normal for 1 or more of the 3 spatial frequencies tested using Vistech contrast sensitivity gratings via an Optec 1000 vision tester) produced the strongest relationship linking poor vision and high crash involvement, especially for 66-75 and 76+ driver age groups (Decina and Staplin, 1993). Neither visual acuity nor horizontal field measures in isolation were significantly related to crash involvement. The study authors recommended periodic screening using the combined criterion, for drivers over age 55.

In McKnight and McKnight's (1998) study of 360 drivers age 62 and older, correlations between low contrast acuity (measured with APT) and observed driving performance were low but significant; correlations between on-the-road performance and time to respond to the acuity stimuli ($r=.23$) were higher than contrast sensitivity errors ($r=.18$).

<u>Dynamic Contrast Sensitivity</u>. In a study of 82 drivers (ages 60-91) who were referred to CA DMV, the correlation between dynamic contrast sensitivity response time for the high contrast 20/80 target (using MultiCAD) and weighted errors on the road test was significant ($r=.2466$, $p<.049$). The stimuli in this study consisted of square wave gratings with vertical bars, with a rate of movement across the screen of 12 degrees per second (see Janke and Eberhard, 1998; Janke and Hersch, 1997; Staplin, Gish, Decina, Lococo, and McKnight, 1998).

Conclusions/Preliminary Recommendations:

Contrast sensitivity is a visual capability, where deficits have been shown to be related to traffic crashes and poor driving performance in older drivers. Correlations between driving performance and contrast sensitivity response time (for correct responses) as well as percent correct responses have been found to be significant. Contrast sensitivity test slides are available for DMV-model vision screener devices, and would be easily implementable in a DMV vision screening protocol. Other presentation methods include wall charts and computer displays of test stimuli.

For acuity, it appears that the time to respond is more strongly related to driving performance than other dependent measures, such as percent correct. This result should be interpreted with caution, however, because as usual, the range of responses on this dependent measure (i.e., correctness) was restricted, and there was potential for substantial "noise" in the data from other sources of variance. Time to respond would be a more difficult measure to implement in a DMV setting unless stimuli were presented by computer.

References:

- Ball and Owsley (1991)
- Ball, Owsley, Sloane, Roenker, and Bruni (1993)
- Brown, Greaney, Mitchel, and Lee (1993)
- Burg (1966, 1967, 1968, 1971)
- Decina and Staplin (1993)
- Henderson and Burg (1974)
- Hennessy (1995)
- Hills and Burg (1977)
- Janke and Eberhard (1998)
- Janke and Hersch (1997)
- Laux and Brelsford (1990)
- Marottoli, Richardson, Stowe, Miller, Brass, Cooney, and Tinetti (1998)
- McKnight and McKnight (1998)
- Owsley, Ball, Sloane, Roenker and Bruni (1991)
- Shinar, Mayer and Treat (1975)
- Shinar, McDowell, and Rockwell (1977)
- Staplin, Ball, Park, Decina, Lococo, Gish, and Kotwal (1997)
- Staplin, Gish, Decina, Lococo, and McKnight (1998)

IA2(c). Deficits in Visual Attention/Speed of Processing

Summary:

A current and potentially most-promising area of inquiry relating crash risk to functional impairment is the study of visual attention deficits and underlying divided attention and speed-of-processing functions. Prominent among studies in this area are those addressing measures of information processing efficiency such as "useful field of view" and "channel capacity;" research summaries are presented below.

A prospective study was conducted with 294 older drivers (ages 56-90) to identify measures of visual processing associated with crash involvement by older drivers (Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley, 1998). This sample had been previously drawn for a case-control study by Ball et al. (1993) from the population of all licensed drivers in Jefferson County, Alabama age 55 and older. The subjects represent 3 crash categories (0 crashes, 1-3 crashes, and 4+ crashes during the previous 5-year period) and 7 age categories (55-59, 60-64, 65-69, 70-74, 75-79, 80-84, and 85+ years of age). Of the 302 subjects drawn for sample, 6 were excluded because they had ceased driving, and 2 did not complete the protocol. The study focused on the prospective 3-year follow-up of the 294 drivers who were assessed in 1990 to determine what visual characteristics were associated with future crash involvement. Subjects received the following sensory tests in 1990: Letter Acuity - ETDRS chart; Contrast Sensitivity - Pelli-Robson chart; Stereoacuity - TNO Test; Disability Glare - MCT-8000 (VisTech); Visual Field Sensitivity -Humphrey Field Analyzer 120-point program for central 60 degree radius field; and visual attention and visual processing speed - Useful Field of View. Impaired useful field of view (UFOV) was the <u>only</u> visual processing variable associated with increased crash risk. A significant, independent association with crash risk in 3-year follow-up was found for UFOV reduction of $\geq$ 40 percent: RR=2.3; 95% CI=1.27-4.29. Of UFOV component scores, speed of processing (subtest 1) and selective attention (subtest 3) were NOT associated with crash occurrence. Impairment in divided attention (subtest 2) was significantly associated with a 2.3 fold increased risk of crashing (95% CI=1.24-4.38, p=0.01). For every 10 points of UFOV reduction, subjects had a 16 percent increase in crash risk. Estimates are that 24 percent of older driver crashes are due to UFOV reduction $\geq$40 percent.

Owsley, McGwin, and Ball (1998) studied 193 older drivers between ages 55-87 (mean=71 years) to identify visual risk factors for vehicle crashes by older drivers that result in injury. Univariate analyses showed that older drivers involved in injurious crashes were more likely to have UFOV reductions (Odds Ratio [OR]=5.3 for reductions of 23 to 40 percent; OR=16.3 for reductions of 41 to 60 percent; and OR=22.0 for reductions greater than 60 percent). Only two variables were independently associated with crash risk in the multivariate analyses: UFOV and glaucoma. UFOV reductions of 22.5-40 percent, 41-60 percent, and >60 percent were associated with 5.2, 16.5, and 21.1-fold increased risk of an injurious crash, respectively compared to those with reductions of less than 22.5 percent. This sample was a subset of the sample described above, consisting of 78 drivers (cases) who had at least 1 crash in the prior 5-year period that resulted in an injury to anyone in the involved vehicles, and 115 drivers (controls) who had no crashes in the same 5-year period. Excluded were 101 subjects who were involved in crashes where no injury was reported.

Goode, Ball, Sloane, Roenker, Roth, Myers, and Owsley (1998) studied 239 older drivers (ages 56-90) to examine the utility of a set of commonly used neuropsychological tests in comparison to the UFOV in predicting state-recorded, at-fault crashes in the prior 5 year period in a group of older drivers, a model using UFOV alone was significant ($p<.001$). This model was as predictive as a model using UFOV and traditional tests (MOMSSE, Trails, Wechsler Memory Scale subtest, and Rey-Osterreith Complex Figures). The classification success was 85.4 percent, with sensitivity of 86.3 percent and specificity of 84.3 percent. The estimated probability of crashing with a UFOV score of 20 was 22 percent; for a UFOV score of 60, the probability of crashing increased to 81 percent. The subjects in this study were recruited from the larger sample of drivers participating in the larger study (Ball et al., 1993). Of the original sample of 294 subjects, 251 received all of the cognitive tests. Those with poor visual acuity ($n=12$) were excluded (since those with acuity worse than 20/50 uniformly fail the first subtest of the UFOV).

Owsley, Ball, Sloane, Roenker, and Bruni (1991) studied 53 drivers ages 57-83 (mean age = 70), to determine whether incorporating eye health, visual function, UFOV (Visual Attention Analyzer), and mental status could predict the number of crashes in the sample. Only the mental status total score and UFOV were significantly related to state-reported crashes. The subjects were recruited from the Primary Care Clinic of the School of Optometry at the University of Alabama at Birmingham, had valid AL licenses, and drove at least 1,000 miles/year. Results indicated that only the UFOV was related to traffic citations. Subjects who failed the UFOV had 4.2 times more crashes than those who passed. For intersection crashes, subjects who failed the UFOV had 15.6 times more intersection crashes than subjects who passed. Subjects with high MOMSSE scores had 6.3 times more intersection crashes. Together, these variables predicted 29 percent of the variance in intersection crashes, $R=.54$, $F(2,49)=9.8$, $p<0.001$. For intersection crashes, UFOV had 26 correct rejections, 14 false alarms, 1 miss, 11 hits.

In Ball, Owsley, Sloane, Roenker, and Bruni's (1993) retrospective study of 294 drivers ages 55-90, UFOV and mental status were the only variables that had a direct effect on crash frequency, accounting for 28 percent of the variance in crash frequency. The test battery included tests described for Owsley, Ball, Sloane, Roenker, and Bruni (1991), plus the following cognitive tests assessing visuospatial abilities: Rey-Osterreith test; Trail-Making test; and the WAIS block design test. As a predictor, UFOV resulted in 142 hits, 18 misses, 25 false-positives, and 109 correct rejections. Of the 25 false-positives, 19 were subjects who reported avoiding driving in general, avoided driving alone, and/or avoided left turns, thus minimizing their driving exposure. Removing these people from the data set increases the correlation between UFOV and crash frequency from $r=0.52$ to $r=0.62$. UFOV had high sensitivity (89%) and high specificity (81%); mental status had sensitivity and specificity values of 61 percent and 62 percent, respectively.

Another, ongoing research study, has yielded results showing UFOV's relationship to performance during an on-road driving evaluation. Of the clients who passed the UFOV test (less than 40 percent reduction in UFOV), the majority pass the on-road evaluation, and of the clients who failed the UFOV test (have more than a 40 percent reduction in UFOV), the majority fail the on-road evaluation. Of the 23 drivers who passed the UFOV, 18 passed the on-road, 4 failed on-road, and 1 is pending. Of the 25 drivers who failed UFOV screening, 6 passed the on-road evaluation, 16 failed the on-road test, and 3 are pending (*pers. comm.*, Tom Kalina, Bryn Mawr Rehab, 10/97).

Hennessy (1995) conducted a study using 3,669 randomly-selected Class C license renewal applicants, licensed in California for at least 12 years, and unable to renew by mail. Four driver age groups were studied: 26-39, 40-51, 52-69, and 70+. Subjects age 70+ showed high variability in visual divided attention ability (subtest 2) and perceptual reaction time (subtest 1 PRT). There was a very small percentage of drivers age 70+ with very good total UFOV. Test scores had small but statistically significant predictive value (2.9%) for subjects age 70+. After adjusting for gender, age, and exposure, total UFOV scores explained 0.9 percent of the variance in crash involvement, PRT explained 0.9 percent and divided attention explained 0.9 percent. The association with crashes for subjects in the 70+ age group was stronger, with total UFOV accounting for 4.1 percent of the variation in crashes, PRT accounting for 4.1 percent of the crashes, and divided attention accounting for 4.3 percent of the crashes in the oldest age group. UFOV was not predictive of crashes in the 3 younger age groups. Of 285 subjects age 70+, 84 (29%) scored poorly. Thirty-six of the 285 subjects had a crash, and of the 36, 13 (36%) scored poorly on the UFOV. Thus UFOV *sensitivity* was 36 percent, specificity was 71 percent, and positive predictive accuracy was 15.5 percent. For citation occurrence, sensitivity was 28 percent, specificity was 70 percent, and positive predictive accuracy was 12 percent.

Brown, Greaney, Mitchel, and Lee (1993) studied 1,475 ITT Hartford Insurance Co. policyholders for whom past driving histories were available through insurance records. They were divided into two groups based on the presence or absence of recent at-fault crashes. Driver age ranged between 50 and 80+. The Visual Attention Analyzer was employed; the overall score from the three subtests—speed of information processing, divided attention, and a measure of distractibility—was used to describe useful field of view loss. Results showed that 42 percent of the sample had an at-fault crash between 1989-1991. The correlation between performance on the UFOV test and at-fault crashes ($r=0.05$) was significant ($p<0.05$). The low correlation was explained by the possibility that because participants were recruited through their insurance company (as opposed to being recruited through an eye clinic and offered a detailed eye exam, as were the subjects in the Ball et al. [1991] study), drivers who were less confident in their driving skills may have elected not to participate for fear that their insurance rates could be affected. Also, a noisy, crowded test environment was described which may have yielded unrepresentative visual attention measures.

Another study using WayPoint (a proprietary test measuring channel capacity or information processing rate) and Subtest 1 of UFOV (measuring speed of processing) examined 101 licensed drivers (39 females and 62 males) ages 72-90, with a mean age of 78.3 (Janke and Hersch, 1997). In this study, WayPoint was administered twice (in succession) to see if drivers with presumed cognitive impairment either failed to improve from the first administration to the second, or did not improve as much as subjects without presumed cognitive impairment. The scoring system determines: (1) channel capacity or information-processing rate, defined as the average speed per exercise on the first administration over two of the exercises; and (2) high vs low risk of preventable and non preventable collisions, reflecting the driver's situational awareness. An on-road driving exam was given by the project driving instructor (owner/operator of a driving school in San Francisco) based on the California Driving Performance Evaluation (DPE). Average time per exercise on the first administration of WayPoint was significantly related to road test weighted errors ($r=.37$) as was channel capacity ($r=.35$). Using only WayPoint 1 average time and UFOV subtest 1 as predictors of weighted error score on the road test yielded multiple $R = .428$; adjusted $R^2=0.166$.

As reported by the test's developer, in six studies with 102 drivers age 20-60, WayPoint correctly classified 72 percent as high or low crash-risk drivers, missed 18 percent of the high crash-risk drivers, and falsely labeled 9.2 percent of the drivers as high-risk when they were actually low risk. Also, results of a study with emergency response (ER) trainees showed that errors on WayPoint were (1) directly related to technical errors on the ER course (a high speed drive circuit), (2) directly related to line-of-travel errors, and (3) positively correlated with lap speed. On the non-emergency test, WayPoint errors were positively correlated with driving errors and with the number of traffic cones contacted on the obstacle course (Cantor, 1995).

In Marottoli, Richardson, Stowe, Miller, Brass, Cooney, and Tinetti's (1998) study of 125 community-living older persons who were active drivers (ages 77+), poor performance on a visual attention task ($\leq$ 48 correct on a number cancellation task, RR=3.0, CI=1.2-7.8) was one of the factors independently associated with (self-reported) adverse driving events (crash, moving violation, being stopped by police during previous 5.75 years) in multivariate analyses adjusting for driving frequency. The number cancellation task involved marking out all of the numbers in a row that matched a circled number at the far left-hand side of the row, within a given amount of time.

Conclusions/Preliminary Recommendations:

Older drivers with 40 percent or greater impairment in their useful field of view—which stems from declines in visual sensory function, visual processing speed, and/or visual attentional skills—appear to be at an increased crash risk. Broadly speaking, there is a strong case that age-related visual processing impairments, particularly in the ability to divide attention, are directly related to future crash risk. Based on the success to date of predicting crashes, it is recommended that the UFOV protocol (or a related procedure validated on the same measurement construct) be incorporated as a diagnostic test of cognitive deficits which predict driving impairments for license renewal applicants; in particular, the evaluation of divided attention (one of the UFOV subtests) is recommended. Quick and inexpensive assessments of gross deficits in attentional and information processing abilities also appear quite valuable; the traditional Trails protocol (see also discussion in next section of *Notebook*) and derivative techniques using paper-and-pencil or computer-based methods are most promising.

References:

- Ball, Owsley, Sloane, Roenker, and Bruni (1993)
- Brown, Greaney, Mitchel, and Lee (1993)
- Cantor (1995)
- Goode, Ball, Sloane, Roenker, Roth, Myers, and Owsley (1998)
- Hennessy (1995)
- Janke and Hersch (1997)
- Marottoli, Richardson, Stowe, Miller, Brass, Cooney, and Tinetti (1998)
- Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998)
- Owsley, Ball, Sloane, et al. (1991)
- Owsley, McGwin, and Ball (1998)

IA2(d). Perceptual Skills

(Visual Search, Spatial Integration, Gap/Headway Judgment)

Summary:

Visual Search. In a study of 3,238 drivers age 65 and older, who applied for renewal of North Carolina driver's license, performance on a paper-and-pencil test of general cognitive function (Trails A and B), measuring speed of visual search, attention, mental flexibility, and motor function was correlated with crash involvement in the preceding 3-year period (Stutts, Stewart and Martell, 1996, 1997). *Trails A Results*: Correlational coefficient with number of crashes = 0.065 ($p<0.001$). Subjects who scored in best quartile had 47 percent fewer crashes (.037 crash involvements per year) than drivers who scored in the worst quartile (.054 crash involvements per year). *Trails B Results*: Drivers in the poorest decile of performance had a predicted average annual crash rate of 1.5 times that of drivers in the highest decile of cognitive performance. Correlational coefficient with number of crashes = 0.072 ($p<0.001$). Annual crash involvements increased with increasing (poorer) cognitive scores.

In a study of 105 drivers ages 65-88 (Tarawneh, McCoy, Bishu, and Ballard, 1993), only the Trail-Making Part B test showed a significant correlation to performance on an on-road driving task, with a correlation coefficient of -0.42 ($p<.0001$). The correlation between Trails A and driving performance was -0.03 ($p<.7329$). Trails B showed the highest correlation of all factors (visual, visual perception, cognitive, range of motion) included in the analysis.

In a study of 39 drivers (21 with Alzheimer's disease) to determine fitness to drive for neurological patients, performance on Trails B was a significant predictor of simulator crashes, with an odds ratio of 30.19 (Rizzo, Reinach, McGehee, and Dawson, 1997).

In a study of 20 drivers age 55 and older, who were administered 11 assessment tests and an on-road driving test, 6 subjects were classified as below minimum standards in driving performance (a total of 19 or more errors on the NY State Driving Exam) (Cushman, 1988, 1992). These six subjects scored more poorly on Trails B (mean Trails B total time =130.5 s) than the subjects whose on-road driving performance was at least adequate (mean total Trails B time = 93.07 s). The Trail-Making Test (Part B) was the only test that was significantly correlated with driving performance for all subjects ($r=0.61$, $p<0.01$).

In the recently completed pre-pilot study conducted in Salisbury, Maryland for the NHTSA "Model Driver Screening and Evaluation Program" project, the present *Notebook* authors found that subjects who took 5 minutes or longer to complete the Trails B protocol were 1.41 times more likely to be crash involved, compared to subjects who completed this test in less than 5 minutes. The mean time to complete the Trails B protocol was 161.14 seconds for the crash-free drivers, and 180.57 seconds for the crash-involved drivers. Subjects ranged in age from 68 to 89 (mean age = 75.7); 131 of the 363 subjects were involved in at least 1 crash in the previous 6-year period (1991-1997).

A modified and automated version of Reitan's (1958) Trail-Making Test (Part A) has been developed. In this test, 14 numbers are presented on a computer monitor arranged randomly against the background of a traffic scene, as observed by the driver through the windshield of a car. The subject must touch the numbers (touch screen display) in numerical order as rapidly and accurately as possible. Timing is

done by the computer. This test was used in a study of 69 subjects ages 60-91 who were referred to the California DMV for reexamination, and 31 paid "volunteers" ages 56-85, recruited through signs posted at study site or by word of mouth (Janke and Eberhard, 1998; Janke and Hersch, 1997). An on-road driving exam was given based on the California Driving Performance Evaluation (DPE). The referral group performed significantly worse than the volunteer group (correlation between Auto-Trails time and Group = .405, $p<.05$). Auto-Trails mean time for referrals was 24.26 seconds; for volunteers, mean time was 16.91 seconds. Auto-Trails time correlated significantly with weighted error score on the road test, for combined referrals and volunteers ($r=.4523$, $p<.000$) and for referrals only ($r=.3748$, $p<.002$). Auto-Trails time did not discriminate the cognitively impaired referral subjects from the cognitively unimpaired referral subjects.

<u>Spatial Integration</u>. In Tarawneh, McCoy, Bishu, and Ballard's (1993) study of 105 drivers ages 65-88, among the visual perception factors, Visual Closure response-time score (from the MVPT) correlated significantly with an on-road driving performance measure (correlation coefficient = -0.38). As percent of correct responses increased on the visual perception tests, performance on the driving test increased; as the reaction time scores increased, performance on the driving test decreased.

In a study of 42 patients with Alzheimer's Disease (mean age = 72.2 years) and 81 normal elderly controls (mean age = 69.1 years), driver simulator performance measures correlated strongly with Visual Memory immediate scores, and Visual Closure subscore of the Motor-Free Visual Perception Test for both AD and control subjects (Keyl, Rebok, Bylsma, Tune, Brandt, Teret, Chase, and Sterns (manuscript under review).

In the recently completed pre-pilot study conducted in Salisbury, Maryland for the NHTSA "Model Driver Screening and Evaluation Program" project, the present *Notebook* authors found that subjects who made 3 or more errors on the MVPT Visual Closure subtest were 1.7 times more likely to be crash involved, compared to subjects who made 2 errors or less. The mean number of incorrect items was 1.91 for the crash-free drivers and 2.62 for the crash-involved drivers. This difference was significant at the 0.002 level. Subjects ranged in age from 68 to 89 (mean age = 75.7); 131 of the 363 subjects were involved in at least 1 crash in the previous 6-year period (1991-1997).

<u>Gap Judgment/Headway</u>. In a study of 82 "referred" subjects ages 60-91 (26 of whom were identified as likely having cognitive impairment) where the ability of subjects to rapidly detect changes in the relative motion of their own versus other vehicles was measured, cognitively impaired referrals had a significantly higher error proportion (they did not brake in 47.3% of the trials where the lead vehicle braked ahead and the brake lights were visible) compared to cognitively unimpaired referral subjects (who did not brake in 21% of the trials). Also, the correlation between proportion of errors on trials where brake lights were visible, and weighted error score on an on-road drive test, was significant ($r=.2801$, $p<.013$). (See Staplin, Gish, Decina, Lococo, and McKnight, 1998; Janke and Eberhard, 1998).

McKnight and McKnight (1998) evaluated the on-road driving performance of 402 drivers age 62 and older. Approximately two-thirds of the subjects were referred to the licensing agency for reexamination based upon reports of deficient driving incidents, and the balance were incident-free volunteers. The road test was based on the Driver Performance Evaluation (DPE) developed by the California Department of Motor Vehicles (see Hagge, 1994). The incident-involved drivers tended to underestimate gap size (stating that they could safely enter gaps of less than 6 seconds) even though they erred on the safe side in the gaps that they actually entered.

Conclusions/Preliminary Recommendations:

Tests measuring visual perception, speed of visual search, and ability to sense changes in angular motion (i.e., cues to the speed and distance of other vehicles) have been shown to predict driving performance in simulators, on the road, and prior crash rate, and also have the ability to distinguish cognitively impaired individuals from unimpaired individuals. It is recommended that a Trail-Making protocol be implemented in driver screening for relicensing.

References:

- Cushman (1988, 1992)
- Engum, Lambert, Womac, and Pendergrass (1988)
- Goode, Ball, Sloane, Roenker, Roth, Myers, and Owsley (1998)
- Janke and Hersch (1997)
- Janke and Eberhard (1998)
- Keyl, Rebok, Bylsma, et al. (submitted)
- McKnight and McKnight (1998)
- Rizzo, Reinach, McGehee, and Dawson (1997)
- Staplin, Gish, Decina, Lococo, and McKnight (1998)
- Stutts, Stewart and Martell (1996, 1997)
- Tallman, Tuokko, and Beattie (1993)
- Tarawneh, McCoy, Bishu, and Ballard (1993)

IA2(e). Memory/Cognition Deficits

Summary:

In a panel data analysis of 507 female drivers and 375 male drivers who participated in the Iowa 65+ Rural Health Study from 1981-1993, having impaired cognitive ability (low score on word recall test) was a risk factor that determined the probability of an older male being involved in a crash (Hu, Trumble, Foley, Eberhard, and Wallace, 1998). Foley, Wallace, and Eberhard (1995) interviewed 1,791 drivers in this cohort, and found that drivers who could remember fewer than 3 of the 20 words given in a free-recall memory test had an increased crash risk (Relative Risk = 1.4, Confidence Interval: 1.1 to 1.9, $p < 0.05$).

In a study of 37 drivers age 65 and older in a case group (suspensions + crashes) and 37 matched controls (no suspensions or crashes), cases had significantly lower immediate memory task performance ($p = .010$) compared to matched controls (Johansson, Bronge, Lundberg, Persson, Seideman, and Viitanen, 1996; Johansson, 1997). Immediate memory was tested by a 5-item recall test, where the subject was required to name and recall 5 objects viewed on a desk after a 10-minute period (the items were not listed in this review). The delayed recall score was 1 point per correct item. Comparison of the 23 case subjects with crashes and the 29 control subjects with no crashes in the past 5 years showed that the crashed drivers had poorer 5-item recall ($p < .003$).

In a study of 360 drivers age 62 and older, measures of short-term and delayed short-term memory (measured with the Automated Psychophysical Test [APT]) showed fairly strong correlations between accuracy and safe driving and response time and safe driving. The correlations were significant, and ranged from 0.22 to 0.34 (McKnight and McKnight, 1998).

Hunt, Morris, Edwards, and Wilson (1993) administered the Logical Memory subscale of the Wechsler Memory Scale, which assesses immediate or delayed recall of verbal ideas presented in two paragraphs, read aloud by the experimenter. Each subject then drove for 1 hour on a pre-designed route using urban streets and highways, that included common driving situations (stop signs, traffic signals, left turns at intersections, entering and exiting an interstate highway, changing lanes, merging, diagonal and parallel parking). Subjects drove in low volume conditions. A gestalt "pass/fail" rating was given by each observer in the vehicle. In a sample of 13 healthy elderly controls (mean age = 73.5) 12 subjects with very mild dementia (mean age = 72.5) and 13 subjects with mild dementia (mean age = 73.4), the correlation between the pass/fail outcome on the road test and performance on the Logical Memory test was significant at the $p < .0009$ level.

In a study of 146 drivers age 65 and older (mean age = 72.0), three tests: the Brief Test of Attention (numbers), Trails A, and the Serial Sevens item in the Mini Mental State Examination (MMSE, see section IC2b(i) of the *Notebook*) were most strongly associated with crashes (Keyl, Rebok, and Gallo, *in press*). Patients who had poor performance on more than one of these tests had a 6.2-fold increase in crash occurrence in the previous two years. [A precaution by Lindal and Stefansson, 1993 regarding gender differences: when women use serial 7's they obtain much lower scores on the MMSE than if they use backward spelling, and conversely, men receive a lower score if they use backward spelling as opposed to serial 7's]

Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994) found that persons with borderline cognitive impairment (MMSE score of 23-25) were more likely to have adverse events (traffic crash, violation, or stopped by police) in the year following examination than those with higher or lower scores (relative risk 2.0, 95% CI, 1.1-3.7). The authors examined the components of the MMSE individually and by cognitive domain (orientation, memory, attention, language, and visuospatial ability), and found that the item most closely associated with adverse events was impaired design copying (24% of persons who could not correctly copy the intersecting pentagons had events compared with 8% of those who could [relative risk 3.0, CI, 1.6-5.6]).

In the recently completed pre-pilot study conducted in Salisbury, Maryland for the NHTSA "Model Driver Screening and Evaluation Program" project, the present *Notebook* authors found that inability to recall three short words was related to crashing (Odds Ratio = 1.52). Subjects ranged in age from 68 to 89 (mean age = 75.7); 131 of the 363 subjects were involved in at least 1 crash in the previous 6-year period (1991-1997).

Conclusions/Preliminary Recommendations:

Impaired cognitive ability, measured using immediate and delayed recall, is associated with increased crash risk and poorer on-road driving performance in older people. The inability to count backwards by 7's (ability to perform a mental function) is also related to increased crash risk in older drivers, but may have a gender bias.

References:

- Hu, Trumble, Foley, Eberhard, and Wallace (1998)
- Hunt, Morris, Edwards, and Wilson (1993)
- Foley, Wallace, and Eberhard (1995)
- Johansson (1997)
- Johansson, Bronge, Lundberg, Persson, Seideman, and Viitanen (1996)
- Keyl, Rebok, and Gallo (*in press*)
- Lindal and Stefansson (1993)
- Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)
- McKnight and McKnight (1998)

IA2(f). Navigation Errors on Road Test

Summary:

In a study of 75 subjects ages 60-91 who were referred to CA DMV for reexamination (26 of whom were identified as probably being cognitively impaired to some degree), and 31 volunteers ages 56-85, cognitively impaired referrals had significantly more "confusion errors" than cognitively nonimpaired referrals. Confusion (concentration) errors occurred when subjects were unable to proceed to the field office at the end of the drive test, or drove past the street on which the field office was located and did not recognize their error. This particular measure was the only on-road driving performance measure where there was a difference between the performance of cognitively impaired and cognitively nonimpaired drivers. (See Janke and Eberhard, 1998; Janke and Hersch, 1997).

McKnight and McKnight (1998) evaluated the on-road driving performance of 402 drivers age 62 and older. Approximately two-thirds of the subjects were referred to the licensing agency for reexamination based upon reports of deficient driving incidents, and the balance were incident-free volunteers. The road test was based on the Driver Performance Evaluation (DPE) developed by the California Department of Motor Vehicles (see Hagge, 1994). Navigation tasks included remembering a series of directions (turning at named streets and following a sequence of turns) and maintaining spatial orientation in order to drive around a block. The instructions given to subjects for the location-finding task were, "Please proceed until (name street) and turn left/right onto (name street again)." The directions given to travel around the block in order to end up at a specified location and traveling direction were, "In a moment, I'll ask you to make a right turn. When I do, please turn right and then make a series of right turns around the block, ending up on this same street, going in the same direction." The correlation between navigation errors and unsafe driving incidents was significant ($r=0.41$). The incident-involved drivers performed more poorly than the incident-free drivers on the on-road navigation tasks.

Conclusions/Preliminary Recommendations:

A destination-finding task should be included in on-road driving tests tailored to detect possible cognitive impairment among older drivers who are referred for reexamination, or to determine the extent to which cognitive impairment has progressed to the point where driving is not recommended (as in the third-year post Alzheimer's disease onset).

References:

- Janke and Eberhard (1998)
- Janke and Hersch (1997)
- McKnight and McKnight (1998)

IA2(g). Discriminating Maneuver Errors on Road Test

Summary:

Older and cognitively impaired drivers, like *all* drivers, commit many common errors both during the stage of information acquisition and in the execution of vehicle control movements that appear to have little bearing on the likelihood of crash involvement—or rather, that the variance that can be accounted for by differences in these behaviors will always be lower than that accounted for by situational factors (Staplin, Gish, Decina, Lococo, and McKnight, 1998). In the study by Staplin et al., almost all of the older drivers (n=62) failed to look both ways before entering intersections to execute a through maneuver during the green (permissive) phase, and instead, treated their movement as one that was protected. Such "common," or *nondiscriminating* errors are therefore poor candidates for the validation of screening indices, or for identifying individuals deserving one sort of intervention or licensing action from another. Dobbs (1997) similarly has advocated the segregation of nondiscriminating from discriminating (or hazardous) errors in the development and application of screening instruments for driving competency.

Dobbs (1997) studied 279 drivers in three groups:

- 176 patients referred to a clinic with suspected decline in mental abilities (majority were diagnosed with Alzheimer's) with mean age of 72 years;
- 70 mature healthy drivers volunteered for the research (mean age = 69 years);
- 33 young healthy controls also volunteered (age range 30-40; mean age = 36 years).

A two-part road test was administered by 2 experienced driving instructors from the Canadian Automobile Association. Testing was conducted in a mid-sized American car equipped with dual brakes. The first part was a closed course on paved streets with curbs, but was undeveloped allowing traffic to be restricted and signs to be placed as desired. The open road test consisted of 37 maneuvers, required 40 minutes to administer, and was conducted on commercial and residential streets, and an urban freeway. Maneuvers were selected to maximize those implicated in older-driver crashes. Some instructions for downstream maneuvers were given; other maneuvers required planning (e.g., a lane change prior to a turn); and some maneuvers required working memory skills (e.g., turn left after two blocks). There was also a "take me to" instruction.

Definition and scoring of errors was as follows.

- Hazardous or potentially catastrophic driving errors: errors committed by drivers who are no longer competent to drive (e.g., wrong-way on a freeway, stop at green light), and would result in a crash if examiner did not intervene or traffic did not adjust.

- Discriminating driving errors: potentially dangerous errors that signal declining driving skill (e.g., poor positioning on turns and straightaways, observational and scanning errors, and overcautiousness).

- Non-Discriminating driving errors: errors made equally often by good and bad drivers, reflecting bad habits as opposed to declining ability (e.g., "rolling" stops and speed errors). Drivers are not penalized for non-discriminating errors. Discriminating errors are documented and scored in terms of their severity (5, 10, or 51 points).

Hazardous errors were renamed as Criterion errors and their commission results in an automatic fail. A combined criterion of one or more criterion errors and/or discriminating point total exceeding criterion, results in a failure on the road test.

Using the joint criterion, all of the young normal drivers passed the road test, approximately 95 percent of the mature control group drivers passed the road test, and only 25 percent of the cognitively impaired (patient) group passed the road test.

In McKnight and McKnight's (1998) study that compared the on-road driving performance of incident-involved and incident-free older drivers [see *Notebook* section IA2(f)], the incident-involved drivers did more poorly on the following measures: intersection visual search (sharing attention); path maintenance through turns; maintaining a constant speed; positioning the car at intersections and merges; and navigating correctly. They also tended to err on the side of over-caution by driving slowly through turns, on straight stretches, and when changing lanes, as well as rejecting safe gaps at intersections.

Researchers who have compared the driving performance of cognitively-impaired (mild dementia) older drivers and healthy older controls have found that older cognitively impaired drivers make the following errors (Hunt, 1991; Hunt, Morris, Edwards, and Wilson, 1993; Hunt, Murphy, Carr, Duchek, Buckles, and Morris, 1997a, 1997b; Cooper, Tallman, Tuokko and Beattie, 1993; Dobbs, 1997; Janke and Hersch, 1997):

- Stopping at green lights
- Making sudden stops for no apparent reason
- Coasting to near stop in moving traffic
- Failure to check blind spot
- Delay in changing lanes when an obstacle appeared
- Drifting into other lanes
- Wrong lane prior to left or right turn
- Wrong lane after left or right turn
- Impulsive and unsafe left turn
- Attempted left turn when not allowed
- Attempted left turn on red
- Inappropriate decision-making ('judgment') in traffic
- Failed to yield right-of-way
- Misinterpretation of traffic signs
- Failure to move over or stop for ambulance
- Collisions or near collisions on hazard avoidance tasks
- Collisions/near collisions with median
- Wrong-way maneuvers
- Getting lost in familiar areas
- Require repeated step-by-step directions
- Require verbal cues to signal when changing lanes throughout the driving task
- Signaling late (when they did signal)
- Driving while pressing the brake and accelerator simultaneously
- Failing to realize why other drivers honked at them

Conclusions/Preliminary Recommendations:

Driving errors demonstrated by cognitively impaired older drivers differ from the types of errors that many drivers, both good and poor, commit (bad habits as opposed to cognitive decline). Therefore, road tests developed to determine driving competency (older driver re-exams) should include the conditions and maneuvers shown to be problematic to drivers with cognitive decline, and scoring of errors (number and severity) should be such that drivers are not penalized for making errors that do not discriminate impaired from unimpaired drivers. The test must be traffic interactive, performance based, and examine cognitive behaviors.

References:

- Cooper, Tallman, Tuokko, and Beattie (1993)
- Dobbs (1997)
- DrivAble Testing, Ltd. (1997)
- Hunt (1991)
- Hunt, Morris, Edwards, and Wilson (1993)
- Hunt, Murphy, Carr, Duchek, Buckles, and Morris (1997a, 1997b)
- Janke (1994)
- Janke and Hersch (1997)
- McKnight and McKnight (1998)
- Staplin, Gish, Decina, Lococo, and McKnight (1998)

IA2(h). Decision-Making and Response Selection in Driving Simulators

Summary:

(Note: See *Notebook* section IC2(b)iv for a description of driving simulators)

Schiff and Oldak (1993) found performance differences *(EasyDriver)* between 109 older subjects (ages 55-95) and 61 younger subjects (ages 15-54) that included:

- Slower driving speeds by older subjects, particularly in the poor visibility conditions and under headlight glare conditions;
- Longer (but not significant) simple reaction time (RT);
- Longer RT's to traffic events such as braking in response to lead vehicle brake lights, a pedestrian, and the basketball (dusk) scenarios;
- Late braking by 40-90 year olds in response to a school bus pulling into their lane; and
- Lack of response by a substantial number of older subjects to the tennis ball and basket ball (dusk) scenarios.

Using GAR score as a criterion, multiple regression analyses were performed to determine which scenarios would best predict driving performance. A Global Accident Risk (GAR) score was the dependent measure, which consisted of the total number of reported at-fault crashes for each driver, with the addition of up to 3 more points for self-reported medical or driving problems (dizziness, attentional lapses, severe arthritis, poor vision, and poor vehicle control). The resulting range of scores was 0-13. Regression analysis were performed separately for older and younger subjects using 65 years as the criterion age split. For the older subjects, RTs from hit pedestrian, tennis ball, basketball (dusk) and city brakes yielded an $R=.47$, accounting for 22 percent of the variance in GAR scores. For young subjects, schoolbus, hit pedestrian, and tennis ball yielded an $R=.41$, accounting for 16 percent of the variance.

In Szlyk, Brigell, and Seiple's (1993) study of 6 subjects with hemianopic visual field deficits (ages 53-80, mean 71 years) and 7 older controls (ages 62-83, mean 70), simulator performance measures of effectiveness (MOEs) included: mean speed (in mi/h); average slowing and stopping to traffic signals; number of lane boundary crossings; mean break pedal pressure; mean gas pedal pressure; number of simulator crashes; lane position; steering angle and vehicle angle to the road. Six staged driving simulator challenges required visuocognitive/motor skills to avoid a crash; three of these were intersections with cross traffic. Two of the four older subjects who had real-world crashes also had the longest slowing times, the longest stopping times, and the most crashes in the driving simulator.

In a study 82 older subjects ages 60-91 (26 of whom were identified as probably being cognitively impaired to some degree) who were referred to the CA DMV for reexamination, the proportion of errors on simulator trials where the driving video (*MultiCAD*) showed a threat vehicle entering the driver's path from the periphery at 15 degrees (divided attention trials) was significantly correlated with weighted error score on an on-road drive test ($r=.2430$, $p<.043$). A gross measure of the number of errors made in the driving video (angular motion sensitivity trials) significantly correlated with weighted error score on the road test (r=.3462, p< .002). In addition, the correlation between proportion of errors on trials where brake lights were visible and weighted error score on the drive test was significant (r=.2801, p<.013). (See Staplin, Gish, Decina, Lococo, and McKnight, 1998; Janke and Hersch, 1997)

Conclusions/Preliminary Recommendations:

Ecologically valid stimuli (realistic views of the driving environment) yield predictive assessments of the cognitive and visual motor components required in driving. A simulation of apparent motion of self through a three-dimensional environment (even if simulated on a two-dimensional screen) which contains the visual scene complexity associated with the actual driving environment is important for simulator measures for predicting actual driving performance. Simulators are recommended for pre-testing drivers recovering from strokes, cerebral vascular accidents, and those with progressive cognitive disorders, to determine their progress and whether it is safe to assess them on the road. They may also be beneficial in highlighting risks for drivers, who may not acknowledge diminished capabilities, and as an educational tool in a rehabilitation environment.

References:

- Janke and Hersch (1997)
- Schiff and Oldak (1993)
- Staplin, Gish, Decina, Lococo, and McKnight (1998)
- Szlyk, Brigell, and Seiple (1993)

I.A. IDENTIFY OLDER PEOPLE WHO ARE AT HIGH RISK OF CRASHES

I.A.3. Avoidance of High Risk Situations and Other Compensatory Behaviors

IA3. Avoidance of High Risk Situations and Other Compensatory Behaviors

Summary:

Data from the 1990 Fatal Analysis Reporting System (FARS) and the 1990 Nationwide Personal Transportation Survey (NPTS) show that people age 75 and older are involved in more fatal crashes *per mile driven* than people of any other age group (Massie and Campbell, 1993; Massie, Campbell, and Williams, 1995). But, because they drive relatively few miles each year, their fatal involvement rate *per licensed driver* is only slightly above the overall rate. While the *per capita* fatal involvement rate for people age 75 and older is lower than for people of all ages combined, this may be explained in part by the fact that relatively lower percentages of people in older age cohorts hold valid licenses (approximately 50 percent of women age 75+ and 80 percent of men age 75+, compared to 84.5 percent of all women and 92 percent of all men in the population of driving age).

At the same time, an analysis of driving and travel patterns between 1983 and 1990 showed that drivers in age categories 65 and older drove at least 30 percent more in 1990 than in 1983, at an annual increase of 4 percent. Older drivers continued to concentrate their driving between 9:00 a.m and 4:00 p.m. Analysis of the fatality rates by day and night showed that the highest daytime rates were for drivers age 75 and older, while the highest nighttime rates were for drivers age 16-19. For older drivers, the nighttime rate is 1.1 times the daytime rate, while for the youngest drivers, it is 6.1 times the daytime rate (Massie and Campbell, 1993; Massie, Campbell, and Williams, 1995).

A panel data analysis found that although annual miles driven is the single most influential risk factor in crash involvement for older male and female drivers, the influence of mileage on the likelihood of being involved in vehicle crashes is significantly smaller in men than in women (Hu, Trumble, Foley, Eberhard, and Wallace, 1998). For female drivers, the amount of annual driving and limitation in gross mobility (inability to raise arms above shoulder height) were the two significant risks in older women being involved in crashes. For males, being employed and cognitively disabled, having a history of glaucoma, and using anti-depression drugs amplify the likelihood of being involved in vehicle crashes. Use of antidepressants by male drivers is the second most important risk next to the amount of annual driving, doubling the risk compared to drivers who do not use antidepressant drugs. After controlling for the amount of annual driving, men who are cognitively impaired (low score on word recall test), are 40 percent more likely to be involved in a crash than men who are not; cognitive ability is irrelevant in older females being involved in crashes.

In driving habits surveys, older drivers report driving fewer miles and avoiding demanding driving situations compared to younger drivers (Tallman, Tuokko, and Beattie, 1993; Janke and Eberhard, 1998; Gutman and Milstein, 1998). In one study, drivers with the highest avoidance scores were those who performed most poorly on an on-road exam, but avoidance score did not discriminate between cognitively impaired and unimpaired drivers (Janke and Hersch, 1997). In another study, drivers who were more visually and/or cognitively impaired tended to report more avoidance and less exposure (e.g., avoid night driving, high-traffic roads, rush-hour traffic, high-speed interstates, driving alone, making left-hand turns across traffic, driving in the rain; and reported driving fewer days per week); however, relationships between mental status and the avoidance items were weaker than those between visual function and avoidance (Ball, Owsley, Stalvey, Roenker, Sloane, and Graves, 1998). In this study, older drivers with cataracts (n=83) reported more avoidance of driving on high-traffic roads, in rush-hour traffic, on high-speed roadways, alone, and in the rain than drivers with no eye health problems (n=126); however, drivers with cataracts **did not** report higher levels of avoidance of driving

at night and making left turns. Older drivers with age-related macular degeneration (n=19) reported higher overall avoidance than the no-eye-disease group for all avoidance categories. Older drivers with multiple impairments (visual and cognitive) restricted their driving to a larger extent and in more situations than those with visual impairments alone, or those who were functionally normal. Drivers with higher numbers of crashes in the prior 5-year period reported more avoidance of driving in the rain, making left turns, and driving during rush hour.

In a sample of 3,238 drivers age 65 and older who were administered a battery of visual and cognitive assessment tests, the prevalence odds of reduced driving exposure were higher for the cognitive function variables than for the visual function variables, and higher for males than for females (Stutts, 1998). Men who scored in the lowest quartile on the Trail-Making A and Short Blessed tests (cognitive measures) were 6 to 9 times more likely to report driving less than 3,000 miles per year than men scoring in the highest quartiles, and women with low scores were three times more likely to report driving less than 3,000 miles than women with higher scores. The effect of reduced high-contrast visual acuity was greater at higher age levels than at lower age levels. A model developed to predict high risk avoidance (not driving after dark, during rush hour or in heavy traffic, on expressways or interstate highways, on busy multi-lane roads, in rain, or other bad weather conditions) found that the cognitive and visual function measures were associated less strongly with avoidance of particular driving situations than with an overall reduction in mileage. Also, in this model, the odds ratio for the cognitive function measures were only slightly higher than those for the visual function measures.

Although Marottoli and Richardson (1998) found that individuals who drove more miles were more likely to rate themselves as being better drivers than their peers, results of their study showed that on-road driving performance and history of adverse driving events were not related to drivers' ratings of self confidence in their driving ability. The subjects in their study were 125 active older drivers age 77 and older, 40 percent of whom reported a history of adverse driving events. In terms of self-ratings of driving ability, none of the 125 participants rated themselves as being worse than other drivers. Of the 50 participants with a history of an adverse driving event, 34 (68%) rated themselves as being better or much better than other drivers their age; this is identical to the proportion of individuals who rated themselves as better or much better and had no history of adverse driving events. In addition, all nine individuals who were rated by a driving therapist as having moderate or major difficulties on a road test, rated their driving ability at least as good as their peers, and 3 of the 9 rated their ability as better or much better than their same-age peers. Of the 125 drivers, 34 (27%) had a discrepancy in their self-rating of ability (i.e., they had adverse driving events or were rated by a driving evaluator as being poor drivers, but they rated their driving ability as better than that of their peers). The authors state that this indicates a lack of awareness, as these drivers may exceed their limitations and place themselves and others at risk.

Turning to a consideration of whether older drivers know when to stop driving, Stutts, Wilkins, and Schatz (submitted) found that older drivers think they will be the first to know when they should stop driving, and most seniors have not considered the possibility that they may not realize when it is time for them to stop driving. The majority of the focus group participants indicated that seniors do not plan for the possibility that they could outlive their driving ability. This information was obtained through focus group discussions with 44 older drivers who had recently stopped driving (half of the group) or believed that they may stop driving within two years.

Stutts et al. also reported that men are particularly reluctant to stop driving, and often deny any deterioration in their driving skills. Some seniors continue to drive "in spite of everything," regardless of physician recommendations against driving and injury-producing, at-fault crashes. On the other hand, there is a subset of older drivers, typically women, who give up driving prematurely. Generally, these drivers never really enjoyed driving, are uncomfortable in today's driving environment, and have a spouse who drives. Although an event like a hospitalization may trigger their decision to stop driving, often they just drive less and less until they no longer feel comfortable behind the wheel.

Wilkins, Stutts, and Schatz (submitted) conducted one-hour, on-road evaluations of eight senior women who wanted to drive more, but had either voluntarily stopped driving or voluntarily drove infrequently (once per week or less). Subjects were screened by telephone to eliminate those who had a vision or other health problem that prevented them from driving more. The evaluations were provided at no cost to the participants, and were conducted by a certified driving instructor under the auspices of a local driving school. Driving evaluations began at each woman's home. The instructor completed a standard evaluation form (Miller Road Test), and provided each woman verbal feedback describing her driving performance, and whether additional practice and/or driving lessons were recommended. When contacted for a telephone follow-up interview, all of the women described the evaluation as a useful experience, and several indicated that it had given them confidence in their driving ability; these women indicated that they were driving more as a result of the evaluations. All three of the women who had previously ceased driving indicated that they planned to resume driving, at least enough to maintain their skills. The authors state that although it is unknown how much the women would be willing to pay for an evaluation and lessons, such a countermeasure would help keep older women on the road safely, longer than they would without such intervention. Education for older drivers as a rehabilitation procedure is described in *Notebook* section IC3a(i).

Conclusions/Preliminary Recommendations:

Mileage-based crash risk increases with age, and this risk can be offset to some degree by self-regulation (driving less frequently and fewer miles, and under less demanding conditions). Many older drivers (who are aware of diminished abilities) compensate for age-related functional declines at the strategic level by planning to avoid rush hour or nighttime driving, and at the tactical level by adjusting speed (driving slower) and accepting larger gaps at intersections. Sensory and physical declines are easier to identify and compensate for (and potentially correct) than are cognitive declines. But, recent research has shown that the prevalence of undetected eye disease increases with age (Decina and Staplin, 1993; Shipp, 1998). Possibly more serious is the driver with diminished cognitive decline. Drivers with dementia overestimate their capabilities (Cushman, 1992) and may not restrict their driving to times and situations that reduce risk (they don't compensate because they are not aware of their decline). Janke and Eberhard (1998) found that the amount of avoidance reported in a driving habits questionnaire did *not* discriminate between cognitively impaired referral subjects and cognitively unimpaired referral subjects. Also, drivers who have no access to alternative transportation and who live alone may be more likely to drive in situations, even when they realize they are at higher risk; reports from older driver focus groups consistently indicate that when there is no choice but to drive to get to doctor appointments, grocery shopping, etc, they will do so.

As reported by Stutts (1998), while approximately half of the drivers in the lowest quartiles of performance on a cognitive function test (Trail-Making A and B), reported driving less than 3,000 miles per year, the other half of this population is driving over 3,000 miles per year, and 20 percent of the entire sample reported driving more than 10,000 miles per year. While many older drivers with cognitive and visual impairments limit their driving exposure, self-regulation alone does not adequately protect the public's health.

A program that provides materials to help older drivers assess their own capabilities and provides tips for reducing driving risk must be accompanied by a coordinated effort that includes health-care professionals, individuals in the community who come in contact with older persons, DMV counter personnel, and law enforcement officers to ensure that older drivers remain safely mobile. In addition, driving evaluations and on-road lessons may help provide confidence in driving ability for older drivers who are fit to continue to drive but cease or restrict driving prematurely.

References:

- Ball, Owsley, Stalvey, Roenker, Sloane, and Graves (1998)
- Cushman (1992)
- Decina and Staplin (1993)
- Gutman and Milstein (1988)
- Hu, Trumble, Foley, Eberhard, and Wallace (1998)
- Hu, Young, and Lu (1993)
- Janke and Eberhard (1998)
- Janke and Hersch (1997)
- Marottoli and Richardson (1998)
- Massie and Campbell (1993)
- Massie, Campbell, and Williams (1995)
- Ranney (*in press*)
- Shipp (1998)
- Stutts, Wilkins, and Schatz (submitted)
- Stutts (1998)
- Stutts, Stewart, and Martell (1996)
- Tallman, Tuokko, and Beattie (1993)
- Wilkins, Stutts, and Schatz (submitted)

I.B. DEVELOP MODEL PROGRAM COMPONENTS TO REGULATE AND COUNSEL HIGH-RISK OLDER DRIVERS AND TRANSPORTATION SYSTEM USERS

I.B.1. DMV/Licensing Activities

IB1. DMV/Licensing Activities

With the sharp increase in the number and percentage of older drivers in the population that will occur in the years ahead, and the decline in a wide range of functional capabilities that is normally associated with aging, there will be an inevitable impact on highway safety unless the most at-risk individuals can be identified through screening procedures that are fair, accurate, and which can be administered cost-effectively by State/Provincial licensing agencies. The development and field testing of a Program which can meet these goals, while educating and counseling affected drivers about options to preserve (or even extend) their mobility are all key to success in this area.

A crucial first step is to evolve a framework to guide and coordinate the activities of the various external sources that may refer drivers into a screening Program, while seeking to standardize the reporting procedures and formalize lines of communication back and forth between these referral sources and a Motor Vehicle Agency. From the very outset of an individual's Program involvement, it must be assumed that community and private sector organizations will play a major role in the identification of at-risk drivers—*and* that motor vehicle agencies will report back to external sources the status of referred drivers within legal bounds of privacy and confidentiality. It is recognized that external referral sources and referral mechanisms will need to be identified and described in detail prior to implementation of the Model Program.

Of course, at-risk drivers may also be identified through activities undertaken by an Agency itself. Applicants for renewal (and, optionally, original applicants), could be"pre-screened" through direct interactions with counter personnel, where candidates for functional screening are selected using standard and objective criteria. Screening might also be triggered by crash or violation experience; by age; or by a statistical sampling procedure (reflecting, for example, the relationship between age and crash rates). Self-selected populations, such as those applying for handicapped status, also could be required to undergo screening. Selection of candidates for testing will vary from one jurisdiction to another. But the Model Program will emphasize the need for drivers, once targeted for functional screening, to be assessed in terms of a common set of "first-tier" performance criteria.

The first-tier screening procedures focus on gross impairments (and, optionally, vision screening and/or road sign and knowledge tests). These tests are designed to catch those persons with the most serious physical or mental limitations using procedures that can be administered in a brief time (under five minutes), by current staff (with special training), in existing facilities, and without special equipment. Such persons would typically experience loss of licensure or restriction of term and/or privilege, allowing for due process. At the same time, the most *capable*—given a clean driving record—would be passed for license renewal without any further action.

Another outcome of the first-tier screening activities could be an administrative determination for additional testing. This might occur, for example, where an individual's standardized scores are marginal (i.e., a gross functional deficit is not demonstrated conclusively), but his/her driving record contains indicators of prior negligence. It is also possible that some individuals, depending upon their source of referral into the Program, could proceed directly to this "second tier" of assessment. Second-tier testing will likely address medical conditions, and/or attentional, perceptual, or cognitive functions, using tests that often require more sophisticated, costly, and lengthy procedures to assess reliably. While an Agency may wish to undertake such testing "in-house," the Model Program will certainly allow for physicians or other health care professionals or (certified) private sector entities to carry out these activities, given uniform reporting requirements.

Under the Model Program, after the requirement(s) for functional testing are completed for a given individual, any among a full range of licensing actions may follow (including no action). Specific actions relating to specific test outcomes or cutoff scores will be suggested but not mandated within the Model Program. States' practices with regard to options for restricting driving privileges will vary, as will drivers' rights to appeal restriction or removal of privilege, to demand retesting when diminished functional capability is indicated, or to demand a road test. In all cases, however, the Model Program will call for an Agency to provide individualized feedback on test performance and its consequences (i.e., prior to a licensing action). Education and counseling activities are also critical: Individuals should be provided with information identifying alternative transportation options in their communities; and, those who retain driving privileges should receive materials describing strategies and tactics to help compensate for future loss of functionality (e.g., flexibility and strength-building exercises, walking, proper nutrition), together with techniques for self-testing to increase awareness of one's own declining abilities.

Pilot studies conducted in Maryland between Spring 1998 - Fall 1999 will evaluate components of the DMV model, with a focus on driver screening and assessment. The objectives of driver testing activities carried out in Maryland are to perform limited validations of Model Program components in a DMV setting, using a retrospective case-control study methodology which tests how well functional measures can discriminate between matched older driver groups who *are* and *are not* (a) crash-involved; (b) medically referred to the MVA for evaluation; and (c) who *have* and *have not* accumulated 3 or more points on their driving records. Thus, data collection and analyses resulting in the preliminary validation of screening instruments in terms of crash involvement, (multiple) violation involvement, and the (medical) referral status of older drivers are study goals. These data will support an assessment of the administrative feasibility of all included functional testing/screening techniques included in the pilot study and may assist with assignments of individual drivers to receive tailored road tests for selected conditions (e.g., visual, cognitive and/or physical problems).

I.B. DEVELOP MODEL PROGRAM COMPONENTS TO REGULATE AND COUNSEL HIGH-RISK OLDER DRIVERS AND TRANSPORTATION SYSTEM USERS

I.B.2. Integrated Health, Social Service, and Community-Based Agency Activities

IB2. Integrated Health, Social Service, and Community-Based Agency Activities

The most comprehensive solution to improved driver screening and evaluation is likely to incorporate a community-based approach where driving assessments and case management components are performed by entities outside of the DMV. Current examples of this approach are the "Getting in Gear" (GIG) program in Florida; Older Driver Evaluation Program of The Ohio State University Medical Center Office of Geriatrics and Gerontology (Franklin County); Michigan Area Agency on Aging "You Decide: Senior Driving Awareness Program" (Ann Arbor, Birmingham, and Romeo); Mature Driver Retraining Workshops (Oakland County, MI); the Older Driver Safety Project (DeGraff Memorial Hospital and Rochester Rehabilitation Center, New York), Howard County, Maryland's "Getting Around—Seniors Safely on the Go" Program; and The Senior Health Center at St. Mary's Hospital (Richmond, VA). The following discussion highlights components of these programs.

Community-based programs offer an opportunity to provide early detection of driving problems and a range of solutions—through referrals to remediation, retraining, and counseling about changes in driving habits and alternative transportation options—in convenient and non-threatening settings. With the availability of affordable and effective tools, applied consistently across settings, interventions in the community can address a range of older driver needs that fall outside of traditional procedures for license renewal. As diagrammed on the following page, the overview of an integrated approach to driver screening and evaluation assigns prominent and complementary roles to the DMV and to service providers in the community.

This approach relies heavily on coordination, cooperation, and communication between various agencies within a community, and while the basic mechanics will be similar across communities, the specific entities will likely vary with each program implementation. Community-based programs, including voluntary programs to assist aging drivers assess their skills and remain safe on the road include the following components: (1) assessment of competency to drive; (2) driver education and training; and (3) case management/agency referral.

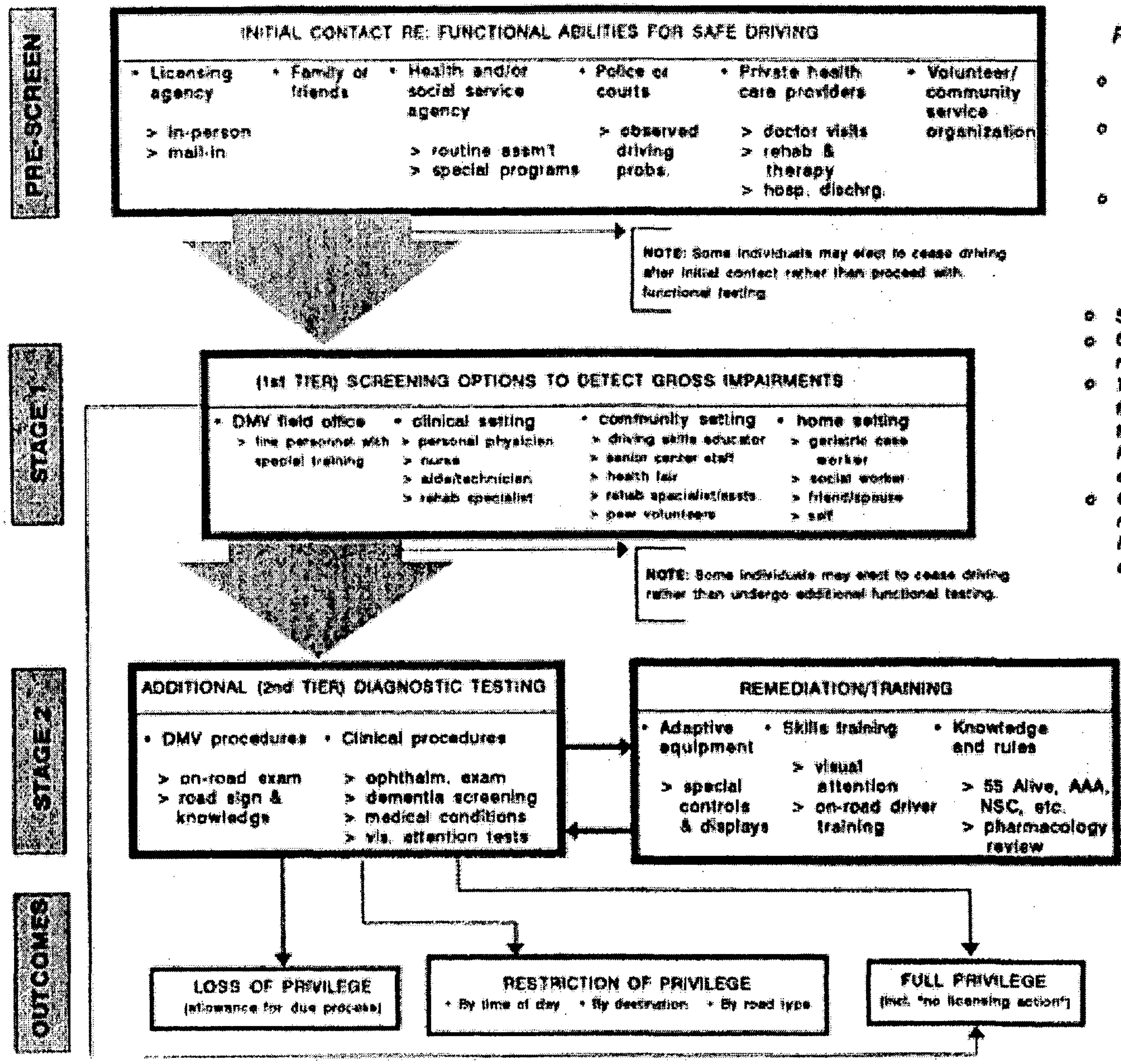
External Referral Mechanisms: External (outside of the DMV) referral mechanisms include: self referral; referral by family, friends, and other caregivers; physicians, hospital discharge planners, Geriatric Evaluation Services (GES); occupational and physical therapists; individuals working in Area Agency on Aging facilities (e.g., senior centers); insurance agents; and law enforcement.

The Older Driver Evaluation Program in Ohio has a formal program with four municipal courts in the area, which allow the Judge or Mayor to give the older adult a choice to agree to undergo the evaluation either as an alternative to formal charges for a motor vehicle violation, as a means of identifying deficits that might threaten future successful driving and independence, or as a means of determining current function and potentially lessening license suspension time frame. However, in the GIG program in Florida, participation in the program is currently voluntary, and there are no consequences for not participating.

Regarding police referral, experience in Florida has indicated that although deputies supported the program and referred a total of 71 drivers during a test period, most of the drivers who were contacted by Program staff during a follow-up telephone call denied that they had diminished capabilities and needed the Program's service. Over 65 percent of those contacted stated they should not have been pulled over (e.g., "no one stops for that stop sign"). Eighty-five percent of those who were contacted declined to participate, once they learned that there were no consequences. Seven place holder for integrated model

INTEGRATED MODEL DRIVER SCREENING AND EVALUATION PROGRAM OVERVIEW

MOD. 3/99



KEY COMPONENTS AND RESOURCE REQUIREMENTS

- *Targeted, accessible information and education materials*
- *Efficient interface between DMV and health & social service providers for referral and follow up*
- *Coordination/counseling for use of transportation alternatives*

- *Standard test protocols*
- *Quick and cheap to administer, with reliable results; face valid*
- *Testing outcomes that lead logically to a requirement for additional testing; to remediation/retraining; or if sanctioned by DMV, to a licensing outcome (renewal)*
- *Counseling and support for decision making by drivers and families, including transition to mobility alternatives*

- *Specialized skills and equipment required*
- *Relatively lengthy procedures and/or multiple sessions needed*
- *Re-testing for progressive conditions, and to monitor retention of training and skill maintenance, may be needed*

- *Includes limits on exposure*
- *May tailor re-testing interval for individual needs*
- *Coordination/counseling re: public & private options to meet quality-of-life needs*

percent of those contacted did participate, and an additional 4 percent gave up their licenses on their own after being pulled over. The Program Director offered that this component "needs an incentive," to get law enforcement-referred drivers to participate. Such an incentive would include implementing a requirement for drivers stopped by law enforcement to participate in the GIG Program in lieu of ticketing, or to reduce the fine. But without this kind of incentive, drivers won't use the program.

For senior assessments at St. Mary's Hospital, patients must be referred to the center by their primary physician. A caregiver or family member with the patient's history must be present at every appointment. The comprehensive senior assessment is helpful for the following kinds of individuals: those with a decline in functional ability; those who may need a change in living situation; those who show increasing frailness; those who show a change in behavior or increased forgetfulness; those who have unsteady balance or have a history of falls; those who have a problem with incontinence; those who use multiple medications; and those with multiple active medical problems. The focus is on identifying remedial problems that, when addressed, can maximize independent functioning, and thereby improve a person's overall quality of life. Often, physicians refer clients for an assessment to avoid the unpleasant consequences of telling a patient that he or she should no longer be driving. Families often want an objective decision to back up their beliefs that a client should not be driving.

The three Area Agencies on Aging sites participating in the "You Decide: Senior Driving Awareness Program" in Michigan coordinate with state and local agencies, and public transportation authorities to identify older drivers who either (1) should no longer be driving; (2) want/need to determine if driving is still safe; or (3) want/need to plan for a future when driving may no longer be possible. These persons are targeted for participation in the Program.

Referral into the DeGraff program are made by primary care physicians, family members, individual older drivers, the Alzheimer's Association, and Allstate Insurance Company officials. In addition, the following community partners will refer older persons into the program: Offices for Aging, health professionals, AARP, the Department of Motor Vehicles, the American Automobile Association, NYS Office of Vocational Services for Individuals with Disabilities, and human service organizations.

<u>Driver Assessment Component:</u> Present assessment tools employed by various programs follow. The GIG program includes the Mini-Mental State Examination (MMSE), the Automated Psychophysical Test (APT), the Useful Field of View (UFOV) test using the Visual Attention Analyzer, and an on-road driving test. Assessments performed by professionals in the Ohio Older Driver Evaluation Program include: a self-report questionnaire to obtain information regarding health status and behaviors, adaptive aids, driving habits, living arrangements, caregiving responsibilities, and much more; a pharmacological review; a hearing screening; MMSE; Trail-Making Parts A and B; vision screening (Optec 2000 Vision Screener); range of motion, balance, strength, and endurance; reaction time and threat recognition subtests of the Doron L225 Driving Simulator; and an on-the-road assessment, first in the parking lot and then in traffic. The Michigan Mature Driver Retraining Workshops (conducted by a AAA-certified instructor) include a 4-hour session using AAA's Safe Driving for Mature Operators course, supplemented with psychophysical tests to allow an individual to evaluate his/her own abilities (participation is voluntary and results are confidential). The tests include simple RT; visual acuity and depth perception; and visual attention (Visual Attention Analyzer/UFOV). An on-road driving evaluation is also given by a retired law enforcement officer who is AAA certified, on a course laid out by University of Michigan Traffic Engineering Department. The instructor indicates problems in driving behavior and offers suggestions for improvement. The on-road appraisal results are also confidential.

At the Senior Health Center at St. Mary's Hospital, driving history and fitness to drive are assessed as part of the health assessment. The client's previous driving record is reviewed, the family is asked if they have observed unsafe driving behavior, and questions are asked of the client and family about whether the patient gets lost while driving. A physician performs a review of the client's medical record, and other team members administer a battery of cognitive and functional tests. The cognitive tests include: the MMSE, a clock draw test, and the set test (which requires clients to name as many items in four categories as he or she can think of). A geriatric depression screen is also administered. Functional tests include a review of activities of daily living, and tests of mobility, gait and coordination. Clients may be referred to a neuropsychologist for more in-depth testing, including reaction time. The assessment outcomes are categorized as follows: (1) clearly safe to drive; (2) clearly unsafe to drive; and (3) possibly safe with intervention/needs more testing.

DeGraff Memorial Hospital and Rochester Rehabilitation Center are developing, implementing, and evaluating a replicable driver assessment, remediation, and referral program for older adults. The evaluation and assessment component includes visual acuity testing (day and night); reaction time testing; cognitive testing; and hearing tests, in addition to an assessment of rules of the road knowledge and an on-road driving assessment.

<u>Driver Education and Training Component</u>: Experienced (i.e., non-novice) drivers participating in the GIG program take the NSC Defensive Driving Course ("Coaching the Mature Driver"). This 6-hour course deals with the effects that aging has on driving ability. Drivers then receive a three-year auto insurance discount. Interestingly, according to the GIG program director, the people who choose to take the National Safety Council's defensive driving course are younger and more mobile than the people who want the driving assessment. Of the 200-300 people she taught over the past year, all have *known* someone else who should stop driving, but none think they have a problem with driving. The Program director noted that none of the Mature Driver class participants came to GIG for assessments or training. Preliminary findings of several research studies currently underway indicate that perceptual skills training to increase the size of the useful field of view (using the Visual Attention Analyzer) may reduce the crash risk of older drivers, and make it a tool for remediation of certain types of deficits [see *Notebook* Section IC3(a)ii]. The Getting in Gear Program has recently implemented UFOV testing and training.

The Mature Driver Retraining Workshops in Michigan include a 4-hour classroom review using AAA Workshop Materials. The workshop is conducted by certified instructors (AAA certified), who are retired enforcement officers (and therefore are age-peers of the participants).

The goals of the "You Decide: Senior Driving Awareness Program," conducted by the Michigan Area Agency on Aging through funds provided by the Michigan DOT Service Development and New Technology Funding Assistance Program, are to assist older persons and their families with driving safely for as long as possible, and to assist older adults with locating appropriate resources, alternatives, and support when safe driving is no longer possible. Educating older persons and providing input into the development of new or alternative/public transportation is also a goal of the Program. The "You Decide" model is based on the program "Driving Decisions for Seniors," developed by Ms. Ethel Villeneuve, in Eugene, Oregon (see Heckmann and Duke, 1997). Older persons will be trained to become volunteer peer-counselors to educate, support, guide, and assist older drivers in making appropriate mobility decisions. (Currently, project coordinators facilitate the groups, however, proper volunteer training is crucial to sustaining the project after the pilot period has ended. Project coordinators will recruit and train up to 10 volunteers to lead the program after the 2-year pilot program has expired). Senior Driving Awareness Program participants meet monthly at local senior centers for a two-part meeting. The first part offers information on a variety of topics including: how to improve or assess driving skills; when to consider restricting driving; how to cope with the emotional aspects of driving restriction or cessation; what public and alternative transportation options are available; how to participate in transportation planning efforts and public forums; and what to consider when planning for future mobility needs. Meeting topics to date have also included video presentation of AAA's "Older and Wiser Driver;" a discussion of the effects of medication and driving with a pharmacist, where attendees bring medications to the meeting for a one-on-one discussion with the pharmacist; and presentations by occupational therapists from the driving rehabilitation programs at several area hospitals. The second portion of the meeting is a support group where older persons and/or family members discuss issues of relevance to the older driver, such as lack of alternative transportation and geographic limitations, dealing with anxiety and feelings of separation associated with no longer driving, and problems with assisting family members who have dementia and other disabling conditions and continue to drive. Group trips are also arranged to help older persons who have never used or are uncomfortable using public or alternative transportation. Whenever possible, group trips are coordinated with travel training programs which are sponsored by local public transportation providers.

The Area Agency on Aging in Michigan publicizes the meetings through press releases, public service announcements, posters, flyers, and senior newsletters, distributed through local senior centers, libraries, YMCAs, and senior apartment buildings. The program has also been featured in at least one local newspaper. An evaluation report was produced by Special Program Evaluators and Consultants, Inc. (SPEC Associates) for the period January-March, 1998. A total of 111 individuals attended one or more sessions. Based on six meetings of the "You Decide: Senior Driving Awareness Program," the average number of participants per meeting has been 15; 72 percent are female and 28 percent are male. The average age of the participants is 75. Forty-eight percent of the participants are still driving with no restrictions and 37 percent are self-restricting their driving in some way. Sixteen percent reported having had a crash in the past two years. Focus group interviews were held with the participants; they dislike the name of the program because of the term "older driver." (Note: the program was begun under the name of "You Decide: Older Driver Program.") The participants agreed on a new name in April of 1998; the name of the Program has been changed to "You Decide: Senior Driving Awareness Program." The evaluation report states that the "Senior Driving Awareness Program helps participants to retain driving privileges for as long as safely possible by attracting a high-risk group of participants and providing for them a forum for discussing driving safety-related issues. The Program helps seniors cope with the emotional distress and life changes that accompany driving cessation by helping them to see that they are not alone in their experiences, and by teaching them how to cope with the substantial changes resulting from cessation of driving." A total of 433 individuals have attended meetings during the period of January 1998 to December 1998.

<u>Case Management/Social Agency Referrals</u>: If a driver decides to reduce or stop driving, or does poorly on the computer and road tests, professional case managers working in the GIG program help link the individual with available social programs such as alternative/public transportation, shopping, meals on wheels, adult day care, housekeeping, etc. Or, the case manager may refer a client to a physician for a physical exam or pharmaceutical review. The case worker works closely with the client's family regarding alternative transportation and dismantling/selling the client's car, if necessary.

In the Ohio Older Driver Evaluation Program, training may be prescribed or doctor visits recommended. A transportation resource guide has been developed to lead people to alternative transportation, if they must restrict or eliminate driving. The program works closely with the family, as the older driver issue is a family issue. The program can also help with alternative housing choices (to make alternative transportation/mobility easier) and other spin-offs of the older driver issue (e.g., nutrition). Program administrators have found that stopping driving can have a negative impact on health, and become involved in conversations with older adults and their families which illustrate these issues on a regular basis. Evaluation outcomes for the 400 drivers evaluated to date are as follows: 56 percent of the clients were found to be capable to drive safely at the time of the evaluation, or were capable with vehicle modifications; and 44 percent were determined to be incapable, which included those who are unsafe now, but may be safe after rehabilitation, surgery (cataracts), etc.

For Senior Health Center (St. Mary's Hospital) clients who are deemed clearly safe to drive, a recommendation is made to the client's family to ride with the driver frequently to keep track of the client's performance, and to notice cognitive changes over time. If a family member becomes uncomfortable riding with a client, that is a danger signal that the person's competency may need to be reassessed. For those who are deemed clearly unfit to drive, a "no driving prescription" is written and the client is reported to the DMV; the DMV will revoke a license. For those who need intervention, a referral is made to additional disciplines, such as ophthalmologists if the problem involves visual capability (e.g., for cataract removal) or to a physical therapist if the problem involves mobility/flexibility/strength. There are two private pay driver evaluation programs in Richmond, VA that provide additional testing and restorative therapy. For drivers who need more testing, referrals also are made to the DMV for knowledge testing, on-road testing, or both (at no charge to the client). The Health Center does not perform driving evaluations. The Center counsels families of clients who are judged not fit to drive, about what to expect from the client (anger, depression, etc.). Tips are given regarding how to keep a cognitively impaired client from driving, who doesn't remember that he or she is not supposed to drive. Alternative transportation options are also explored, including public transportation, connections with volunteers, paid private drivers, as well as a consideration of moving to an assisted living community that provides transportation.

One of the products that will be produced by the "Senior Driving Awareness Program" will be an information and referral database to include a variety of mobility resources for older drivers including: current defensive or driver improvement courses; physician assistance and medical retraining/evaluation programs; secretary of state offices; counseling resources; public and alternative transportation resources; and peer-support programs including the "Senior Driving Awareness Program." This will fill a void—there is no local or regional source that older adults and families can turn to for comprehensive information and assistance with mobility decision-making and planning. Area Agency on Aging staff have reported making referrals for participants to defensive driving/educational programs, medical programs, local transit providers, and housing.

Possible interventions included in the DeGraff program are: referral to special vehicle modifiers; referral to driver specialist for on-road remediation; referral to medical personnel; referral to driver retraining programs (AAA or AARP); support group/counseling for driver (and family) who is advised to cease driving; and counseling on options/alternatives to driving.

The GIG Program manager indicated that several issues should be considered in future programs. First, some drivers who give up or lose their driving privileges may be physically isolated (no spouse, friends, grown children) and become emotionally isolated. They stop socializing, going to church, and doing proper (healthy) grocery shopping. They are at risk of clinical depression and can become suicidal. The GIG program manager recommends that a depression screen be part of any program, and be completed within 3 months following the decision/requirement to cease driving, so counseling can take place, if necessary. For those who choose to reduce driving, GIG recommends a re-test after 1 year, and during that year they suggest that the driver learn about and experience alternative forms of transportation. A recent study that highlights the importance of staying socially connected in one's community deserves mention. Researchers at Iowa State University in Ames, Iowa, and the University of Iowa College of Medicine in Iowa City concluded that extreme loneliness was a significant predictor of admission to a nursing home among rural older men and women. Study senior author Dr. Robert Wallace of the University of Iowa says, "interventions to prevent loneliness should be explored in order to keep older people independent." He and his colleagues believe that many of elderly living in rural areas need better access to transportation so that they can more easily stay in contact with relatives and friends. Community groups need to be encouraged as a means of bringing still-independent individuals together. Regular involvement in group activities seems to help ward off a dependence on nursing home care. For example, the investigators discovered that elderly churchgoers experienced much lower rates of nursing home admissions compared with those who did not regularly attend services.

Next, it was brought to the GIG program director's attention that a young/middle-aged female may not be the best choice for counseling older men to restrict or eliminate driving. Older men are proud and independent and see the car and driving as part of themselves. In homes where there is a wife, there is often domestic abuse; oftentimes, the wife is silent about encouraging the husband to reduce or stop driving. The director suggests having older men mentor older men, possibly through the employment of retired police officers who would go to a driver's home to help him make decisions about stopping/reducing driving, what to do about a car (e.g., how to sell it), and going with the older person to show him how to use alternative transportation.

On the other hand, older women who have never driven but find themselves faced with no transportation after the death of a spouse, may start or resume driving, with little skill. Older women may benefit from referral to a driver education program, as well as information about alternative transportation in the area. Additionally, assertiveness training may be recommended, because it was noted that many women will not ask for help from providers of transportation (stepping up on a bus) and will just not use the alternative transportation option.

<u>Diversity of Practices Regarding Interactions with DMVs</u>: Currently in Florida, only with the client's consent can GIG staff provide feedback regarding poor performance to the Department of Driver Licensing (DDL), and to the family, the physician, and other care providers, for that matter. Otherwise, test results are confidential, and GIG believes referral to the DDL without permission is a breech of confidence that would be a detriment to the success of the program. However, if a client decides to voluntarily surrender his or her license after counseling by GIG staff regarding computer and road testing performance, a voluntary surrender form, developed by the DDL can be signed, and a GIG case manager can forward the form to the DDL. The DDL will update the driver history and send the driver a letter of appreciation. If a driver voluntarily surrenders his or her license directly to the DDL, the DDL will contact GIG, if there seems to be a need for counseling and social services link up (regardless of age).

Although not currently in place in Florida, if a driver fails a DDL mandated re-examination (e.g., can not pass the road test after 5 tries), he or she will be given the choice of immediately having the license suspended or having a 45-day suspension with the opportunity to participate in the GIG program. The driver will need to successfully complete the DDL re-examination to keep his or her license. DDL and GIG procedures act independently of one another, such that a road test given by GIG does not count as a test given/passed/failed by DDL. If the driver does not contact GIG and re-take the DDL re-examination or does not voluntarily surrender the license, the Florida 5-day process will continue (the re-exam must occur in 5 days, or the license will be immediately suspended). One point the program director at GIG made was that some proportion of drivers whose licenses are suspended continue to drive. GIG wants to analyze some of the DL records this year. Also, if a person with dementia has his or her license suspended, who follows up to make sure the individual isn't driving? Who helps the person with selling the car?

The results of the assessment conducted by Older Driver Evaluation Program staff (Ohio) are provided in written consult form to the older adult's physician, with a copy sent to the older adult to facilitate communication and compliance with recommendations. Of particular interest, is that a consultation letter is not sent to the Bureau of Motor Vehicles. The evaluation is a health care referral program, and is handled within the health care boundaries between program staff, the older adult, and his or her physician. It is the physician's responsibility (moral obligation more so than a legal obligation) to ensure that an unsafe driver doesn't drive, and the evaluators work closely with the referring physicians to identify liability and other legal issues related to the driving decisions of their patients.

Participation in the Michigan Mature Driver Retraining Workshops is voluntary. No psychophysical test scores are maintained, and the results of the on-road evaluation are confidential. The Workshop results have no bearing on driver licensing.

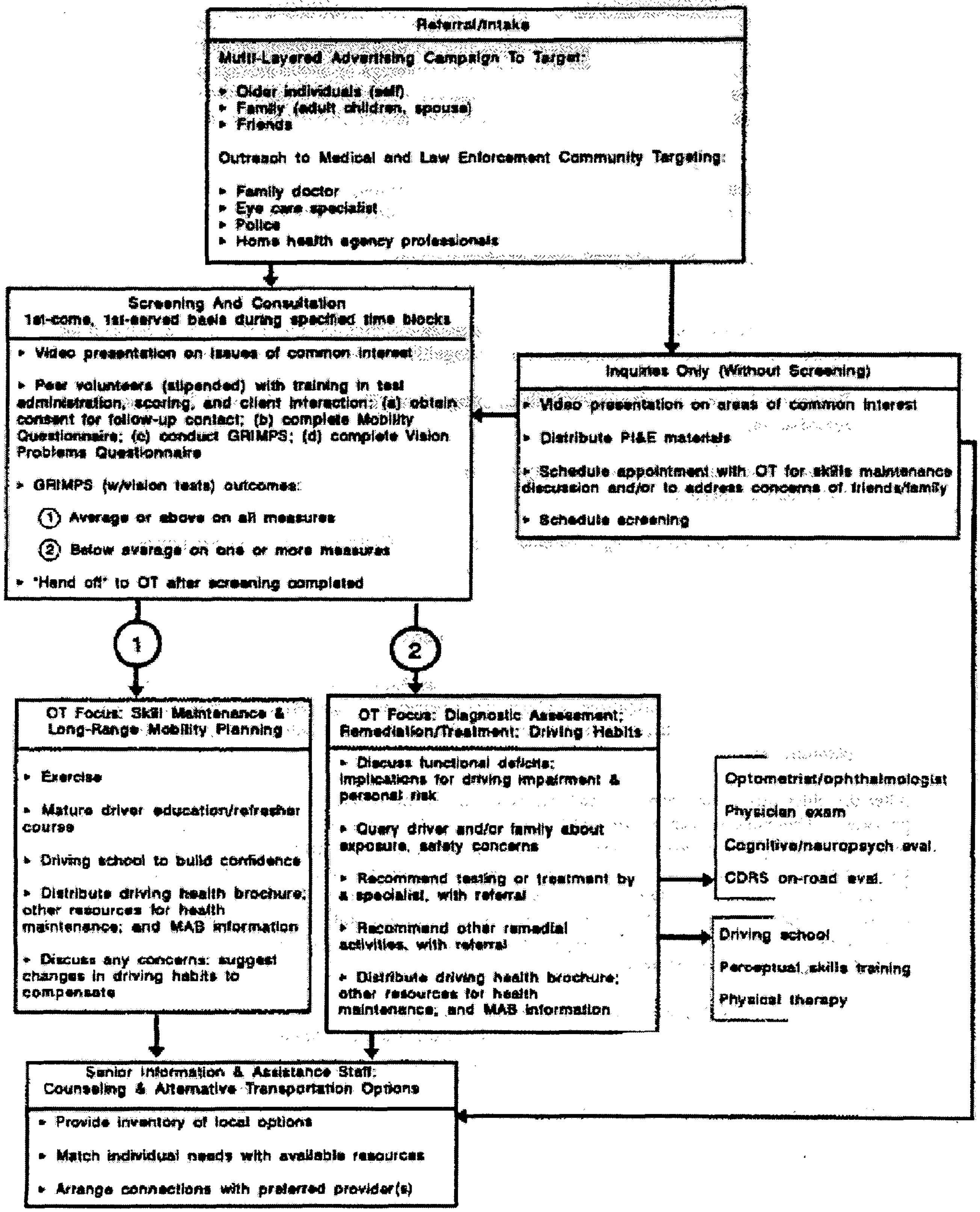
Getting Around--Seniors Safely on the Go. Another, noteworthy attempt to implement and evaluate an integrated, community-based model for driver screening, counseling and referral activities is being carried out as part of the Maryland Pilot Study, in Howard County, MD, through the Area Agency on Aging and its affiliated Senior Centers in the county. An overview of key elements in this project is presented in the diagram on the following page.

The Howard County, MD project is funded initially to run from March through December, 1999, beginning with two and expanding to four Senior Centers. Its stated goals are to: (1) Keep older drivers safely on the road as long as possible; (2) Provide effective intervention for unsafe older drivers; and (3) Ensure that older adults who no longer drive are provided with appropriate and adequate alternative transportation in order to remain connected with their communities.

In its 9-month pilot phase, the Howard County effort will help explain how well functional abilities for safe driving—as measured by a quick, simple, and low-cost screening tool (GRIMPS)—relates to seniors' driving experience. Analysis of the data for a projected sample of 650 seniors may contribute to a preliminary validation of the screening tool. By performing the screening in Senior Centers, it may also be determined if the national Area Agency Network can be utilized to engage seniors in maintaining safe mobility—by driving as long as they can safely do so and then choosing the best transportation alternatives to sustain a high quality of life—through accurate screening, counseling, and referral services. Follow-up information for all seniors taking the screening will be collected for up to five years by telephone and/or mail surveys. This includes changes in health, driving habits, use of transportation alternatives, and driving incidents and crashes.

Project activities are carried out by older volunteers trained as "peer screeners," Occupational Therapists (OTs), and staff of the Senior Centers themselves. Senior volunteers are trained to administer GRIMPS, but provide feedback to older drivers only to the extent of sorting performance into two categories: "below average" versus "average or above," based on "cut points" for each test procedure provided through NHTSA's "Model Driver Screening and Evaluation Program" contract. Further feedback, interpretations of screening results, referrals, etc., is provided by an OT who has completed in-service training in driver evaluation by a Certified Driver Rehabilitation Specialist (CDRS). Screening and counseling is done on an appointment basis only. The OT reviews page for Howard County AAA diagram

Pilot Study Elements Conducted Through the Area Agency on Aging



and discusses the screening results with the driver. This health professional provides feedback to the driver in one or more of the following areas depending on whether the focus is skill maintenance and/or long-range mobility planning for those who score average or above average on all GRIMPS measures. For drivers with below average scores, the OT's recommendations may be in the direction of follow-up assessments, remediation/treatment activities, and/or changes in driving habits. These include:

- Recommendation to see an eye-care specialist, either through the older person's primary care physician, or an eye-care specialist covered under the driver's medical insurance;

- Recommendation for a physical exam or pharmacological review by the driver's primary care physician;

- Recommendation for examination by a neuropsychologist/psychologist (by referral through the primary care physician) if dementia or other cognitive impairment is suspected or evident;

- Recommendation for consultation with an Occupational Therapist or Physical Therapist for remediation;

- Referral to a senior center, community wellness center, or other exercise program for health maintenance activities;

- Referral to a certified driving rehabilitation specialist (CDRS) if the driver has recently suffered a stroke, head trauma, appears unfit to drive, or could benefit from adapted driving equipment;

- Referral to a driving school is the person is fit to drive but lacks confidence; or

- Referral to a mature driver retraining class (such as AARP's 55-Alive) if general information is needed such as visual, cognitive, and physical changes with age; effects of medication and fatigue; review of signs, signals, pavement markings, driving in adverse weather; trip planning, etc.

After the older driver has been screened, but before he or she is seen by the OT, written material is provided. This material can be perused by the driver while waiting for counseling, and may be referred to during the counseling session. The older driver is given material on alternative transportation in Howard County, senior resources, and material related to safe driving and aging. For access to public transportation, the driver may be referred by the OT (which can be reinforced by the Senior Center staff) to the Senior Information and Assistance staff who can certify older adults over the phone and will discuss other types of community-based transportation depending on the individual needs of the older person.

At the end of the screening and counseling session, participants are given written information describing reporting procedures and review practices of the Maryland Medical Advisory Board (MAB). While the Howard County Office on Aging will not directly report any program participants to the Motor Vehicle Administration, it is appropriate to reinforce knowledge of existing laws and procedures regarding medical competence to drive.

The Howard County Office on Aging promotes the screening and counseling program through:

- Publicizing in the Howard County Office on Aging *Senior Connection* newspaper;
- Local cable coverage through regular senior shows and special taping of screening and counseling activities with willing older drivers;
- Direct promotion through all Howard County Senior Centers;
- Direct mailing to approximately 10,000 seniors on Office on Aging mailing list;
- Interviews of volunteers and/or participating older drivers with local and regional newspapers;
- Press releases to newspapers in Baltimore-Washington area;
- Promotion to local churches, senior groups, and other appropriate organizations;
- Purchase of advertising in local newspapers;
- Promotion to groups consisting of adult children;
- Posting information on the Howard County Office on Aging web site;
- Promotion of project through other community publications such as Howard County General Hospitals "Wellness Matters" mailed to all Howard County households; and
- Publicizing through Howard County government internal newsletters (such as *The Daily Grind* for Howard County employees, and the Police Department's paper).

In addition, word-of-mouth promotion is very effective in the senior community. The use of senior volunteers in the screening is considered part of the promotion process, with an aim of conveying the feeling that this activity is "safe" and part of the valuable actions which seniors can take to make themselves and the community safe for driving. Program promotion also includes medical professionals chosen because of the nature of their speciality or if they have a practice consisting of large numbers of older patients. Physicians are educated by the Maryland Medical Advisory Board on functional abilities needed for safe driving, the nature of remediation for older drivers to promote safe driving, and alternative transportation resources in the community for patients choosing to self-restrict or cease driving. The Howard County Police Department has expressed interest in the project, and will design appropriate linkages with the Office on Aging to promote and support the activities. To complement these activities, the Howard County Office on Aging will make available materials providing guidance to law enforcement officers in identifying older drivers at high risk.

I.B. DEVELOP MODEL PROGRAM COMPONENTS TO REGULATE AND COUNSEL HIGH-RISK OLDER DRIVERS AND TRANSPORTATION SYSTEM USERS

I.B.3. Information and Educational Support for Safe Mobility Choices by Public Agencies, Private Professionals/Organizations, and Concerned Individuals

IB3. Information and Educational Support for Safe Mobility Choices by Public Agencies, Private Professionals/Organizations, and Concerned Individuals

Summary:

In a recent study investigating high-risk older driver state reporting requirements and practices, as well as information outreach programs, Aizenberg and Anapolle (1996) examined over 75 documents and other materials. They found that less than 15 percent of the materials collected for the review provided counseling tips for assisting older drivers with problems or for assessing driver competency (e.g., self-assessment questions, warning signs). About one-third of the publications discussed licensing issues; and only a very few addressed reporting unsafe drivers to authorities. In addition, less than one-half of the publications mentioned the possibility of driving cessation and about one-third specifically advised or made reference to using alternative transportation. The reviewers concluded that most of the materials dealt with the issue of older driver safety on a very general level. Few publications dealt with specific problem groups or with interventions that may be especially effective or justified with different subpopulations.

Decina, Staplin, and Lococo (1997) identified several dozen safety publications in their information search, which are currently available to the public from state licensing agencies and other organizations (predominantly the American Association of Retired Persons [AARP], American Automobile Association [AAA], and AAA Foundation for Traffic Safety) to help older drivers and their concerned family and friends. The material collected ranged from booklets and pamphlets, to less common items such as flyers, reference cards, newsletters, and even some videos. Most of the publications targeted older drivers themselves. However, a small percentage of materials targeted caregivers, including family members. These publications covered a wide range of topics, including: older driver safety; vehicle design and adaption measures; vehicle maintenance; environmental/road design and adaptions; driver improvement and rehabilitation; behavior change; occupant protection; aging and health; specific medical problems (i.e., vision, dementia); professional referral sources; licensing issues and procedures; transportation options; driving cessation; assessment tips; and counseling tips. Aging and health issues were common topics mentioned in the publications. These issues covered information on demographic trends, morbidity and health characteristics of the older population, and cognitive and physical changes that accompany the aging process. Other common topics were references to professional resources (i.e., physicians, optometrists); driver improvement and rehabilitation; and behavioral changes and safe driving practices to reduce collision risk.

The American Association of Motor Vehicle Administrators (AAMVA) Public Affairs and Consumer Education (PACE) Committee compiled a catalog of written and audio visual materials pertaining to older drivers, in its member jurisdictions (US States and Canadian provinces). The most widely available pamphlets are in the self-help category, directed at older drivers. AAMVA states that few pamphlets are available that provide advice to older drivers' families, friends, and caregivers. (The Malfetti and Winter report is helpful in this area). AAMVA also identified gaps in the topics of medical community responsibility, and alternative transportation.

The success of Model Program activities will rely on effective informational and educational (I & E) materials, using a variety of appropriate media, which:

- Facilitate self-regulation by sensitizing older drivers to the types of functional declines they may experience, and their consequences for safe driving.

- Provide advice and identifying resources to aid friends and family in problem identification and support for driving reduction/cessation.

- List and describe alternative transportation options specific to a community/county.

- Inform physicians of the driving risks associated with identified functional deficits, and describe feasible and standardized techniques for functional screening.

- Describe behavioral cues that police officers can use to identify at-risk older drivers, and procedures for referring suspect motorists for screening (in lieu of citation or other punitive actions).

- Provide easy-to-use tools for health care and social services field personnel to identify gross impairments, guidelines for referrals for follow-on tests and/or remedial programs, and advice on issues of confidentiality and reporting to licensing authorities.

The Maryland pilot study will include the Public Information and Education (PI&E) goals of promoting: (1) a broad social awareness that driving while (functionally) impaired is a serious public health issue; and (2) a broad social awareness that loss of mobility is a serious health and quality of life issue for older people. After a review of the available materials (listed above), a working group within the Maryland Research Consortium (MRC) will: develop Public Relations (PR) materials which illustrate how safe mobility lowers costs to society while improving quality of life for seniors; develop PR materials which illustrate how maintaining safe mobility is central to maintaining physical and mental health in old age; identify a spokesperson(s) to deliver the message; identify available PI&E resources and determine additional needs to attain the goal; and create the campaign content, implementation strategy, and evaluation plan.

An educational brochure created for distribution to seniors who participate in the screening activities conducted at several Senior Centers and Motor Vehicle Administration offices in Maryland during the pilot study is presented ot the end of this section. It will be a 2-sided, 3-fold brochure, and will be enlarged to measure 11 inches by 17 inches, to increase its legibility.

References:

•AAMVA (1997)
•Staplin and Lococo (1997)
•Aizenberg and Anapolle (1996)
•Decina, Staplin, and Lococo (1997)

<u>SELF AWARENESS GUIDES</u>

• USAA. (1990). *Adaptive Driving: Safe At Any Age.*
• Brenton, Myron (1986). *The Older Person's Guide to Safe Driving.* Public Affairs Committee, Inc,
• PennDOT. *Drive Smart and Drive Longer: Tips for the Older Driver.*
• PA Dept. of Aging. *Getting Older...And Going Places: Benefits for Older Drivers and Older Riders*
• USAA. (1992). *Helpful Tips to Reduce Your Risks While Driving.*

• Maryland Motor Vehicle Administration. *Maryland's Guide for Drivers Over 55.*
• South Carolina Dept. of Highways and Public Transportation, SC Commission on Aging. *Mature Driving: Some Serious Thoughts for Older Drivers.*
• AAA Foundation for Traffic Safety. (1997). *Older and Wiser Driver.*
• AARP. (1992). *Older Driver Skill Assessment and Resource Guide.*
• Platt, Fletcher N. (1996). *Going on 80: Tune up your Driving Skills.*
• AAA. (1992). *Straight Talk for Older Drivers: Good Vision...Vital to Good Driving.*
• AAA. (1993). *Straight Talk for Older Drivers: Maintaining your Vehicle.*
• AAA. (1992). *Straight Talk for Older Drivers: Meeting the Challenge.*
• AAA. (1992). *Straight Talk for Older Drivers: Rx for Safe Driving.*
• Nevada Office of Traffic Safety. *Tips to Help Older Drivers Ease on Down the Road: Alcohol and Medications.*
• Nevada Office of Traffic Safety. *Tips to Help Older Drivers Ease on Down the Road: Safety Belts.*
• Nevada Office of Traffic Safety. *Tips to Help Older Drivers Ease on Down the Road: Vision.*

GEARED TO PHYSICIANS

• Texas Medical Association/Texas DOT. (1991). *The Physician, the Older Patient, and Driving Safety: A Physician's Guide.*

GEARED TO LAW ENFORCEMENT

• Malfetti, J.L. and Winter, D. J. (1987). *Safe and Unsafe Performance of Older Drivers: A Descriptive Study.*
• McKnight, A.J. and Urquijo, J. I. (1993), "Signs of Deficiency Among Elderly Drivers." *Transportation Research Record*, 1405.
• Zimmerer, L. *Florida Highway Safety Patrol Questionnaire*

GEARED TO GENERAL PUBLIC/FAMILY MEMBERS

• Malfetti, J.L., and Winter, D.J. (1991). *Concerned About an Older Driver? A Guide for Families and Friends*; AAA Foundation for Traffic Safety
• PennDOT. *Talking with Older Drivers: A Guide for Family and Friends*; PA Dept. of Aging, PA Dept. of Transportation.
• CALDMV. *Tips you Can Give to a Mature Driver*

DON'T IGNORE THE WARNING SIGNS

HAS THIS HAPPENED TO YOU?

- ◊ *A friend or family member has expressed concern about your driving.*
- ◊ You sometimes get lost while driving on routes that were once familiar.
- ◊ You have been pulled over by a police officer and warned of poor driving behavior, regardless of whether or not you received a ticket.
- ◊ You have had several moving violations, near misses, or *actual crashes in the past three years.*
- ◊ Your doctor or other health care giver has advised you to restrict or stop driving.

— ⚘ —

- ✓ Listen to what people tell you who know you best and care the most about you.
- ✓ Discuss driving with your doctor--he or she can evaluate the interactions and side effects of all the medications you may be taking.
- ✓ Refresh your knowledge of safe driving practices and learn about new traffic control & roadway design features through a mature driver class.
- ✓ Begin planning for alternative ways of meeting your mobility needs. Now is the time to learn about mobility options in your community -- try them out...see what works best for you.

SELF AWARENESS: THE KEY TO SAFE DRIVING

While we all want to keep driving for as long we can, none of us wants to be a threat to ourselves or to others because we are no longer able to drive safely. A leading cause of accidental death among older persons is automobile crashes.

— ⚘ —

It's important to remember that most seniors *are* capable, and have a lifetime of valuable driving experience. Decisions about a person's ability to drive should never be based on age alone.

— ⚘ —

Fortunately, most seniors take appropriate steps when they detect a problem with their driving. But it's not always obvious when a general health problem, vision problem, or a side effect of medications will lead to a driving impairment.

— ⚘ —

Self awareness is the key. People who can accurately assess their fitness to drive can adjust their driving habits, and stay safe on the road. They will retain the personal mobility that comes with driving, while limiting the risks to themselves and to others.

— ⚘ —

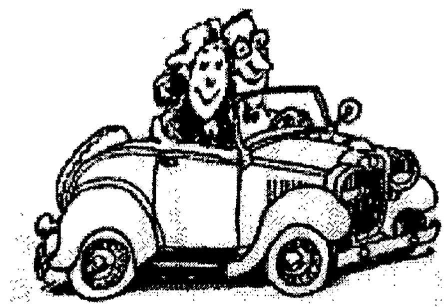
This brochure can increase your awareness about different problems that lead to unsafe driving. It also gives you tips to help keep you behind the wheel. For more information, contact:

To find a driver rehabilitation specialist in your area:
- Association of Driver Educators for the Disabled
  (608) 884-8833
- Maryland Board of Occupational Therapy Practice
  (410) 764-4728

To find a mature driver education class in your area:
- AARP/55-Alive
  Toll Free: 1-888-AARP-NOW (1-888-227-7669)
- AAA Safe Driving for Mature Drivers
  (Call your local AAA club for availability of classes)

For information about benefits & services for older persons provided by the Agency on Aging in your area:
- Senior Information & Assistance Programs
  Toll Free: 1-800-AGE-DIAL (1-800-243-3425)
  TTY 410-767-1083

How Is Your Driving Health?



A Self-Awareness Checklist

&

Tips to Help You Drive Safely Longer

A product promoting *Safe Mobility for Life* from the Maryland Research Consortium on older drivers, and the National Highway Traffic Safety Administration.

VISION

Good driving health begins with good vision. With declining vision, your responses to signals, signs, and changing traffic conditions become slower, increasing your crash risk.

Warning Signs

- You have problems reading highway or street signs, or recognizing someone you know across the street.
- You have trouble seeing lane lines & other pavement markings; curbs & medians; and other vehicles & pedestrians, especially at dawn or dusk, and at night.
- You are experiencing more discomfort from the glare of oncoming headlights at night.

Tips

✓ Make sure your corrective lenses have a current prescription, and always wear them. If you lose or break your glasses, don't rely on an old pair; replace them right away with your new prescription.

✓ Do not wear sunglasses or tinted lenses at night. This reduces the amount of light that reaches your eyes, and makes driving much more hazardous.

✓ Keep your windshield and headlights clean, and make sure your headlight aim is checked when your vehicle is inspected.

✓ Sit high enough in your seat so that you can see the road within 10 feet in front of your car. This will make a big difference in reducing the amount of glare you experience from opposing headlights at night. Use a cushion if your car seats don't have vertical adjustment.

✓ People age 61 and older should see an optometrist or ophthalmologist every year to check for cataracts, glaucoma, macular degeneration, diabetic retinopathy, and other conditions for which we are at greater risk as we grow older.

PHYSICAL FITNESS

Diminished strength, flexibility, and coordination can have a major impact on your ability to control your vehicle in a safe manner.

Warning Signs

- You have trouble looking over your shoulder to change lanes, or looking left & right to check traffic at intersections.
- You have trouble moving your foot from the gas to the brake pedal, or turning the steering wheel.
- You have fallen down in the past 3 years.
- You walk less than 1 block per day.
- You can't raise your arms above your shoulders.
- You have difficulty climbing stairs.

Tips

✓ With your doctor's approval, do some stretching exercises, and start a walking program. Walk around the block, or in a shopping mall. Also, check your local health clubs, YMCAs, senior centers, community colleges, and hospitals for fitness programs geared to the needs of seniors.

✓ Get examined by a podiatrist if you have pain or swelling in your feet. If you have pain or stiffness in your arms, legs, or neck, your doctor may prescribe medication and/or physical therapy.

✓ An occupational therapist or a *certified driving rehabilitation specialist* may be able to prescribe special equipment for your car to make it easier to steer and to use your pedals.

✓ Eliminate your driver's side blind spot by re-aiming your mirror. First, lean your head against the window, *then* adjust your mirror outward so that when you look at the inside edge you can barely see the side of your car. *If* you use a wide-angle mirror, get *lots* of practice judging distances to other cars before using it in traffic.

ATTENTION AND REACTION TIME

Driving often requires quick reactions to safety threats. As we grow older, it becomes more difficult to divide attention and to make rapid responses.

Warning Signs

- You feel overwhelmed by all of the signs, signals, markings, pedestrians, and other vehicles that you must pay attention to at intersections.
- Gaps in traffic are harder to judge, making it more difficult to turn left at intersections, or to merge with traffic when turning right.
- You take medications that make you drowsy.
- You often get lost or become disoriented.
- You aren't confident that you can handle the demands of high speeds or heavy traffic volumes.
- You are slower in recognizing cars coming out of driveways or side streets, or realizing that another car has slowed or stopped ahead of you.

Tips

✓ Plan your route. Drive where you are familiar with the road conditions and traffic patterns.

✓ Drive during the day, and avoid rush hours.

✓ A passenger can serve as a "second pair of eyes." But don't get distracted in conversation!

✓ When approaching intersections, remember to stay alert for cars and pedestrians entering from the side unexpectedly.

✓ Leave enough distance between you and the car ahead to react to a sudden stop, but understand that *too* large a gap will invite others to cut in front of you in heavy traffic. A gap of 3 seconds or more is most desirable, conditions permitting. Look for a tree, sign, etc. When the car ahead of you passes this point count "1001, 1002, 1003." If you can count to 1003 by the time you get to the same point, this equals a 3-second gap.

I.C. DEVELOP TOOLS NEEDED TO IMPLEMENT MODEL PROGRAMS

I.C.1. Identification Procedures/Program Intake Mechanisms

(a) Internal (DMV) Identification

(b) External Referral of At-Risk Drivers

(c) Problem Identification Through Self-Testing Activities

IC1(a)i. Direct Observation by Counter Personnel

Summary:

A questionnaire was developed and distributed to Driver License Administrators in the 50 United States and 12 Canadian Provinces to broadly determine cost and time parameters that could influence implementation of Model Program activities, while addressing details of the Model Program concept which conceivably could be impacted by their legal, ethical, or policy implications in each State and Province (Staplin and Lococo, 1997). When asked whether it would be feasible to "Implement a referral mechanism for functional screening/evaluation in which DMV counter personnel use a checklist to record a brief, structured set of observations, and/or question-and-answer responses, for members of the driving public who appear before them," sixty-four percent of the respondents (38 of 59) reported that this practice would be feasible to implement while 36 percent (21 of 59) replied that it would *not* be feasible.

YES			NO	
Alabama	Missouri	Saskatchewan	Alaska	Minnesota
Arizona	Montana	South Dakota	Alberta	Nevada
Delaware	Nebraska	South Carolina	Arkansas	New York
Florida	New Brunswick	Texas	British	Newfoundland and
Hawaii	New Hampshire	Utah	Columbia	Labrador
Indiana	New Jersey	Vermont	California	Northwest Territories
Iowa	North Carolina	Virginia	Colorado	Nova Scotia
Kentucky	North Dakota	Washington	Connecticut	Ontario
Louisiana	Ohio	Washington, DC	Idaho	Pennsylvania
Manitoba	Oklahoma	West Virginia	Illinois	Quebec
Maryland	Oregon	Wisconsin	Kansas	Tennessee
Massachusetts	Prince Edward Island	Wyoming	Maine	
Michigan	Rhode Island			

Reasons for why this practice would <u>not</u> be feasible were:

- Not all of their customers go to a service outlet, and as such, this procedure would not be "watertight."
- DMV counter personnel are well able to observe customers and make notes on them for review, but are generally not qualified to use structured lists without training that may be inappropriate to their classifications.
- Questions and answers would be acceptable, but not the use of a set of observations.
- "Another good idea that would require extensive training and increase lines in the offices."
- "Our right to examine a disabled person based upon visual observations has been challenged in court based upon the Americans with Disabilities Act (ADA). Clear standards for initial screening are necessary to accommodate the ADA. We must turn to rehabilitation specialists to evaluate those who are disabled. Only trained physical therapists can install special equipment and train the disabled persons to operate this equipment. After the training is completed, DMV personnel should conduct the standard road test to avoid the accusation of discriminations under the ADA."

Cobb and Coughlin (1997) conducted a telephone survey of 51 DMV line examiners in the 50 U.S. States and Washington D.C. Most respondents revealed that the single most important criteria for identifying an impaired driver is how he or she looks coming through the door at the DMV. There is a heavy reliance on the examiner's skill and judgment when attempting to determine a driver's fitness. However, the survey also found that the legal requirement to appear in person before a licensing official is not used by many States as a means of controlling unsafe drivers. Also, respondents reported that administrative resources and tools to adequately judge an individual's performance are not as good as they would like. Adequate time for assessments is beyond most States' budgets, and many test techniques rely on imperfect methods (e.g., strength tests performed by having a driver press against an examiner's hand or reaction tests performed using a ruler-drop test).

Fields and Valtinson (1998) provide a table showing State license renewal requirements for passenger car vehicles in the United States. Currently, 28 States require all drivers to come to the DMV each time they renew their licenses (generally, every 4 to 5 years, with the exception of Wisconsin, which has an 8-year renewal cycle). This includes: Alabama, Arizona, Arkansas, Colorado, Delaware, District of Columbia, Georgia, Hawaii, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Mexico, North Carolina, North Dakota, Ohio, Pennsylvania, Rhode Island, South Dakota, Virginia, Washington, and Wisconsin. Many States allow mail-in license renewal; only a few of these States specify an age limit where the individual must appear in person (see *Notebook* section IC1(a)iv for license renewal distinctions for older drivers). Some States require in-person renewal at *every other* renewal cycle (resulting in a DMV only seeing a person every 8 to 10 years). Florida requires in-person renewal at *every third cycle*, which means that a driver with a clean record will not step foot into a DMV for 18 years (or 12 years for an unclean record).

Petrucelli and Malinowski (1992) state that "the examiner's personal contact with the applicant is the only routine opportunity to detect potential problems of the functionally impaired driver. This opportunity should not be lost because of inadequate examiner training." They also provide the following statistics. Fourteen jurisdictions provide some level of orientation to their examiners to enable them to observe for and recognize potentially hazardous signs and symptoms (British Columbia, Connecticut, Florida, Indiana, Iowa, Maryland, Missouri, Montana, North Carolina, North Dakota, Oregon, Prince Edward Island, and Washington). The orientation programs are based on the 1976 training program, "Screening for Driver Limitation" (DOT-HS-802-136).

The American Association of Motor Vehicle Administrators (AAMVA) Associate Director of Services (see Janke and Hersch, 1997) stated that driver licensing staff could ask questions of renewing drivers to separate medically (functionally) impaired drivers from normal (unimpaired) drivers. Questions such as "please spell your name; verify your address and date of birth" (e.g., verifying questions) are much less insulting than "tell me what your name/address is...I want to see what you know/remember" types of questions.

There are currently two chapters in the *Florida Examiner's Manual* that deal with identification of driver limitations: Chapter 10 contains information for an examiner to adequately screen for driver limitations, and Chapter 11 contains information to help an examiner identify a physical impairment or handicap and to know what physical skills are affected by the handicap. Guidelines are provided in the form of signs and symptoms for the identification of cardiovascular conditions, neurological conditions, mental and emotional conditions, diabetes, and age-related problems. Signs and symptoms listed for age-related problems are: (1) slowed reactions, stiffness of the joints, lack of attention, and disorientation; (2) nervous system conditions, identified by tremors, retarded reflexes, and slower adjustment to stimuli; (3) cardiovascular conditions, identified by wheezing, gasping, and general breathing difficulty, bluish tint to skin especially under fingernails, and extreme fatigue; and (4) visual impairment.

Chapter 11 provides the following information in the section "Identifying a Physical Handicap:"

> While checking the application form or giving the eye test, notice any physical defects the applicant may have. In the majority of cases, it is not necessary to let the applicant know that the way he [she] walks or the way he [she] uses his [her] arms or hands is being observed. If anyone has a noticeable limp, an arm or leg missing, walks with crutches, is particularly small, or has a brace, question him [her] closely, but tactfully about his [her] ability to drive.

A list of physical skills is provided (coordination, range of motion, strength of motion), as well as adaptive equipment and restrictions that may be necessary for compensation of physical impairments.

Wisconsin has written a chapter for their field staff about how to determine a customer's functional ability by visual inspection. It defines functional ability and provides the standard, so the employee knows what the benchmark should be. The functional abilities that need to be observed and the functional standards that need to be applied are presented below. A person who does not meet these standards, and whose license is not properly restricted, may be required to submit to an actual driving skills test or evaluation, file a medical report, or both. This information was taken from Section 235 "Evaluating Medical Conditions or Disabilities."

Ability	Standard
Lower body strength, range of motion, mobility and coordination to use foot-operated vehicle controls.	Person is able to walk to a DMV service counter unaided physically by another person or significant support device (i.e., walker, wheel chair, breathing apparatus, or artificial limb). There is no loss (full or partial) of a leg or foot. No excessive shaking, tremor, weakness, rigidity, or paralysis.
Upper body strength, range of motion, mobility and coordination to use hand-operated vehicle controls and to turn the head and body to the left, right, and rear to observe for other traffic and pedestrians.	Person is able to turn the head and upper body to the left and right, and has full use of the arms and hands. There is no loss (full or partial) of an arm. There is no loss of a hand or finger which interferes with proper grasping. No excessive shaking, tremor, weakness, rigidity or paralysis.
To hear other traffic and vehicle-warning devices (i.e., horn or emergency siren).	Person is able to hear the normal spoken voice during the licensing process, with or without a hearing aid.
To see other traffic, road conditions, pedestrians, traffic signs, and signals.	Person is able to meet applicable vision requirements by passing a DMV vision screening or presenting evidence of similar testing by a vision specialist.
Cognitive skills (i.e., to think, understand, perceive, and remember).	Person exhibits cognitive skills. Responds to questions and instructions (i.e., is able to complete an application, knowledge test, or vision screening). No obvious disorientation.

Ability	Standard
To maintain normal consciousness and bodily control (i.e., ability to respond to stimuli).	Person exhibits normal consciousness and bodily control (i.e., no self-disclosed or obvious incident or segment of time involving altered consciousness. No loss of body control involving involuntary movements of the body characterized by muscle spasms or muscle rigidity, or loss of muscle tone or muscle movement). No obvious disorientation (i.e., responds to questions and instructions. Is able to complete an application, knowledge test, or vision screening).
To maintain a normal social, mental, or emotional state of mind.	Person does not exhibit an extremely hostile and/or disruptive, aggressive behavior, or being out of control. No obvious disorientation.

An ADA (Americans with Disabilities Act) suit was filed with the Department of Justice against the Wisconsin DMV by an out-of-state driver in a wheelchair who came to the DMV for a license transfer. The person did not have any restrictions on his out-of-state license, which is unusual; there should have been a restriction that he must only operate a vehicle with hand controls. So, the DMV required him to take a road test, and he thought that was discriminatory, because the person behind him in line was also out-of-state and did not have to take the road test (but also was not in a wheelchair). Wisconsin's practice was not considered discriminatory by the ADA (the driver did not win the suit). Nor did the ADA have any comments about how to improve their practices. A state can require a road test for the purpose of assuring highway safety. The Wisconsin Supreme Court has held that the operation of motor vehicles in Wisconsin is a privilege, not a right, and is subject to reasonable regulation by the police power. Like the U.S. Department of Transportation, the DMV has a legislative mandate to protect public safety and maintain safe highways. The driving evaluation is rationally related to the achievement of such purposes and is not based on prejudice, stereotypes, or unfounded fear. It is therefore not a violation of the spirit or letter of the ADA to conduct a driving evaluation as may be necessary to determine if a person adequately compensates for a medical condition or functional impairment, to safely operate a motor vehicle with or without license restrictions. Wisconsin DMV sent their chapter about determining functional ability to other states to see what they thought. A DMV representative stated that some states go overboard worrying about ADA when really, Wisconsin found that the focus should be on doing the right thing, which is preserving highway safety.

Conclusions/Preliminary Recommendations:

The practice of requiring drivers to renew their licenses in person presents the opportunity for licensing personnel to objectively evaluate general cognitive and physical fitness to drive, through simple observation and communication with the renewing drivers. Several States already participate in this practice and have comprehensive procedure manuals and field employee training to ensure that observations are made for relevant capabilities and in a respectful manner, while the majority of surveyed States/Provinces indicated that this practice would be feasible to implement in their jurisdictions. This practice has passed the scrutiny of the ADA, and is recommended as a means of identifying at-risk drivers in the Model Program.

References:

- Cobb and Coughlin (1997)
- Fields and Valtinson (1998)
- Florida Department of Highway and Motor Vehicle Safety: Counter Procedures
- Janke and Hersch (1997)
- Petrucelli and Malinowski (1992)
- Staplin and Lococo (1997)
- Wisconsin Department of Transportation: Counter Procedures

Ic1(a)ii. Responses on License Application/Renewal Forms

Summary:

The NHTSA/AAMVA *Model Driver Screening and Evaluation Program: Guidelines for Motor Vehicle Administrators* (NHTSA, 1992) states that medical fitness questions included on a driver license application should be designed to identify applicants who may have: loss of consciousness, cardiovascular disease, alcoholism or a drinking problem, mental illness, drug addiction or dependence, diabetes, and vision impairment. It further states that medical questions can take two forms: (1) those that ask for medical conditions, and (2) those that ask for symptoms. The questions selected for inclusion on the application should have the potential to identify individuals with medical disabilities that might impair their driving. In order to simplify the application, AAMVA recommends that agencies use common lead-in lines for several questions, such as, "Have you in the last three years..."" or "Have you ever been...?" Driver License Application forms from several jurisdictions are included at the end of this section.

Practices vary widely across jurisdictions (see examples of forms used in Alabama, Maryland, Utah, and Wisconsin at the end of this section). In Oregon, screening at renewal consists of a short medical questionnaire on the renewal application, and a mandatory vision (acuity) screening for drivers over age 50. About 22 percent of Oregon medical program referrals come from answers to medical questions on renewal applications. In previous years, field office employees received at least brief training in informal screening of renewal applicants. However, that practice has been discontinued in recent years, with the result that fewer applicants are referred based on informal screening, and more of the referrals received are inappropriate.

In Ohio, when individuals go to the DMV to apply/reapply for a license, they are asked only two questions: (1) Do you have any physical or mental conditions that could impair safe driving performance? (2) Are you taking any medications that may impair safe driving performance? If the applicant answers "yes" to either question (or indicates that they have some sort of progressive disability (e.g., Multiple Sclerosis, Parkinson's, Muscular Dystrophy, Cerebral Palsy, Narcolepsy, high blood pressure) or has suffered the loss of a limb, then a medical packet is mailed to the individual, who then must undergo a physical examination by a physician.

In Utah, applicants must answer whether they have had any of 12 medical conditions in the past 5 years (diabetes; cardiovascular; pulmonary; neurologic; epilepsy; learning and memory; psychiatric; alcohol and drugs; visual acuity; musculoskeletal/chronic debilities; functional motor impairment; and other). Descriptions and examples are included on the form for each category.

Janke and Hersch (1997) stated that although affirmative answers to medical questions are not common, an analysis of 579 license applications showing affirmative answers to health questions found that self-reporting drivers (median age=37.3) had significantly worse prior crash-involvement records than a randomly selected comparison sample (median age=37.8 years). The authors concluded that the application's medical impairment question serves a beneficial traffic safety purpose.

The practice of including medical questions on driver licensing applications has been brought before the ADA, and has passed investigation. In 1993, an action was filed against the Alabama Department of Public Safety (DPS) by an applicant who alleged that the licensing requirements discriminated against him, under the ADA Act of 1990. The applicant reapplying for an Alabama driver's license, had sought help from a psychologist who diagnosed him with depression and recommended in-patient treatment at a private psychiatric hospital for 30 days. The licensing application procedure used by AL DPS includes, among other things: (1) use of a license application form that contains broadly worded questions seeking information about whether an applicant has "ever" been treated for a "mental" or "nervous condition" or has "ever" received in-patient treatment in a "mental facility;" (2) a requirement that an applicant answering questions of this type in the positive to furnish copies of all prior medical records for review by the Defendant without regard for time frame, nature of the medical history, or its impact on an applicant's ability to safely and responsibly operate a motor vehicle; and (3) use by the Department of a Medical Advisory Board (MAB) to advise the applicant on medical criteria relevant to the licensing process and to screen applicants.

The applicant stated that the existing driver's licensing process results in overt denial of treatment of individuals with disabilities, or the establishment of exclusive or segregative criteria that act to bar individuals with disabilities from participation in services, benefits, or activities, and more specifically, the opportunity to obtain and hold a lawfully issued driver's license. The applicant further stated that the process employs segregative criteria including intrusive and over-broad application forms and information requirements. The voluntary hospitalization for a psychiatric condition, according to the applicant, is immaterial to the driver licensing process and would constitute an invasion of his privacy if such information were disclosed.

In 1995, the claims of the plaintiff were dismissed by the US District Court for the Middle District of Alabama; however, general provisions required (1) the adoption of standards for the licensing of drivers with medical conditions; (2) development of procedures for administrative review of driver license denials, suspensions, revocations and cancellations for drivers with medical conditions; (3) implementation of a restricted driver license; (4) the employment of a Registered Nurse on a 2-year contract to assist in administering the program regarding medical requirements for drivers; (5) the attempt to pass legislation increasing the number of physicians on its MAB; (6) the attempt to pass legislation amending the state statute prohibiting the issuance of licenses to certain persons; (7) allowance of all persons who have previously been denied a driver license for medical reasons to reapply under the standards and procedures as set out in the decree; and (8) institution of a program of training for driver license examiners.

The Alabama Driver License Application was revised 9/95; a chapter on Medical Standards for Driver Licensing was rewritten and enacted 3/11/96. The medical information on the new form asks: "Within the last 2 years, have you experienced an episode of altered consciousness or loss of body control, or had any medical condition that may affect your ability to drive safely? Conditions that may affect your ability to drive safely include: brain or head injury; insulin controlled diabetes; heart; lung; mental; muscle or nerve; seizure disorder; stroke; addiction to alcohol or drugs." Also included for "yes" answers are: date of last episode, whether driver is presently being treated or has been recommended treatment within the past 2 years, and the physician's name.

Conclusions/Preliminary Recommendations:

The inclusion of questions on license application and renewal forms regarding medical conditions/symptoms and medications that affect driving performance may help the licensing agency identify drivers who are at increased crash risk, particularly in jurisdictions where reporting by physicians is not mandatory. Because many conditions that were previously linked to increased crash risk are controllable through medical technological advances and because research studies show mixed results for many conditions, follow up with the treating physician for individuals who report conditions is a necessary step before any licensing action is undertaken. Also, because drivers may not consider their particular health condition as one that may affect their driving performance or may not recognize it in a list of body systems (e.g., "cardiovascular"), the wording of medical conditions should be non-technical and easily understood by the general public (e.g., "heart"), and should include examples of conditions and symptoms (e.g., irregular heart beat, heart attack, heart surgery, high blood pressure).

A form that includes the following questions is thus recommended. The conditions were obtained from Maryland (old version) and Utah's application forms, and from the data presented in section IA1 (a through m) and IA2(a) of this *Notebook*. Definitions and or symptoms should be included for each medical condition, as shown on the Utah form.

In the past 4 years, have you been diagnosed with any of the following conditions?(Check Yes or No)		
Medical Condition	**Yes**	**No**
Epilepsy		
Stroke		
Diabetes		
Glaucoma		
Cataracts		
Bursitis		
Alcohol Abuse		
Severe Anxiety Disorders		
High Blood Pressure		
Manic Depressive Disorder		
Parkinson's Disease		
Alzheimer's Disease		
Heart Disease/Irregular Heartbeat		
Schizophrenic Disorder		
Muscular Dystrophy		
Drug/Narcotic Addiction		
Cerebral Palsy		
Diabetic Retinopathy		
Multiple Sclerosis		
Please check either yes or no for each of the following questions:		
Have you fallen down in the past 2 years?		
Do you have difficulty walking 1 block?		
Do you have difficulty walking up 1 flight of stairs?		
Do you have persistent back pain?		

References:

- Alabama DMV
- Janke and Hersch (1997)
- Maryland MVA
- NHTSA (1992)
- Ohio DMV
- Utah (Abbreviated Health Questionnaire)
- Wisconsin DOT

DL-2 Rev. 8/95

Alabama Department of
Public Safety

Alabama Driver License Application

Microfilm Number

First Name - Middle/Maiden - Last Name								Alabama Driver License No.
Mailing Address								Alabama DL Expiration Date
Residence (Street) Address								Class
City		State		Zip Code		Social Security No.		
Date of Birth	Age	Race	Sex	Weight	Height	Eyes	Hair	Restrictions
Previous State License No.		State		Class		Previous License Expiration Date		
County of Residence	Birth Verification Documents		Occupation		Employer or School			
Additional Restrictions								Date Examination Passed
Comments								

The applicant named herein has met all requirements and may be issued the license represented above		Examiner's Signature
Issue Date	County No.	Signature of Issuing Authority

Applicant Questions

#	YES	NO	
1			Have you ever taken any part of an examination for a driver license in Alabama? If so, what year? ______ Which County? ______ Were you licensed? ______ What type of license was issued? Operator ______ Commercial ______ Motor-Driven Cycle ______ Motorcycle ______ Learner License ______ Vessel ______ If under a different name, what name? ______
2			Are you now or have you ever been licensed to drive in ANY OTHER STATE? If so, which state(s)? ______ Is your other state license expired? ______ If yes, what year did it expire? ______
3			Have you ever been convicted of DUI, Reckless Driving or other serious violations? If yes, what? ______ When? ______ Where? ______
4			Have you ever had your driver license or privilege revoked? ______ suspended? ______ cancelled? ______ denied? ______ If so, what year? ______ Which state? ______ Why? ______ Have you been authorized to be re-licensed? Yes ______ No ______

I do solemnly swear or affirm that all of the above statements are true and correct. I understand that any false information herein will result in license cancellation.

______ Applicant's Signature ______ Witness Signature ______ Date

Examination Results

Make of Car	Year	Tag Number	Expires	Accompanying Driver	Applicant's Signature

Date	Receipt Number	Written				Skills		Comments
		Test No.	Class D	Class M	Vessel	Result	Fail Reason	

Alabama Driver License Application - Page 2

Applicant Medical Information

1. Within the last two (2) years, have you experienced an episode of altered consciousness or loss of body control, or had any medical condition that may affect your ability to drive safely? Conditions which may affect your ability to drive safely include the following:

1. Yes ____ No ____ Brain or head injury
2. Yes ____ No ____ Insulin controlled diabetes
3. Yes ____ No ____ Heart
4. Yes ____ No ____ Lung
5. Yes ____ No ____ Mental
6. Yes ____ No ____ Muscle or nerve
7. Yes ____ No ____ Seizure disorder
8. Yes ____ No ____ Stroke
9. Yes ____ No ____ Addiction to alcohol or drugs

If you answered "yes," give the date of last episode ________________

2. Are you presently being treated, or has a physician recommended that you be treated for any of the conditions listed above within the last two years?
Yes ____ No ____

Physician's name ________________________________

Vision

YES	NO	Do you wear glasses or contact lens?

Without Corrective Lenses	With Corrective Lenses	Color	PV		Init
Left Right Both 20/____ 20/____ 20/____	Left Right Both 20/____ 20/____ 20/____	____ Red ____ Green ____ Amber ____ Normal	R ____ L ____ ____ Total	____ Pass ____ Fail ____ DIER2	

Hearing

YES	NO	Does applicant wear a hearing aid or aids?

Hearing without aids? Good ______ Poor ______ Deaf ______
Hearing with aids? Good ______ Poor ______ Deaf ______

I do solemnly swear or affirm all of the above statements are true and correct. I understand that providing any false information will result in the suspension, revocation or cancellation of my driving privilege until all required medical documents are reviewed by the Driver License Medical Unit.

Applicant's Signature ________________________ Date ____________

Witness ________________________ Date ____________

Examiner's Comments

____

____

____

____

Application for Maryland's Non-Commercial Driver's License, Learner's Permit, Corrected or Duplicate Driver's License

Please read and complete both sides.

I want to be licensed to operate the type of vehicle(s) checked below:

A - All non-commercial vehicles except motorcycles.

B - Non-commercial vehicles and combinations of non-commercial vehicles 26,001 or more pounds GVW and Class C non-commercial vehicles except tractor-trailers and motorcycles.

C - Non-commercial vehicles less than 26,001 pounds GVW except motorcycles.

M - Motorcycle

Application for Non-Commercial Driver's Licenses:

Learner Permit Under 21 | Learner Permit Over 21

Driver License Under 21 | Driver License Over 21

Duplicate License

Reason for Duplication:

Lost | Mutilated | Stolen | Frontal Photo

Corrected License

Reason for Correction:

Error | Divorce | Marriage | Other | Reassume Birth Name or Other Former Name (See instructions below.)

Court Order (If your name was changed by Court Order, attach a copy of that Order.)

If name changed, give former name:

First | Middle | Last

Instructions to reassume birth name or former name: An individual may reassume a name previously used provided the name is used openly, consistently, and without fraudulent intent. To reassume a previous name, you must bring an original or true test copy of the birth certificate or marriage license and one other form of identification. For example, social security card, voter registration card, bank statement, etc.

Social Security Number (Social Security Number will be used only for driver licensing & registration purposes.)

First Name | Middle Name | Last Name

*Residence Address - Street Address or R.F.D. and Box No.

City/Town | State | County | Zip Code

*The use of a Post Office Box or private mail drop is not permitted. A P.O. Box may be listed after a residence address, if the P.O. Box is in the same city and zip code.

Restriction | Height | Weight | Sex | Race | Date of Birth (M/D/Y)

Race Codes: (1) Black; (2) White Caucasian, Asiatic Indian; (3) Asian, Native Pacific Islander, Eskimo; (4) American Indian; (5) Multiracial

Please check if, upon your death, you desire to help others by becoming an organ donor. ☐ **Yes** ☐ **No**

Register *then Vote* — Register to vote with your driver's license application. Ask a customer service representative for details.

MVA
Motor Vehicle Administration

Customer Service Center: **1-800-950-1MVA (1682)** • From Out-of-State: **1-301-729-4575**
TDD for the hearing impaired: **1-800-492-4575**
To close public access of your driver's record call toll free 1-888-MVA-3772 or ask a customer representative at any MVA office.

1. For the safety of all drivers, the Motor Vehicle Administration must consider your medical status as part of your license request. If you have a medical condition which could affect your driving, you are required to report it to the MVA. All medical data is kept confidential and will only be used by the MVA to determine your qualifications to drive.

   Have you been diagnosed with any physical or mental disabilities, other than vision, which may affect your driving? ☐ Yes ☐ No

   If yes, please submit with this application, a certificate from you doctor indicating the onset of the disability, diagnosis, prognosis, and medications, if any. Thank you.

2. Do you presently hold a Driver's License? ☐ Yes ☐ No If yes, give Type or Class ______ State ______

   ______
   List License Number(s) Exp. Date(s)

3. Is your driver's license or privilege to operate a motor vehicle revoked, suspended, cancelled, or refused in this or any other state, D.C. or Canada? ☐ Yes ☐ No IF YES, YOU ARE NOT ELIGIBLE TO APPLY.

   ______
   If yes, When? Where?

4. Have you ever applied for a Maryland license under a different name? ☐ Yes ☐ No

   ______
   If yes, print other name

5. Do you have vehicle(s) registered in another state? ☐ Yes ☐ No If yes, give Tag Number(s) & State

   ______
   Tag Number State Tag Number State

Certification

I certify, under penalty of perjury, that the statements made on this application are true and correct to the best of my knowledge, information and belief.

______
Signature of Applicant Date

______
Employer Name Telephone Number

______
Employer Address

Co-Signature of Parent, Guardian, or responsible adult required when applicant is under 18 years of age.
I certify, under Penalty of Perjury, that the statements made on this application are true and correct to the best of my knowledge, information and belief. My relationship to the applicant is that of:

☐ Parent ☐ Guardian ☐ Spouse ☐ Employer ☐ Or, a Responsible Adult (if not parent, documentation is required)

______
Signature of Co-Signer Soundex #

Maryland law requires you as a co-signer to notify the MVA within 30 days of changing your mailing address. The requirement remains in effect until the minor becomes 18 years of age. Be sure to include the above minor's full name on your change of address request.

MVA
Motor Vehicle Administration

ABBREVIATED HEALTH QUESTIONNAIRE

UTAH DRIVER LICENSE DIVISION
4501 SOUTH 2700 WEST 3RD FLR SO
P O BOX 30560 SLC UT 84130-0560

PRIVATE VEHICLE DRIVER ☐
COMMERICAL VEHICLE DRIVER ☐
EXEMPT INTRACITY ZONE ☐ YES ☐ NO
MEDICAL CARD EXPIRES ____________

Last Name	First Name	Middle or Maiden Name	Date of Birth	Driver License Number

The Driver License Medical Advisory Board has determined the following conditions may be directly related to driving safety. These questions must be answered by every applicant applying for any Utah Driver License or Medical Certificate.

(Answer all Questions) **DO YOU HAVE, OR HAVE YOU HAD, ANY OF THE FOLLOWING IN THE LAST FIVE YEARS?**

☐ Yes ☐ No **A. DIABETES:** Diabetes (high blood sugar, sugar diabetes, you control with diet, medication or insulin) or hypoglycemia or other metabolic condition etc., which may interfere with driving safety?

☐ Yes ☐ No **B. CARDIOVASCULAR:** Heart condition, with or without symptoms, (heart attack, heart surgery, irregular rhythm, general heart disease) within the last five years; or hypertension (high blood pressure) currently requiring medication for control?

☐ Yes ☐ No **C. PULMONARY:** Pulmonary (lung) condition (asthma, emphysema, passing out from coughing, etc.), sleep apnea or shortness of breath which has required treatment?

☐ Yes ☐ No **D. NEUROLOGIC:** Neurological condition (stroke, head injury, narcolepsy, cerebral palsy, multiple sclerosis, muscular dystrophy, Parkinson's Disease, etc.) which may interfere with driving safety?

☐ Yes ☐ No **E. EPILEPSY:** Epilepsy, seizures, other episodic conditions which includes any recurrent loss of consciousness or control? [Commercial: Anytime in life? ☐ Yes ☐ No]

☐ Yes ☐ No **F. LEARNING AND MEMORY:** Learning and memory difficulties observed personally or reported to you by others?

☐ Yes ☐ No **G. PSYCHIATRIC:** Psychological condition (anxiety, severe depression, behavorial mood conditions, schizophrenia, etc.), for which a physician has recommended that you take medication?

☐ Yes ☐ No **H. ALCOHOL AND DRUGS:** Excessive use of alcohol and/or prescription drugs, or use of any illegal drugs, or treatment or recommendation for treatment of alcohol use or chemical dependency?

☐ Yes ☐ No **I. VISUAL ACUITY:** Awareness of decrease of vision worse than 20/40 in either eye, or a decrease in peripheral vision (side vision)? Are you currently wearing corrective lenses? ☐ Yes ☐ No

☐ Yes ☐ No **J. MUSCULOSKELETAL/CHRONIC DEBILITIES:** Loss or paralysis of all or part of an extremity; or onset of a general debilitating illness requiring treatment? New or changed past 5 years? ☐ Present longer than 5 years? ☐

☐ Yes ☐ No **K. FUNCTIONAL MOTOR IMPAIRMENT:** Need for use of a brace, prosthesis or compensating accessories for driving? New or changed in past 5 years? ☐ Present longer that 5 years? ☐

☐ Yes ☐ No **L. HEARING:** [Commercial Only: Cannot perceive forced whisper in better ear at greater than 5 feet or do you have an average hearing loss in better ear greater than 65 decibels?] Do you use a hearing aid? ☐ Yes ☐ No

☐ Yes ☐ No **OTHER:** Other health problems or use of medications which might interfere with driving ability or safety?
Please explain: ____________

DO YOU WISH TO BE AN ORGAN DONOR? ☐ Yes ☐ No

COMMERCIAL DRIVER LICENSE QUESTIONS

Are you required to carry a Medical Certificate? ☐ Yes ☐ No If no, state reason: ____________

If yes, are you now in compliance with these standards? ☐ Yes ☐ No My Medical Certificate expires: ____________

I hereby certify under penalty of law that information contained in this health questionnaire is true to the best of my knowledge.

DATE: ____________ SIGNATURE: ____________

DLD 275 10/92

Wisconsin Operator License Application Instructions

Wisconsin Department of Transportation

APPLICANT INFORMATION
All applicants - complete sections B and C.
If under age 18, sections B, C, and D must be completed.
If applying for a commercial driver license, complete sections B, C, and E. Have your Federal Medical Certificate to show examiner if you meet the requirements of 49 CFR 391.

DONOR You may choose to be recorded as a potential organ donor. Answer the donor question in section B. Your response will be recorded on your driver file. The purpose of maintaining the record of potential donors is to more easily determine whether a person is a potential donor in the event of death. Your response to the donor question will not affect the issuance of your license in any way. A "yes" response does not in itself authorize an anatomical gift.
To effectively indicate your desire to make an anatomical gift:
1. Sign the back of your operator's license/identification card;
2. Let your closest relative know of your desire to make an anatomical gift.

ADA The Wisconsin Department of Transportation complies with the Americans with Disabilities Act (ADA).

SOCIAL SECURITY NUMBER (SSN) Anyone applying for a Wisconsin operator's license must furnish his/her SSN. This is required by s.343.14(2)(b) Wisconsin Statutes and the U. S. Commercial Motor Vehicle Safety Act of 1986 P.L. 99-570. The Federal government has authorized use of the SSN for driver licensing. The department and other agencies may use the SSN for purposes authorized by law. The number must correspond with the number issued to the applicant by the U. S. Social Security Administration. It will also be used to link your driver license and vehicle registration records.

WARNING Any person who, on applying for an operator's license, presents fraudulent or altered documents or makes a false statement to the issuing officer or agency, may be subject to a fine of not more than $1,000 or imprisonment for not more than 6 months, or both, and revocation of operator's license privilege for one year.

RELEASE OF INFORMATION The Department uses information provided to issue driver licenses in Wisconsin, collect fees and enforce laws. Under Wisconsin open records law, the department may make nonconfidential information available to others for business purposes. If you want your name and address withheld, complete and return form MV3592 or contact Madison for more information, (608) 266-2353.

SECTION A - COMPLETED BY DOT EMPLOYE

Reason for Reissue

Date		Badge Number		Application Type: ☐ ORG ☐ RNW ☐ DUP ☐ REI ☐ RSM ☐ AMD ☐ COA
ID Proof Shown		Social Security Number Verified		License Type: ☐ REGI ☐ CDLI ☐ CYCI ☐ SPRI ☐ JUVI ☐ MPDI ☐ PROB ☐ RGLR ☐ OCCL ☐ SPRR ☐ JUVP ☐ NON
Out-of-State License Number		State	Expiration Date	
Visual Acuity	Without RX	With RX	Temporal Field of Vision in Degrees	Class(es) Issued: ☐ A ☐ B ☐ C ☐ D ☐ M
Right Eye	20/	20/		Endorsements: ☐ F ☐ H ☐ N ☐ P ☐ S ☐ T
Left Eye	20/	20/		Federal Medical Certificate Shown: ☐ YES ☐ NO — Restrictions: ☐ K ☐ L
Corrective Lenses ☐ YES ☐ NO	Color Perception	Hearing	Driver Education	☐ Check ☐ Cash Amount $
Other Restrictions	Skills Test Number	Highway Signs	Knowledge	X

(Examiner Signature) (Badge Number)

SECTION B APPLICANT - PLEASE PRINT

Wisconsin Driver License Number			Expiration Date	Social Security Number
Former Name If Changed Since Last License				Applicant Name - First, Middle Initial, Last
Mailing Address - ONLY If Different From Residence Address - In Care Of				Residence Address - Street or Route - Box Number
Street Address and/or Post Office Box				City — State — Zip Code
City	State	Zip Code	Country	County of Residence — Birthdate - Month Day Year
If applying for a duplicate license, state reason				Sex — Race — Eyes — Hair — Weight — Height

Do you wish to be recorded as a potential organ donor? ☐ YES ☐ NO

I certify that the information on this application is true and correct and that I am a resident of Wisconsin.

X

(Applicant Signature) (Date)

WISCONSIN OPERATOR LICENSE APPLICATION
MV3001 1197 Ch. 343 Wisconsin Statutes

CLASSIFIED LICENSE INFORMATION MV3001

Commercial Vehicle Classes

A Any combination of vehicles Gross Combined Weight Rating (GCWR) over 26,000 pounds provided Gross Vehicle Weight Rating (GVWR) of towed vehicles is over 10,000 pounds (GCWR, actual, or registered weight).

B Any single vehicle GVWR over 26,000 pounds or such vehicle towing a vehicle under 10,001 pounds GVWR (GVWR, actual, or registered weight).

C Any single vehicle, or combination of vehicles, that does not meet the definition of Class A or Class B as above, but that either is designed to transport 16 or more passengers including the driver, or is placarded for hazardous materials. Requires H, P, or X endorsement.

Noncommercial Vehicle Classes

D Any vehicle not in classes A, B, C or M

M Motorcycle

Endorsements

F Farm Service Industry Commercial Motor Vehicle

H Hazardous materials

N Tank vehicles

P Passenger

S School bus

T Double/triple trailers

Restrictions

K No commercial motor vehicle operation in interstate commerce

L Vehicles without air brakes

SECTION C - ANSWER ALL QUESTIONS COMPLETELY

	YES	NO
1. Has your license or operating privilege been revoked, suspended, disqualified, cancelled, or denied? If yes, give date and place __________	☐	☐
2. Have you been convicted of operating while intoxicated OUTSIDE of Wisconsin in the last 10 years? If yes, give date and place __________	☐	☐
3. Do you hold a valid operator's license/identification card FROM ANOTHER STATE/COUNTRY? If yes, list __________ Years of licensed driving experience? ______	☐	☐
4. Do you need glasses or contact lenses for driving?	☐	☐
5. Is your hearing impaired? (hard of hearing)	☐	☐
6. In the past year, have you had a loss of consciousness or muscle control, caused by any of the following conditions? If yes, check condition(s) and give date __________	☐	☐

☐ Brain or Head Injury ☐ Heart ☐ Mental ☐ Seizure Disorder
☐ Diabetes ☐ Lung ☐ Muscle or Nerve ☐ Stroke

SECTION D - FOR PERSONS UNDER AGE 18

School Certification: I certify under s.345.17 Wis. Stats., that this applicant is enrolled in approved behind-the-wheel training which begins no later than 60 days from date signed

School Name	Official WI DOT Test Results	Law ☐ P ☐ F	Sign ☐ P ☐ F

Authorized School Official/Instructor Signature ____ Date Signed
X

Sponsor Certification: As the adult sponsor, I accept responsibility and verify that minor is not a habitual truant and meets the educational requirements under s.343.15 Wis. Stats.

Sponsor Name - Print ____ Relationship to Applicant

Sponsor Wisconsin Driver License Number

Sponsor Signature (Must be notarized)
X

State of Wisconsin County Of ____ Subscribed and Sworn to before me this date

Notary Public or Authorized Agent of DOT ____ My Commission Expires
X

Do NOT Use Notary Seal

SECTION E - COMMERCIAL DRIVER LICENSE APPLICANTS ONLY

Answer the following questions:

	YES	NO
1. In the past 5 years, have you had a loss of consciousness or muscle control, caused by a neurological condition, for example, seizure disorder?	☐	☐
2. In the past 2 years, have you taken insulin to control a diabetic condition?	☐	☐
3. In the past 5 years, have you been convicted of a felony or offense against public morals in Wisconsin or in any other state? If yes, give date and place __________	☐	☐
4. Do you meet all the driver qualifications as required by 49 CFR 391 to operate a commercial vehicle? If yes, show your valid Federal Medical Certificate (FMC) to the examiner.	☐	☐
5. Is the vehicle in which you will take the commercial driver license skill test representative of the type of vehicle you will operate or intend to operate?	☐	☐
6. Is the vehicle you will be operating equipped with air brakes?	☐	☐

NOTE: See classes at top of page.

Check class(es) for which you are applying

☐ A ☐ B ☐ C

Check endorsements for which you are applying

☐ F Farm service ☐ H Hazardous materials ☐ N Tank vehicles
☐ P Passenger ☐ S School bus ☐ T Double/triple trailers

IC1(a)iii. Contact Based on Driving Record

Summary:

The use of a single point system for all ages assumes that the relationship between points and crash risk is the same at each age level. The purpose of the analysis performed by Gebers and Peck (1992) was to determine if there is a quantitative justification for intervening against older drivers on the basis of fewer traffic conviction and/or crash points, in light of the hypothesis that older drivers who accumulate traffic convictions and crashes may represent atypical individuals who are not completely compensating for declining skill level. They calculated the expected number of predicted crashes per 1,000 drivers based on the negligent operator point total for all drivers in general, and for drivers in the 60-69 age group and 70+ age group. This was for the expected number of crashes in a subsequent 3-year period and number of negligent-operator points in the prior 3 years. At the lower point levels (0, 1, 2), the older drivers were equal to or better than all drivers in terms of the expected number of crashes for a given number of points. At the 3-point level and above, there is a slightly steeper increase in the number of predicted crashes for drivers age 70+, relative to what would be expected among the total population. A similar trend was found for drivers ages 60-69 who had more than 5 points in a 3-year period. Among the group who accumulated 6 points in 3 years, there is an expected rate of 437 crashes per 1,000 drivers in the next 3 years for the general population, 441 crashes among drivers ages 60-69, and 512 crashes for drivers age 70+. An analysis of covariance of crashes and convictions occurring over the same 6-year period demonstrated that drivers ages 60-69 or 70+ begin to exceed the number of crashes among the general population when they have reached the point of accumulating two or more convictions.

In Iowa, the Department may require a special reexamination when a licensee has been involved in two crashes within a 3-year period, and the investigating officer's report of each crash lists one of the following "driver/vehicle related contributing circumstances: ran traffic signal; ran stop sign; passing, interfered with other vehicle; left of center, not passing; failure to yield right-of-way at uncontrolled intersection; failure to yield right-of-way from stop sign; failure to yield right-of-way from yield sign; failure to yield right-of-way making left turn; failure to yield right-of-way to pedestrian; failure to have control." The Department may require a special reexamination when a licensee who is age 65+ has been involved in a crash, and information in the investigating officer's or the person's own report of the crash indicates the need for a reexamination. A circumstance that may indicate a need for reexamination includes (but is not limited to) any of the following actions by the licensee: left turn resulting in the crash; failure to yield the right-of-way at a stop sign, yield sign, uncontrolled intersection, at a traffic control signal; the licensee's vision may be a contributing factor to a nighttime crash; the licensee has a physical disability-related license restriction other than "corrective lenses" and the crash involved one of the above-listed circumstances.

Conclusions/Preliminary Recommendations:

Gebers and Peck conclude that an age-mediated point system in which driver control actions are initiated at a lower threshold for drivers above age 60 or 70 would serve as an early warning system for detecting functionally impaired older drivers, but interventions should not be unduly obtrusive or punitive at the first level of intervention (e.g., a self-assessment brochure would be appropriate).

References:

- Gebers and Peck (1992)
- Iowa Code

Ic1(a)iv. Contact Based on Age at Renewal (includes random and stratified sampling selection procedures)

Summary:

Petrucelli and Malinowski (1992) stated that while chronological age is a poor predictor of functional capability, it is used as a screening tool. A subset of States and Provinces require a medical report/ examination or vision screening after a certain age at the time of renewal, as shown in the table below (data from Alcee, Jernigan, and Stoke, 1990; Fields and Valtinson, 1998; Janke, 1994; and Petrucelli and Malinowski, 1992).

State/Province	Licensing Requirements: Distinctions for Older Drivers	Age
Alaska	No renewal by mail; vision test required	70
Alberta	Medical report every 2 years at age 70, every year at age 80	70, 80
Arizona	Reduction of interval between renewal (from 12 years to 5 years at age 55); No renewal by mail (age 70+)	55, 70
British Columbia	Medical report at age 75, every 2 years at age 80	75, 80
California	No renewal by mail; vision test required; written knowledge test required	70
Connecticut	Reduction of interval between renewal from 4 years to 2 years	65
District of Columbia	Medical report plus reaction test; at age 75, additional knowledge and road tests (optional)	70
Hawaii	Reduction of interval between renewal from 6 years (ages 18-71) to 2 years	72
Idaho	No renewal by mail	69
Illinois	Reduction of interval between renewal from 4 years (age 21-80) to 2 years (age 81-86); Reduction of interval between renewal to 1 year (age 87+); No renewal by mail, vision test required, and on-road driving test required (age 75+)	75, 81, 87
Indiana	Reduction of interval between renewal from 4 years to 3 years; on-road driving test required.	75
Iowa	Reduction of interval between renewal from 4 years to 2 years	70
Kansas	Reduction of interval between renewal from 6 years (ages 16-64) to 4 years	65
Maine	Reduction of interval between renewal from 6 years to 4 years at age 65; Vision screening test at renewal for age 40, 52, and 65; every 4 years after age 65	40, 52, 65
Manitoba	Medical report for renewal	65
Maryland	Medical report for new drivers over age 70	70
Montana	Reduction of interval between renewal from 8 years (ages 21-67) to 1 to 6 years (age 68-74); 4 years at age 75	68, 75
Nevada	Vision test and medical report required to renew by mail	70
New Mexico	Reduction of interval between renewal from 4 years to 1 year	75

State/Province	Licensing Requirements: Distinctions for Older Drivers	Age
New Hampshire	Road test at renewal	75
Newfoundland	Medical report every 2 years at age 70, every year after age 80	70, 80
Ontario	Medical report for renewal	65
Oregon	Vision screening test once every 8 years (every other license renewal)	50
Pennsylvania	Random physical examinations for all drivers over age 45; usually the drivers are over age 65	45
Quebec	Medical report every 4 years at age 70, every 2 years at age 74-80, every year at age 80	70, 74, 80
Rhode Island	Reduction of interval between renewal from 5 years to 2 years	70
Yukon	Medical report and renewal every 2 years at age 70	70
Wisconsin	No renewal by mail	70

Pennsylvania's "Older Driver Reexamination Program" is a mechanism for identifying medically incompetent drivers. Each month, 1,650 drivers over the age of 45 are selected for retesting at the time of license renewal. Driver selection is weighted heavily toward the oldest drivers, and results in (almost) every driver over the age of 85 being selected. Each selected driver is required to undergo both vision and physical examinations. The medical evaluation may be conducted by any licensed physician. The vision screening may be completed by a physician, or, at a Driver License Center at no charge. As a result of this program, 28 percent of the drivers selected for reexamination do not have their licenses renewed. This number includes drivers who have already stopped driving while retaining a license and drivers who voluntarily surrender their license in lieu of completing the exams. Less than one percent actually fail the medical or vision exams. An additional 26 percent of the drivers selected have restrictions placed on their driving privileges. Ninety-nine percent of these restrictions are related to vision or hearing problems. If warranted by the results of the medical examination, the selected drivers are required to successfully complete an on-road driving examination. PennDOT has found that the driver's examination is warranted for less than 1 percent of the drivers. Freedman, Decina, and Knoebel (1986) found that the reexamination program is effective in discovering medical and visual conditions that require remediation, restrictions on driving, or withdrawal of operating privileges, especially among drivers age 60 and older. They stated that based on the data on new restrictions, failures, and other reasons for loss of license, as well as crash data, very little is gained by requiring drivers under age 60 to undergo reexamination.

In four states under study, McKnight and Lange (1996) found that in states requiring age-based on-road driving tests for renewal (Indiana and Illinois), tested drivers evidenced significantly lower (7%) relative involvement in crashes than their counterparts in the comparison states (Ohio and Michigan). However, while age-based testing appeared to lower the rate of crashes for older drivers, it did not lower the proportion of single-vehicle crashes. The authors note that testing may serve to induce drivers to drive less frequently rather than to remove unsafe drivers from the road. They concluded that age-based road testing as a means of selectively removing unsafe drivers from the road, or even reducing the amount of their driving, receives no support from the comparisons made in their study. Rock (1998) noted that McKnight and Lange's non-tested group (age 70-74) in one of the testing states (Illinois) had just come off of a testing requirement, which may have had a lingering effect, potentially affecting their study findings. Rock explored the changes made to Illinois' revised renewal requirements for older drivers and found that eliminating the road test for those ages 69-74 had no negative impact on crashes. In addition, shortening the renewal term to 2 years (from 4 years) for drivers ages 81-86 did not appear to have any benefit.

A discussion of attitudes toward the testing of older drivers for relicensing is useful. Although AARP believes that age-based testing is discriminatory and arbitrary, they support "a combination of driver education, improved testing methods, and the availability of alternative transportation for those who are unable to drive" for drivers of all ages (AARP, 1995). In addition, AARP believes that "states should achieve greater consistency in licensing programs and procedures, such as graduated licensing and testing procedures, and should develop educational materials to educate older drivers, their families and caregivers, and the general public about the effects of functional age on driving, the availability of specialized licenses, the procedures involved in the re-examination process, and alternatives to driving." Older drivers' attitudes toward age-based testing are presented next.

Gutman and Milstein (1998) asked 162 focus group participants ages 56 to 76+ the following question: "If older drivers were required to be retested before their license was renewed, at what age should this happen?" Twenty-eight percent of the total sample were against retesting on the basis of age without an additional reason; 44 percent of the drivers age 76 and older were against testing on the basis of age, compared to 22 percent of those ages 56-65 and 30 percent of those ages 66-75. The most frequent age specified by those who indicated that age-based testing was appropriate was 70 (by 41 percent of all respondents), followed by age 65 (by 31 percent of the group). When asked, "Does retesting of older drivers discriminate against them," 70 percent replied "no," 25 percent replied "yes," and 5 percent did not respond. When asked what kinds of tests drivers would be required to pass for license renewal, 55 percent of the participants stated an eyesight exam, 54 percent stated a medical checkup, 51 percent a road test, 41 percent a fitness test, and 36 percent a written test (multiple responses were permitted). Drivers age 76 and older were approximately half as likely as those in the two younger age groups to indicate criteria for license renewal. However, drivers age 76 and older were more than twice as likely as the two younger groups to state that *all* tests should be required for *all renewals*, regardless of age. When asked, "Who should decide when you should stop driving," the most frequent response was the doctor (45%), followed by self (36%), scores on an unbiased test (33%), the licensing department (22%), the person's family (15%), and a panel of experts (7%). In the oldest driver group, self determination was reported more frequently (56%) than physician (48%).

In a survey of 384 older driver ages 68 to 88 (mean age=75.7) conducted in Salisbury, MD for the NHTSA "Model Driver Screening and Evaluation Program" project, the present *Notebook* authors found that 61 percent responded in the affirmative when asked whether there should be mandatory retesting of drivers based on age. Of those older drivers who believe that mandatory age-based testing should be implemented, 23 percent indicated that testing should begin at age 80, 20 percent stated at age 75, 17 percent at age 65, 14 percent at age 70, 13 percent at age 85, and 10 percent at age 60. A further question asked who should pay for mandatory retesting for license renewal, with the following options provided: (1) Self--you pay full cost; (2) co-pay--self shares cost with State or with insurance company; (3) State pays full cost; and (4) Insurance pays full cost. The majority (37%) indicated the State; 25 percent indicated "self;" 21 percent indicated "co-pay;" and 15 percent indicated "insurance." When asked what kind of professional would be qualified to administer testing (from a list that included doctor, other health-care professional, police, Department of Motor Vehicles, occupational/physical therapist, and community service worker), the vast majority (84%) indicated doctor, followed by DMV (64%). Twenty-seven percent of the subjects indicated that the police would be qualified to administer tests, 22 percent identified other health-care professionals, 18 percent identified occupational/physical therapists, and 13 percent indicated community service workers. The final question asked who should hold the ultimate responsibility for deciding whether and how much an individual should drive (from a list that included DMV, doctor, family/friends, self and other). Eighty-five percent the subjects indicated "self," 49 percent indicated doctor, 40 percent indicated DMV, and 29 percent indicated family/friends.

In a smaller survey of 26 older drivers ages 57 to 86 (mean age=71) sampled by the present *Notebook* authors while conducting Pennsylvania Department of Transportation (PennDOT) project number 96-13, "Driver Safety Public Information and Education (P.I.&E) Campaign," 69 percent responded "yes," i.e., there some age at which all drivers should be retested on their fitness to drive. The ages provided by this sample and the number of subjects indicating each age are as follows: age 16 (n=1); age 55 (n=2); age 60 (n=3); age 61 (n=1); age 70 (n=2); age 75 (n=3); age 80 (n=3); and age 85 (n=3). Drivers in this survey were asked to provide a rank ordering of their preference for the type of individual who should administer license renewal testing. The list included eight agencies/professionals; (1) the Department of Motor Vehicles; (2) the police; (3) family doctor; (4) health care professional other than a physician (e.g., nurse, medical technician); (5) volunteer service provider (e.g., community/senior center activities director); (6) Government agency case worker (e.g., Department of health, social services, area agency on aging); (7) occupational or physical therapist; and (8) local AARP chapter. The agency/individual ranked as first preference by the largest percentage of subjects was the DMV (by 34.6%), followed by doctor (30.8%) and AARP (19.2%). The most frequent second-choice agency/individual chosen by subjects was health care professional other than physician (by 34.6%). The agency/individual most frequently chosen as the least-preferred (ranked 8th) for administering testing for license renewal was the police (by 38.5% of the subjects) followed by a Government agency case worker (by 23%).

Stutts, Wilkins, and Schatz (submitted) reported that the majority of the older drivers who participated in their focus groups believe that older drivers should be more carefully evaluated than they are now, with more rigorous and more frequent testing. Participants could not agree on an age when testing should begin; however, most indicated that it should be "sooner rather than later" so that seniors could get comfortable with the idea.

Conclusions/Preliminary Recommendations:

Age-based medical and visual testing upon license renewal are common among many jurisdictions, and have been shown to be a good means of identifying drivers with age-related functional impairments that may affect safe driving performance. It appears that age-based reexaminations are not appropriate for drivers under the age of 60. A road-test requirement for all renewals over a certain age does not appear to add any additional information about a driver's ability to safely carry out the driving task, and may be best reserved for drivers who are referred to a DMV by family, friends, police etc., for observed unsafe driving performance; drivers who have been referred by physicians for specific medical disorders (e.g., dementia); or drivers who have been involved in point violations or crashes between renewal periods.

There is some support by older drivers for age-based testing upon license renewal. Older drivers have identified physicians and the DMV as most appropriate for administering testing, and police among the least-appropriate individuals for conducting license renewal testing.

References:

- Alcee, Jernigan, and Stoke (1990)
- Decina, Staplin, and Lococo (1998)
- Fields and Valtinson (1998)
- Freedman, Decina, and Knoebel (1986)
- Gutman and Milstein (1988)
- Janke (1994)
- Lange and McKnight (1996)
- McEwan (1997)
- Petrucelli and Malinowski (1992)
- Rock (1998)
- Stutts, Wilkins, and Schatz (submitted)

IC1(b)i. Family/Friend Referral

Summary:

Fifty-four of 60 Driver License Administrators surveyed in 60 U.S. States and Canadian Provinces indicated that it would be feasible in their jurisdictions to have family or friends refer drivers they believe to be impaired (Staplin and Lococo, 1998). Many States already have this referral process in place. The Pennsylvania Department of Transportation (PennDOT), for example receives approximately 500 signed letters from family members each year. Sixty-five percent of these drivers ultimately lose driving privileges. Family members account for 5 percent of requests for reexamination by the DMV in Iowa, and 10 percent of the requests in Michigan. Five percent of the "Behavior Reports" submitted to the Wisconsin DMV in 1996 were from citizens. Wisconsin's "Driver Condition or Behavior Report" (Form MV3141) is presented at the end of this section. Wisconsin's Guidelines (Section 235, Evaluating Medical Conditions or Disabilities) state that "persons volunteering information about other licensed drivers should be told that the information will be available to the driver they are reporting under Wisconsin's Open Records Law. This includes unsolicited reports from physicians and other health care specialists. A pledge of confidentiality cannot be given after an individual has provided information to the department. Pledges of confidentiality are not given routinely."

The Ohio Bureau of Motor Vehicles accepts referrals from anyone (friends, family, police, court, physician), but the individual must be willing to be named as the source of information (Staplin and Lococo, 1998). When family and friends report an individual, the Bureau conducts a pre-investigation before requiring a re-test, to make sure the report is legitimate. Police officers who observe unsafe driving performance can submit a "re-examination or re-certification" and a judge who is trying a case (e.g., for a traffic violation) can also submit for re-exam or re-cert, if he or she suspects that the person has some medical problem that could increase crash risk (e.g., Alzheimer's Disease). In the case of police, the court, and physician reporting, the Department does not do a pre-investigation. Age is not used as a basis for re-exam; however, a large proportion of the drivers who are "requested for re-exam or re-cert" are older. According to the Director of the Ohio State University's Office of Geriatrics and Gerontology, family members appear to be a good referral source and friends (in general) are not (*pers. comm.*, B. Kantor, 1/98).

Family members were identified in Oregon as a likely source of information about older drivers with medical impairments (Janke and Hersch, 1997). Families have the ability to observe these drivers over longer periods of time, and therefore may be aware of conditions or behaviors not observed by physicians or licencing agencies.

Information about the status of this issue in Illinois was obtained from a 1990 report, entitled "*Report of the Driver Safety Advisory Committee*," which was submitted to the Secretary of State, Jim Edgar (Illinois Retired Teachers Association, Inc. ,1990). In this report, it states that the Driver's License Act of 1953 provided the Secretary of State with the discretionary authority to examine a driver if there was good cause to believe the person holding the driver's license or permit was incompetent or otherwise unqualified to operate a motor vehicle. However, in 1974, the office of the Illinois Secretary of State determined that family members and insurance companies would no longer be considered an authorized source for requesting a citation for re-examination. In 1990, a panel of traffic safety experts, medical professionals, members of senior citizen organizations, and law enforcement officials were appointed to review a Cite for Re-examination proposal, which would allow family members to request a re-examination for drivers who show deteriorating driving skills. The panel, named the Driver Safety Advisory Committee, concluded that the proposed amendment did *not* discriminate against any driver. It was further recommended that family requests for re-exam not be held confidential, as a deterrent to fraudulent reports. This amendment, dubbed the "tattletale plan" by the media, was withdrawn from consideration as a result of criticism from opponents running for Governor against the current Secretary of State, who first proposed the legislation. Only doctors, police officers, judges, and secretary of state employees are authorized to make such reports.

Approximately two-thirds of 50 participants in focus groups (family members concerned about an older driver) indicated that they would report a family member who was a problem older driver (Sterns, Sterns, Aizenberg, and Anapolle, 1997). The characteristics and patterns of unsafe driving they describe are many of those that are listed in section IA2(g) of this *Notebook*: forgetfulness; confusion; bad judgment; new dents and dings on the vehicle; reports to family members about an unsafe older relative, from police, neighbors, other family members; driving too slow on the expressway; driving too fast/close to the car in front; weaves in and out of lanes; slowing/stopping for green lights; ignoring red lights; not looking when backing; not using mirrors; and couldn't find brake/accelerator. All family members and friends indicated that they were able to recognize unsafe driving behavior among the elderly of their concern. Several had attempted to report such drivers to their State DMV, or to physicians. Only a few had the support of a physician, and none had the support of law enforcement or the DMV.

The New York State Office for the Aging conducted a survey of family and caregivers concerned about the safety of an older driver (see Lepore, 1998). Respondents included 123 individuals who voluntarily completed a questionnaire that requested detailed information about the driver, family concerns, and the types of help they would like to have. The majority of respondents (79%) were female family members who lived no more than 30 minutes from the driver, and most had jobs or other caregiver responsibilities. Most notably, over 70 percent of the respondents reported that they had been concerned for more than 1 year about the driving safety of the older family member, and that their first indications of a safety problem came from watching the driver (slow reactions in traffic, slow driving, and inattention to other road users and hazards). Of the drivers identified as unsafe, 85 percent were age 75 and older; over 90 percent lived in their own home or apartment, and almost 75 percent lived alone. Despite having serious concerns about an older family member's driving safety, 60 percent of the respondents reported that they were unable to discuss the problem with the driver, or to intervene. The most common reason (provided by 80 percent of those who could not intervene) centered on concerns about taking away the driver's independence. These individuals stated that alternative transportation options, plus the support of a physician to prescribe "no driving" and/or refer the older driver to the DMV, would be helpful. Over three-quarters of the surveyed family members voiced support for a DMV driving test. A second survey is currently underway, to learn about how family members and friends successfully resolved an unsafe older driver situation, or helped an older person to return to driving safely. This survey can be downloaded from the internet at http://aging.state.ny.us/nysofa. The information will be used to develop a handbook for families, caregivers and others concerned about the safety of an older driver, entitled "When You are Concerned: A handbook for those concerned about the safety of an aging driver." The planned publication date of the handbook is Fall of 1999; it will be available from the New York State Office for the Aging. The handbook will include the following information: resources-- what to expect in the way of assistance; monitoring an aging driver, even when you don't live nearby; solutions for when an aging driver is at-risk, including discussions and interventions; transportation when driving is not an option; strategies for helping the aging driver cope with the loss of a license and overcoming the guilt of intervention; and strategies for keeping an aging driver safe on the road.

In another survey that included 119 health care and rehabilitation specialists, 30 percent responded that they had reported an older person to State authorities (Sterns, Sterns, Aizenberg, and Anapolle, 1997). Of particular significance was the fact that for two-thirds of the respondents who had reporting experiences, their report was initiated by concerned family or friends.

Conclusions/Preliminary Recommendations:

Referrals from families or friends about impaired older drivers are an important source of information for licencing agencies. Family members have more of an opportunity to observe these drivers on a daily basis. Family and friends also have the strongest concern for older drivers, and therefore are motivated to keep them safe. Steps need to be taken to facilitate this process, however. These steps may include distribution of information to the public detailing if, when, and how one should refer an impaired driver. In addition, since physicians are the most frequent contact, and are often reluctant to get involved with families and issues of driving cessation, social marketing campaigns must include and target health care personnel. Family and friends require the support of physicians, law enforcement personnel, and the DMV for reporting and retesting.

References:

- Illinois Retired Teachers Association, Inc. (1990)
- Staplin and Lococo (1998)
- Janke and Hersch (1997)
- Lepore (1998)
- Sterns, Sterns, Aizenberg, and Anapolle (1997)
- Wisconsin DMV

DRIVER CONDITION OR BEHAVIOR REPORT

MV3141 5/94

Submit To: Wisconsin Department of Transportation
Medical/Alcohol Review Section
P. O. Box 7918
Madison, WI 53707-7918

The following information is submitted for consideration as "Good Cause" for Departmental action as authorized under section 343.16 Wisconsin Statutes. Advanced age alone, cannot be considered as good cause. Positive driver identification must be established. License plate number only is not sufficient.

This information is subject to Wisconsin's Open Records Law.

Driver Name - First, Middle, Last	Birth Date	Driver License Number	State of issuance

Address	City	State	Zip Code

Driver Condition - Check appropriate boxes. Describe below. Use back of form for additional comments.

- ☐ Physical Condition
- ☐ Mental/Emotional Condition
- ☐ Blackout, Seizure, Fainting Spell
- ☐ Confused/Disoriented
- ☐ Alcohol/Other Drugs
- ☐ Defective Vision

Driver Behavior - Check appropriate boxes. Describe below. Use back of form if needed.

- ☐ Traffic Violation(s)
- ☐ Dangerous Action (Accident prevented by another person)
- ☐ Lack of Driving Skill - Describe below.
- ☐ Gross Lack of Attention
- ☐ Other - Describe below.
- ☐ Caused Traffic Accident
- ☐ Lack of Knowledge of Traffic Laws
- ☐ Obstructing Traffic

Describe in detail incidents or conditions which brought this driver to your attention. Give specific information such as dates, places, accident reports, all other available information to support need for re-examination.

Type of Enforcement Action Taken

Incident Location	Incident Date	Time	Person Hospitalized?
			☐ Yes ☐ No

☐ I observed incident. ☐ I investigated incident. ☐ Incident reported to me by person identified below.

Title and Signature of Person Completing this Form	Print Full Name	Area Code - Telephone Number
X		
Address - Please Print	City - Please Print	Zip Code

Print Full Name of Person Who Can Verify the Above Information - Private Citizens or Family Members	Area Code - Telephone Number

Address	City	Zip Code

See reverse side for additional space/instructions.

Comments continued from front

Complainant Name
Address
City, State, Zip Code

For private citizens or family members who use this form:

I understand that I may be held legally and personally responsible for the accuracy of this report.

X ______________________________
(Complainant Signature) (Date)

IC1(b)ii. Law Enforcement Referral

Summary:

Evidence of unsafe behaviors by older drivers is provided in a study by McKnight and Urquijo (1993), who examined the criteria that law enforcement personnel use when referring older drivers for reexamination, following their observations of signs of incompetence when an older driver is stopped for a violation or is involved in a crash. The data consisted of 1,000 police referral forms from the motor vehicle departments of California, Maryland, Massachusetts, Michigan, and Oregon. Referrals were classified on the basis of initial contact, as well as the behaviors leading to the contact and the deficiencies that served as the basis of referral. Initial contact could result from one of four conditions: a crash; a violation; police observation of aberrant behavior; or referral by an outside source such as friends, relatives, or physicians. The specific behaviors contributing to the contact between the aging driver and the police officer included: driving the wrong way or on the wrong side of the street; driving off the road; rear-ending a vehicle; failing to yield the right-of-way or come to a complete stop at a stop sign; infringing on the rights of a pedestrian or cyclist; turning across the path of oncoming vehicles; crossing lane markings; operating at low speed; backing improperly; and other behaviors.

Results of the data analysis showed that older driver crashes were the leading source of referrals (48 percent), followed by violations (44 percent). Observed behavior accounted for 7 percent of the referrals and outside referrals accounted for only 1 percent. The primary behaviors that brought these drivers to the attention of police were: driving the wrong way on a one-way street or on the wrong side of a two-way street, which contributed to many violations (149), but few crashes (29) and accounted for 19 percent of the referrals; driving off the paved surface, which contributed to many crashes (176) but few violations (8) and accounted for 19 percent of the referrals; and failing to stop or yield to other traffic, which contributed to significant numbers of crashes (74) and violations (114), and accounted for 18 percent of the referrals. Making unsafe turns in front of other traffic was half as frequent as the three aforementioned behaviors, but is a mistake in which older drivers are generally overrepresented; turning across traffic contributed to 46 crashes and 43 violations, or approximately 9 percent of the referrals. Other contributing behaviors, in decreasing frequency, included: driving very slowly; rear-ending another vehicle; backing improperly; failing to observe lane markings; and not yielding to pedestrians and bicyclists.

After being pulled over, officers reported a number of deficiencies that served as the basis for referral for reexam. These included: aberrant behavior (taking too long to pull over, difficulty producing identification, etc.); attentional deficit (admission of being generally unaware of other vehicles, traffic control, what they had done that resulted in violation or crash); cognitive deficit (lack of recall, inability to comprehend, failure to know rules of the road, etc.); medical problems (blacking out, diabetes, Alzheimer's, fainting/dizziness, Parkinson's disease, seizure, epilepsy, stroke, etc.); mental problems (confused, disoriented, lost, senile, drowsy or fatigued, etc.); motor problems (slow reflexes, inappropriate manipulation of controls, such as brake and accelerator, generally poor coordination, observed difficulty walking, shaking or tremors, physical disability, general weakness, extremely short stature); and apparent sensory deficits (impaired vision or hearing, poor depth perception, degraded night vision, recent eye surgery or cataracts).

The Pennsylvania Department of Transportation (PennDOT) annually receives about 2,000 police reports and 500 crash reports concerning potentially impaired drivers of all ages. Approximately 50 percent of the drivers who are reported lose driving privileges following a medical or driving exam.

Data from Wisconsin DOT indicates that in 1996, two-thirds of reports concerning impaired drivers of all ages in the State came from law enforcement officials.

A survey of driver licencing agencies in nine states (CA, CT, FL, MA, MI, OH, OR, TX, and WI) indicated that 24 percent of older driver referrals were submitted by law enforcement officials (Aizenberg and Anapolle, 1996). In Oregon, law enforcement is a significant reporting source of older drivers, accounting for 24 percent of reports for older drivers compared to 17 percent of all reports. However, information from Oregon indicates that police officers tend to be responsible for many unnecessary reexaminations and medical referrals (Janke and Hersch, 1997). Michigan receives approximately 5,000 referrals annually; physicians and law enforcement are the two primary reporting sources, followed by family members (Aizenberg and Anapolle, 1996).

An external referral program in the State of Florida with participation from two police agencies resulted in the referral of 71 impaired older drivers to an education/training program. Only 7 percent of the drivers identified decided to participate in a driver education program, with another 4 percent voluntarily surrendering their driving privileges. Most of the drivers contacted by the older driver program administrator denied that they had diminished capabilities and needed retraining. Over 65 percent of those contacted stated that they should not have been pulled over by law enforcement officers.

An elderly driver special referral form developed for use by the Florida Highway Safety Patrol (Zimmerer, undated) is presented on the next page. A draft paper has been developed by Zimmerer/NHTSA (*in press*) describing cues for possible impairment that law enforcement should observe when encountering older drivers. These include observations of the driver's awareness and cognitive status (e.g., does he or she know time of day, day of week, month of year, the origin and destination of the trip; does the person stumble over words or ramble); appearance (e.g., does the person exhibit poor hygiene or inappropriate clothing); and physical status (does the person take a long time to walk a short distance, stumble/fall, shake, seem uncoordinated). The purpose of the observations are for constructive intervention (e.g., referral for remediation) and to assist the older driver in self assessment.

Conclusions/Preliminary Recommendations:

Law enforcement agencies have the ability to identify and refer impaired older drivers. Officers are not qualified to make medical judgments, but can be provided with guidelines and support materials, and can be trained to recognize behavioral indicators of age-related impairments. This approach is expected to cut down on unnecessary referrals. In addition, the participation of potentially-impaired drivers in education or remediation programs should be <u>mandatory</u> (e.g., once stopped for unsafe driving behavior, an older person may choose re-training or receive a traffic ticket with points); a majority of drivers will not participate otherwise.

References:

- Aizenberg and Anapolle (1996)
- Florida: Law Enforcement Component of "Getting in Gear" Program
- Janke and Hersch (1997)
- McKnight and Urquijo (1993)
- PennDOT (1997): Information Distributed at Pennsylvania Governor's Highway Safety Conference
- Wisconsin: 1996 Behavior Report Statistics
- Zimmerer (*in press*) police form

ELDERLY DRIVER SPECIAL REFERRAL FORM

Name of Driver ______________________

INCIDENT

- ☐ Turn left across traffic
- ☐ Weaving over lanes
- ☐ Wrong way driving
- ☐ Striking parked vehicle
- ☐ Driving off road
- ☐ Failure to properly obey traffic control device (running a red light or stop sign, or stopping for a green light)
- ☐ Speed - Too Fast
- ☐ Speed - Too slow
- ☐ Lane selection, Following lane markings (i.e., turning right from left lane)
- ☐ Pedestrian/Bicycle Incident
- ☐ Backing up Incident
- ☐ Right of way violation
- ☐ Rear-end accident
- ☐ Failure to pull over
- ☐ Failure to stop for accident
- ☐ Other (Describe)

____
____
____
____
____

REASONS OBSERVED OR GIVEN FOR THE INCIDENT

Visual Search
- ☐ Did not see pedestrian
- ☐ Did not see traffic control device or signs
- ☐ Poor visibility
- ☐ Did not check for traffic or pedestrian
- ☐ Did not turn head or look back
- ☐ Could not see traffic or object
- ☐ Did not see lines

Mental States
- ☐ Became confused
- ☐ Did not think of the hazard
- ☐ Did not know rules of road (eg., use of two way left turn lane)
- ☐ Was lost or disoriented
- ☐ Forgot destination
- ☐ Lack of concentration
- ☐ Blacked out/fell asleep
- ☐ Confused about traffic pattern
- ☐ Was surprised by location of turn

Control of Vehicle
- ☐ Incorrectly use of auto's controls
- ☐ Lost control of vehicle
- ☐ Needed more room to increase turning radius
- ☐ Drifted out of lane
- ☐ Feared losing control of vehicle

Attention Problems
- ☐ Failed to notice traffic controls or signs
- ☐ Failed to notice oncoming cars or pedestrian
- ☐ Did not attend to lines
- ☐ Loss of concentration
- ☐ Was distracted

Judgment
- ☐ Misjudged speed of traffic
- ☐ Incorrectly judged right of way rules
- ☐ Misjudged distance
- ☐ Over-reaction to other traffic conditions
- ☐ Overly cautious
- ☐ Was surprised by other's behavior
- ☐ Did not know how fast they were going

Other (Describe)

____
____
____
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____
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____
____

OBSERVED DEFICIENCIES

Sensory
- ☐ Vision
- ☐ Hearing
- ☐ Depth Perception
- ☐ Night Vision
- ☐ Other ____________

Mental States
- ☐ Confused
- ☐ Disoriented
- ☐ Lost
- ☐ "Senile"
- ☐ Drowsy
- ☐ Other ____________

Motor Deficiency
- ☐ Slow reaction time
- ☐ Poor coordination
- ☐ Other ____________

Cognitive Deficiencies
- ☐ Poor memory
- ☐ Inability to comprehend
- ☐ Poor decision making
- ☐ Other ____________

Physical Deficiency
- ☐ Difficulty walking
- ☐ Shaking or tremors
- ☐ Physical disability or handicap
- ☐ General weakness
- ☐ Other ____________

Other Deficiencies (Describe)

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IC1(b)iii. Court Referral

Summary:

The Ohio State University Medical Center "Older Driver Evaluation Program" has an agreement with municipal courts allowing judges to give the older adult a choice to agree to undergo the evaluation as an alternative to formal charges for a motor vehicle violation, as a means of identifying deficits that might threaten future successful driving and independence, or as a means of determining current function and potentially lessening license suspension time frame. Referred drivers complete a medical profile, undergo tests of perceptual, cognitive, and psychomotor skills, and on-road driving tests. The outcome of the evaluation may involve a recommendation for or against independent driving, or remedial training. One judge stated that sentencing is a very subjective procedure; the OSU program takes a lot of the subjectivity out (Mader, 1994). There are two scenarios for referral (Ottolenghi-Barga, 1993). In the first, an officer stops a driver, determines that he or she is at risk on the road, and orders a court appearance and retesting by the Bureau of Motor Vehicles (BMV). In the second scenario, the court recognizes a driver's pattern of minor or major crashes and infractions, and suggests that the driver participate in the Older Driver Evaluation Program (ODEP). Under either scenario, a driver who agrees to go through ODEP may not be charged with the violation and may not receive points. The traffic case is continued pending completion of the program, and the BMV may or may not be requested to retest, based on the ODEP results. A driver is not forced to participate, but if he or she refuses to do so, the ramifications of refusal may include mandatory retesting and conviction on the driving infractions. Points resulting from the conviction may lead to insurance premium increases or cancellation.

Conclusions/Preliminary Recommendations:

The effectiveness of this program has yet to be evaluated, however, court-mandated testing of older drivers who have come before the courts as a result of a traffic violation or crash represents a potentially successful mechanism for identifying impaired older drivers. Retesting and referral into a training/remediation program that is presented by the judicial system to the older driver as an alternative to legal action will result in a higher rate of participation than a purely voluntary initiative.

References:

- Mader (1994)
- Ottolenghi-Barga (1993)

IC1(b)iv. Occupational/Physical Therapist Referral

Summary:

Occupational therapists provide a variety of services geared toward assisting the older driver. Their goals are to keep people independent. As such, driving programs have two goals: (1) to provide objective evidence of who would be dangerous on the road; and (2) to prolong the mobility of those who have the potential to be safe drivers. Generally, occupational therapists have 5 parts to their evaluation: (1) an interview to determine why the person came to them and to see if the person has insight as to why the doctor or family wanted the evaluation; (2) physical assessment of strength, range of motion, and sitting balance; (3) cognitive evaluation to determine the ability to organize and react to traffic information; (4) sensory evaluation to determine the ability of the person to perceive his/her environment; and (5) simulation to evaluate driving performance (Hunt, 1990).

Drivers come to the attention of OTs through various mechanisms, including physician referral, hospital point of discharge (e.g., after a stroke, a patient may enter a rehab program), court referral, clergy referral, and through concerned family members and friends. Occupational therapists help older drivers cope with age-related changing abilities by developing programs designed to retrain older drivers. They also retrain drivers who have had amputations, strokes, and chronic arthritic disease to use adaptive equipment (hand controls, spinner knobs, grip attachments, seat height adjustors, pedal extenders, signal switchers, blind spot mirrors) to maintain safe mobility. OTs provide objective assessments that help to guide decisions regarding continued mobility or driving cessation. Conducting driving evaluations thus requires an understanding of the impairments associated with normal aging, as well as the interactions of age effects with effects of disease, and how these factors influence on-road driving performance. Because OT practitioners are trained to look at physical and cognitive issues, they are in a good position to evaluate and retrain disabled or elderly drivers (OT Week, 1998; Hunt, 1996; Ranney and Hunt, 1997; American Occupational Therapy Association Brochure). Descriptions of several programs follow.

Ohio State University Medical Center's Older Driver Evaluation Program is physician-driven; a physician oversees the program, which is staffed by an occupational therapist, a geriatric clinical nurse specialist, and an on-the-road evaluator. The assessment is conducted in two parts. The first part consists of cognitive, vision, and mobility tests. The second part consists of simulator and on-road driving tests. Also included in the evaluation is a pharmacological review. Results of these tests are forwarded to the driver's physician and to the driver, but never to the Bureau of Motor Vehicles. Evaluation outcomes for the 400 drivers who have been evaluated thus far, are as follows: 56 percent were deemed capable with training or vehicle modifications; and 44 percent were deemed incapable to continue driving. Those deemed incapable are sorted into two categories: incapable to drive now and in the future; and incapable now, but may be capable in the future with remediation (e.g., cataract removal). Evaluations last 3 hours, require 2 visits, and cost $330.00. According to the program administrators, this program is not meeting the need of all the older drivers in the state, based on cost and time to administer the evaluation. The program developers are working to create a short screening tool to be administered in physician's offices. They have followed the mammography model regarding desired sensitivity and specificity, in that they cannot tolerate sending a poor driver out on the road; therefore they err on the side of conducting full assessments on drivers whose driving ability is not compromised (*pers. comm.*, Bonnie Kantor and Linda Mauger, 1/20/98).

Penn State offers a comprehensive, three-phase driver rehabilitation program. Drivers are first evaluated on visual and perceptual skills, reaction time, cognition, attention, dexterity, and judgment. Remediation is provided in areas found to be weak. An instructor accompanies the driver to the State licencing exam. Counseling regarding alternative transportation services is provided to those judged unfit to drive (Geisinger/Penn State Medical Program: Support Services Brochure).

Bryn Mawr Rehabilitation's Adapted Driver Education Program provides an in-depth examination of driving ability. Their assessment includes tests of vision, divided attention, reaction time and cognition, as well as an on-road driving evaluation. Results of the exam are forwarded to patient's physician, who has the responsibility to report to the DMV. Driver training and equipment prescriptions are part of the program (Bryn Mawr Rehabilitation Hospital Adapted Driver Education Program Brochure).

DeGraff Memorial Hospital and Rochester Rehab Center have proposed a driver assessment, remediation, and referral program for older adults. Components will include: (1) evaluation and assessment (vision, reaction time, cognition, hearing, rules of the road, safety features, on-road assessment); (2) reporting (a written analysis of findings and recommendations for enhanced safety); and (3) interventions (referral to vehicle modifiers, driver remediation, counseling on driving alternatives, and support groups). The total cost per person assessed is estimated at $253.00 for 4 hours and 40 minutes (DeGraff Memorial Hospital: Older Driver Safety Project Executive Summary, Dr. Gary Brice).

Kim White of Sinai Rehab Hospital (Baltimore, MD) highlighted several issues important to the discussion of OTs and driving evaluations. First, driving rehabilitation/training is not a covered service (not covered by Blue Cross/Shield, Medicare, or Medicaid); insurance companies do not consider driving a medically necessary activity. Second, many people do not know how to go about getting the question answered regarding whether they are (or a family member is) a safe driver. There are very few OTs involved in driving evaluations. More certified driving instructors are needed and more information needs to be disseminated to the public describing driving evaluation. Finally, regarding reporting to the Motor Vehicle Administration, Sinai uses an informed consent approach: if a driver fails an evaluation, Sinai reports the results to the MAB. This has resulted in only a few drivers not participating in an evaluation. However, she states that it is often difficult to collect payment for the evaluation from drivers who fail.

Conclusions/Preliminary Recommendations:

Some occupational therapists/hospital rehabilitation programs already have comprehensive driver assessment, counseling, and remediation programs in place. These programs can be used to identify impaired drivers, and to determine whether the impairments can be remediated through training or adaptive equipment. There is a need for more driving assessment/rehabilitation professionals, and a need to educate the public about the existence of these programs. At issue is who will pay for these services, and whether results will be confidential or will be reported to a DMV. In many cases, the results of these assessments are only made available to the driver, or occasionally to the driver's physician. In addition, it is currently the case that a driver who passes a driving evaluation by an OT must also pass the State exam, if an exam is required in a jurisdiction for renewal, or reinstatement after suspension for medical reasons.

References:

- American Occupational Therapy Association (AOTA) Brochure: "Able Driving is Safe Driving: How Occupational Therapy Can Assist the Older Driver"
- Bryn Mawr Rehabilitation Hospital Adapted Driver Education Program Brochure
- DeGraff Memorial Hospital: Older Driver Safety Project Executive Summary (Dr. Gary Brice)
- Geisinger/Penn State Medical Program: Support Services Brochure
- Hunt (1990)
- Hunt (1996)
- Ohio State University Medical Center Older Driver Evaluation Program Evaluation (*pers. comm.*, Bonnie Kantor and Linda Mauger, 1/20/98)
- OT Week (1998)
- Ranney and Hunt (1997)
- Review of Sinai Hospital Driver Rehabilitation Program at Maryland Research Consortium Meeting (Presentation by K. White 3/98)

IC1(b)v. Referrals from Social Service Providers

Summary:

Maryland Geriatric Evaluation Services (GES) undertakes comprehensive evaluations of older individuals referred by family, friends, clergy, etc. who are at risk of losing their independence (to a nursing home admission) because of health, social, or environmental problems. The assessment helps to determine the person's functional status and what an individual's needs are to maintain community living for as long as possible. The 1.5 hour, in-home evaluation consists of medical, psychosocial, environmental, psychiatric, and economic assessments (performed by licensed certified social workers and nurses, in addition to consulting physicians and psychiatrists). After the evaluation is complete, a plan of care is prepared that provides recommendations for resources. The evaluation is free; however, case management services are charged to the client on a sliding scale basis. Results are kept confidential, but occasionally a letter is sent to DMV indicating that a person should not be driving. This letter does not mention specific information about diagnosis; instead, behavior is described to avoid patient confidentiality issues.

Genesis ElderCare is an organization that provides health care services through a network of people, places, and programs. They were established in 1985 and are working in 12 States on the east coast. Services include: family counseling and care coordination; adult day health programs; physician services; nutrition management services; pharmaceutical care and medical supply services; home care support services; respite programs; rehabilitation services; assisted living and retirement communities; and long-term care centers. A "Full Life Counselor" conducts a 2-hour, in-home assessment that includes health status, behavior, ability to perform activities of daily living (ADLs) and instrumental activities of daily living (IADLs), social interaction, emotional and intellectual well-being, and living situation and financial situation. The assessment includes the Mini-Mental Status Examination (MMSE). The assessment costs $225.00 and includes a "full life plan," which is a three-section written course of action for the elder and caregiver based on the assessment. The first section is a summary of the information collected in the assessment as well as the counselor's observations during the assessment. The second section is a summary that indicates how well the customer functions in each of the six areas critical to maintaining a full, independent life (sensory perception, mobility, continence, nutrition, medication management, and behavioral health). The third section is the counselor's recommendations to help the customer achieve the goals for independent living. A client or family may purchase on-going care coordination for $65.00/month. This is used for problem-solving of situations as they occur and for consultations with the customer to monitor the customer's satisfaction with the plan. A full life counselor may help to coordinate service for nearly any request. For example, one customer called them when a toilet overflowed, and Genesis arranged for plumber service. According to Abby Weintraub (a Full Life Counselor in Kennett Square, PA), driving and transportation are a big issue; the counselor asks whether the client drives, wears a seat belt, and should be driving. Genesis has an ambulance service, and is working to develop a transportation company (Genesis ElderCare Brochures; *pers. comm.*, Abby Weintraub, Full Life Counselor, Kennett Square, PA, 4/98).

A service organization named "National Eldercare Services Company" is an independent company that has been created to utilize existing Employee Assistance Programs (EAPs) in companies to help employees (typically the adult children) deal with problems related to the care of an older parent. Employers who purchase this service can use existing EAP counselors working in a company's benefits administration or human resources department to troubleshoot problems an older parent may have staying independent in his or her own home. A Preliminary Eldercare Profile (PEP) computer program has been designed to "red-flag" problem areas such as lack of a social network, safety of the immediate environment, health status of the elder parent, what benefits can be coordinated between the parent and child, etc. This level of service (Level 1, similar to a triage) is the minimum level/least expensive option to the employer that Eldercare contracts out to the employer, and the PEP is free to employees who utilize the service. Problems and concerns that the employee identifies about the older parent's driving will be "red-flagged" during the PEP.

The second through fourth levels of service provided by National Eldercare can be capitated as an employer-paid benefit; otherwise, the service is available on an elective basis and is paid out of the employee's pocket. Level 2 is a Home Evaluation Profile (HEP), conducted under the auspices of National Eldercare, and provides National eldercare the opportunity to see what is going on in the home and with the health of the older person. Interventions can be accommodated at this time to correct immediate health and safety problems that the PEP identified. Specifically, the HEP covers: (a) an assessment of the older person's health and physical ability; (b) a comprehensive drug review that examines the self-medication patterns, warns against potential drug interactions, and suggests improvements; (c) assessment of the older person's mental health and neighborhood ties; (d) notes on how to modify the residential structure and its amenities to make it more "elder-friendly"; and (e) notes on access to neighborhood facilities and the available transportation options.

Level 3 is a Review Panel and Preparation of the Eldercare Action Plan. The National Eldercare Review Panel is a group of 5 professionals who represent the five divisions of service delivery being organized in the company's preferred provider network. These five divisions are: (1) Health and Allied Services, including Wellness programs; (2) Home and Personal Services, including home safety, home modification, custodial care services, transportation, etc.; (3) Elderlaw, including estate planning; (4) Financial Planning and Asset Management; and (5) Case Management/Quality Assurance and Utilization Review. An action plan is developed that prioritizes the steps that need to be taken to help keep the older person living safely in his or her own home; recommends providers within the closed-panel network of eldercare specialists, including estimated costs and fees; evaluates insurances and entitlements; and attempts to maximize third-party reimbursement.

The fourth level is Resource Management and Core Management Services. A Resource Manager, supported by the National Eldercare's database operations, is called upon to be an advocate for the family and the well-being of the older person in his or her own community and home setting. The Resource Manager recommends core management services (typically elective and paid for on a fee-for services-basis) may include drug utilization review; personal emergency response system; wellness regimen/preventative care and participation in outside activities by the older person; home maintenance; etc. In a basic core management services contract between National eldercare and the family, a fixed monthly amount is determined and billed on a monthly cycle. Other episodic or one-time charges are incurred as needed and as agreed to by the family.

Notwithstanding the usefulness of programs such as Genesis ElderCare and National Eldercare, similar networks of professionals already exist at the State-level, provided through the Older Americans Act. The Older Americans Act of 1965 is the major categorical grants program provided in federal law to advance the interests and needs of older persons relative to the provision of social and health-related services. It provides a central focus for a broad range of constituent activity on the part of various public and private sector organizations, institutions, agencies, and individuals seeking to improve the aged's actual status in society. It provides an integral stimulus—through a partnership of federal government with state and local governments, the private sector, and older persons themselves—for promoting the allocation and/or redistribution of resources on behalf of the elderly beyond those granted by the federal government. The Older Americans Act has, for the past 30 years, played a crucial role in bringing national resources to bear in addressing older persons needs. The overall design of the Act is anchored on the premise that decentralization of authority and the use of local control over policy and program decisions are necessary ingredients for creating a more responsive supportive service system at the local level.

When first enacted in 1965, the Older Americans Act established a federal Administration on Aging responsible for overseeing the creation of a more responsive service system at the community level specifically designed to meet the social and human service needs of the elderly. Today, AoA is the principal agency in federal government responsible for building strong inter-governmental partnerships to address the concerns and problems of older Americans. AoA has defined its mission in terms of two major goals. These are: (1) To promote opportunities for older persons to secure and maintain independence and self-sufficiency; and (2) To ensure, to the extent possible, that services or other appropriate assistance are available to those older persons in the greatest social or economic need. In pursuit of these goals, AoA has sought to (1) serve as a federal focal point for addressing issues affecting older persons; and to (2) assist states and localities to promote the development of coordinated, community-based service systems for those older persons in need.

The State Office on Aging is the statewide leader in the planning, coordination and delivery of programs and services for older adults to promote their health and well-being. These services are provided at the local level, through **Area Agencies on Aging**. Title III is the principal service title under the Older Americans Act. It is predominantly through the programs and structures of Title III that the Older Americans Act touches older people. Title III is organized into several parts. The main parts that are currently funded include: general provisions (part A); supportive services and senior centers (part B); congregate nutrition service (part C-1); home-delivered nutrition service (part C-2); in-home services for frail older individuals (part D); and, disease prevention and health promotion services (part F).

Definitions used by the Older Americans Act to describe Title III-B services are provided below.

<u>Adult Day Care</u>: a program of therapeutic social and health activities and services provided to adults who have functional impairments, in a protective environment that provides as noninstitutional an environment as possible.

<u>Advocacy</u>: action taken on behalf of an older person to secure his/her rights or benefits. Includes receiving, investigating and working to resolve disputes or complaints informally. Does not include services provided by an attorney or person under the supervision of an attorney.

<u>Chore</u>: performance of house or yard tasks including such jobs as seasonal cleaning, essential errands, yard work lifting and moving, simple household repairs, pest control, and household maintenance for eligible persons who are unable to do these tasks for themselves because of frailty or other disabling conditions.

<u>Case Management</u>: begins with initial client intake and continues through the application process, assessment of need, service planning for a client, provision or arranging for provision of services, review and reassessment of client need, and revision of service plans as appropriate.

<u>Counseling</u>: the exploration of a client's interests and skills, problem solving, emotional support and guidance and encouragement for adopting new behaviors, and setting of realistic goals. It also may

include diagnosis and structured treatment of psychological and psychosocial problems. The counseling takes place on a one on one basis and may include family members.
Companionship: visiting a client who is socially and/or geographically isolated, for the purpose of relieving loneliness and providing continuing social contact with the community by casual conversation, providing assistance with reading, writing letters, or entertaining games.

Discount: a reduction made on goods or services from a regular or list price.

Education/Training: providing formal or informal opportunities for individuals to acquire knowledge, experience, or skills.

Emergency alert/response service: a community based electronic surveillance service which monitors the frail homebound elderly by means of an electronic communication link with a response center.

Employment: assisting an individual to secure appropriate paid employment. This may include part time, full time, or temporary employment.

Escort: personal accompaniment of individuals to or from service providers. Escorts may also provide language interpretation to people who have hearing/speech impairments or speak a foreign language.

Home Health Aide: the provision of medically oriented personal health care services by a trained home health aide employed by a licensed home health agency to an individual in the home under the supervision of a health professional.

Homemaker Service: the accomplishment of specific home management duties including housekeeping, meal planning and preparation, shopping assistance, and routine household activities by a trained homemaker.

Housing Improvement: providing home repairs or alterations for an eligible person or assistance in obtaining needed repairs or alterations for the client's home; arranging for home improvement grants or loans; providing assistance to obtain adequate housing; securing fuel and utilities, and provision of pest exterminating services. Housing Improvement is distinguished from Chore in that Housing Improvement and Emergency Home Repair may encompass repairs requiring a permit for accomplishment while Chore may not.

Health Support: activities to assist persons to secure and utilize necessary medical treatment as well as preventive, emergency and health maintenance services. Examples of Health Support services include obtaining appointments for treatment; locating health and medical facilities; obtaining therapy; and obtaining clinic cards for clients.

Information: responding to an inquiry from a person, or on behalf of a person, regarding resources and available services.

Interpreting/Translating: explaining the meaning of oral and/or written communication to non-English speaking and/or handicapped persons unable to perform the functions.

Legal Assistance: broadly defined in the Older Americans Act as meaning "legal advise and representation by an attorney (including, to the extent feasible, counseling or other appropriate assistance by a paralegal or law student under the supervision of an attorney), and includes counseling or representation by a non-lawyer when permitted by law, to older individuals with economic or social need." Legal Assistance for program delivery purposes is defined as services to assist clients to become aware of and protect their civil/legal rights through activities or direct intervention by attorneys or legal paraprofessionals.

Letter Writing/Reading: reading and/or writing business or personal correspondence.

Material Aid: aid in the form of goods or food such as the direct distribution of commodities, surplus food, the distribution of clothing, smoke detectors, eyeglasses, security devices, etc.

Medical Therapeutic Services: corrective or rehabilitative services which are prescribed by a physician or other appropriate health care professional. Such therapies may include occupational therapy, physical therapy, respiratory therapy, and services for individuals with speech, hearing and language disorders.

Outreach: making active efforts to reach target group individuals, either in a community setting or in a neighborhood with large numbers of low income minority elderly, making one-to-one contact, identifying their service need, and encouraging their use of available resources.

Personal Care: services to assist the functionally impaired elderly with bathing, dressing, ambulation, housekeeping, supervision, emotional security, eating and assistance with securing health care from appropriate sources.

Placement: assisting a person in obtaining a suitable place or situation such as housing or an institution such as a nursing home.

Recreation: participation in or attendance at planned leisure events such as, games, sports, arts and crafts, theater, trips and other relaxing social activities.

Referral: an activity wherein information is obtained on a person's needs and the person is directed to a particular resource; contact with the resource is made for the person as needed; follow-up is conducted with the referred person and/or resource to determine the outcome of the referral. Agencies making referrals will usually obtain intake information from the client to be used as part of the referral process.

Respite Care: relief or rest from the constant/continued supervision, companionship, therapeutic and/or personal care, of a functionally impaired older person for a specified period of time.

Shopping Assistance: assisting a client in getting to and from stores and in the proper selection of items. An individual Shopping Aide may assist more than one client during a shopping trip.

Screening and Assessment: is defined as administering an assessment test or other eligibility instrument to determine new applicant's eligibility for services or ongoing eligibility for services for current clients.

Supervision: overseeing actions and/or behavior of a client to safeguard his rights and interest for the purpose of protection against harm to self or others.

Telephone Reassurance: communicating with designated clients by telephone on a mutually agreed schedule to determine their safety and to provide psychological reassurance, or to implement special or emergency assistance.

Transportation: travel to or from service providers or community resources.

One Area Agency on Aging that has a very active senior transportation component is the Central Plains Area Agency on Aging (CPAAA) in Kansas. The CPAAA in Wichita, KS developed a model to improve senior transportation services in a tri-county area (Sedgwick, Butler, and Harvey Counties) populated by 80,000 seniors (one-third of whom are age 75+). A two-year demonstration grant was awarded to the CPAAA by the Administration on Aging (9/93 to 9/95). One objective of this project was to "establish linkages between the Area Agency on Aging, local law enforcement, and driver's license offices to connect the elderly who may be at-risk of losing accessibility through their automobile with information on alternative transportation resources" (Central Plains Area Agency on Aging, 1996). This model has three main components: (1) planning for retirement from driving; (2) learning how to drive safely longer; and (3) peer counseling to help ease the transition. Planning allows time to obtain knowledge about alternative transportation resources. Learning how to drive safely longer allows a driver to take action such as self assessment, exercise or physical therapy, and refresher courses such as 55 Alive. Peer counseling addresses a need for counseling to seniors experiencing problems dealing with the transition from driver to retired driver. This proactive approach was hypothesized to lead to voluntary retirement from driving, as opposed to involuntary retirement/loss of license due to DMV action or traffic violations/crashes.

The CPAAA developed a partnership with the Helping Our Own People (HOOP) program, which is a volunteer peer counseling program. CPAAA also developed *Older Drivers in Crisis: A Handbook for Peer Counselors*, as a supplement to training required of counselors participating in the local HOOP volunteer peer counseling program. The five goals of peer counseling for older drivers are: (1) to show empathy, respect, and genuine caring to help an older driver in crisis; (2) to help the older driver by listening to his or her individual situation and then help solve the problem; (3) to use the counselor's awareness of issues involved in retiring from driving and communicate those to the older driver in crisis; (4) to use the counselor's knowledge of the aging process to counsel older adults; and (5) to familiarize the counselor with local transportation resources and increase access to those resources for older adults.

CPAAA created a brochure entitled, "Planning for the Day You Retire From Driving." The brochure targets seniors who are still driving, but advocates planning ahead for the day they retire from driving since that day could come unexpectedly, as a result of a crash or sudden illness. It contains several yes/no questions to get drivers thinking about their health, driving habits, and trip planning, and provides simple tips in these areas to help drivers drive safely longer (e.g., annual vision checks, exercise programs, schedule trips during non-rush periods). Because one of the objectives of the CPAAA's Senior Transportation Project was to link seniors who lose their drivers licenses to information on transportation alternatives, seniors are also encouraged to use the Wichita Metropolitan Transit Authority's "Senior Transportation Hotline" for specific information about transit resources in their area. The brochure encourages seniors to contact the CPAAA for peer counseling to help those already in transition from driving. The brochure is distributed to local senior centers, social service agencies, driver's license offices, rural law enforcement offices, AARP's "55 Alive" program administrators, health care providers, and other agencies.

Another brochure was developed in conjunction with the CPAAA and Rehability (a national rehabilitation corporation specializing in physical therapy) called "Helping You Drive Safely Longer." It contains a (self) driving assessment (17 yes/no questions) of hearing, vision, head/neck flexibility, and problems with arms and hands, and legs and feet. It also provides tips related to these areas, as well as simple exercises for helping seniors drive safely longer. A 20-minute video was also produced with this title. It contains testimonials of two seniors who took the driving assessment and underwent approximately six weeks of exercise recommended by rehability. Simple exercises are demonstrated that seniors can do at home to improve problem areas or weaknesses which affect their driving ability. Driving assessment clinics and exercise demonstrations were a part of this program so that groups of seniors at senior centers and nutrition sites could view the video, assess their driving ability using the tool in the accompanying brochure, and be shown personalized exercise routines by a physical therapist facilitating the clinic.

An evaluation of the brochures and clinic was conducted and is described in the CPAAA Final Report (CPAAA, 1996); the lessons learned are summarized next.

The "Planning for the Day You Retire from Driving" brochure was completed long before the "Helping You Drive Safely Longer" package was produced. The "Planning" brochures were distributed to 67 agencies in the tri-county area to test reactions and experiment with distribution methods. One-thousand brochures were sent to: 3 driver's license examining stations; 3 city police departments in small towns; the Kansas Highway Patrol; Kansas Safety Belt Education Office; the Kansas Traffic Safety for Older Adults Private and Public Agency Working Group; 41 senior centers; 4 social service agencies; 13 health care providers; Wichita Metropolitan Transit Authority; a Life Enrichment Program at a community college; and 1 church. A short survey was conducted to determine seniors' reactions to the brochures; 39 agencies responded to the survey. Some agencies displayed the brochures, but most chose to either personally hand them out or to combine a display with a hand-out. Of the agencies who discussed the brochure with seniors, most said the topic received a negative reaction. Only 12 percent of the 39 agencies stated that the information was well received. The distributing agencies were in agreement that the brochure was a good idea, however, since this is a sensitive subject, they indicated that a different distribution method should be evaluated that would be less offensive to seniors. A second distribution method involved a well-known and respected Community Liaison law enforcement officer who spoke at a Senior Center about issues surrounding retiring from driving to a group of 25 seniors. He spoke about the effects of aging and driving, and alternative transportation options. Brochures were handed out to the participants. Seniors were receptive to the topic and accepted this type of information dissemination.

Next, the "driving safely longer" package (brochure and video) was provided to 41 senior centers in the tri-county area, selected health care providers (hospitals, home health agencies, and private physicians), public libraries, and three grocery stores that have video departments. The materials were also incorporated into the AARP 55-Alive defensive driving courses delivered throughout Kansas, the Kansas Department on Aging, and the University of Kansas Transportation Center Lending Library. Rehability conducted six driver screening clinics in the Spring of 1996, that were attended by a total of 140 seniors. The attending physical therapist from Rehability conducted a short presentation. Then the majority of the participants were assessed by the therapist, and were provided with written examples and demonstrations of simple exercises, tailored to their particular needs.

In addressing the problem of seniors who are unsafe behind the wheel, but continue to drive, CPAAA found that seniors reacted most positively to presentations that included a showing of the "Helping You Drive Safely Longer" video and distribution of the accompanying brochure and the "Planning For The Day You Retire From Driving" brochure, or driving assessment clinics in which the video is shown, brochures are distributed, and exercises are demonstrated. CPAAA states that because the seniors responded positively to these methods, they will be more likely to give up driving when they can no longer drive safely. The "Planning For the Day" brochure distributed alone, on the other hand, even though written with a positive tone was threatening.

One point of interest, is that the clinics ceased to be administered when the funding for the pilot study was no longer available (at the end of the project). A contract had been drawn with a regional medical center rehabilitation department to have a physical therapist perform the assessments, at no cost to the consumers. When the pilot study ended, the Area Agency on Aging did not renew the contract with

Rehability. This points to the need to develop alternative funding sources for assessments and training that can be performed through Area Agencies on Aging, such as corporate sponsors or insurance companies.

Conclusions/Preliminary Recommendations:

Area Agencies on Aging are well-positioned to provide education, training, assessment, counseling, and referral services to older drivers. These social service providers (and potentially, volunteers they would need to recruit) could be a significant source of information for and about impaired older drivers, however, few of these agencies presently advertise services specifically related to safe driving, or appear to even communicate with DMVs. What the commercial and Government services have in common are services to assess needs for remaining independent, links to resources to help maintain independence, and support when independent living is not safe. They (including Genesis and National Eldercare) all have the potential to be incorporated into a Model Driver Screening and Evaluation Program, as they include assessment of functional capability. What is not known is what kinds of confidentiality issues there are to overcome, and what the impact of reporting to a DMV would be for individuals requesting assistance. Since GES is part of the State Health Department, the confidentiality issue may be able to be resolved, and possible negative impact on requests for assistance may be reduced. The benefits of providing drivers with information about self-assessment, alternative transportation, and peer counseling by AAA volunteers may be enough to enable drivers to make responsible driving decisions; referral to the DMV may only be necessary when drivers refuse to drive responsibly and need the hand of authority and license revocation before admitting that they are no longer safe to drive. For those drivers where this is the case, peer counseling may become an appreciated component. It is recommended that a position (or two) be funded at each local area Agency on Aging to develop and coordinate a program geared to assisting older drivers in assessing their ability to drive safely, counseling older drivers about how to remain safely mobile longer, and about how to use alternative transportation when needed.

References:

- Central Plains, KS: Area Agency on Aging (1996)
- Genesis ElderCare Brochures; *pers. comm.*, Abby Weintraub, Full Life Counselor, Kennett Square, PA, 4/98
- Maryland Geriatric Evaluation Services (GES) Brochure; *pers. comm.*, L. Dersch, Harford County, MD, 1/98; *pers. comm.*, B. Fleming, Baltimore, MD, 1/98
- National Eldercare (President: Richard J. Lank), Box 12364, Silver Spring, MD 20908. Website: www.natleldr@bellatlantic.net
- Older Americans Act; Title III

IC1(b)vi. Hospital Plan of Discharge/Care Referral Plan

A description of geriatric discharge planning was obtained from the internet (Bayfront's Health Adventure), and is provided as follows. Seniors who are completing a stay in a hospital or nursing home typically receive help in preparing for the move home. This discharge plan helps prevent a condition from worsening, which often leads to readmission to the hospital or nursing home. It also lessens the need for visits to the emergency room and speeds recovery. Like geriatric care assessments, discharge planning involves a nursing and social work assessment to find support available in the home, community, and family. The discharge plan might cover steps the senior must take to pay the rent and other bills and the availability of insurance and income to cover healthcare. Or, the assessment might also identify what follow-up examinations the senior will need to check on the response to therapy. A physical therapy evaluation is also part of discharge planning. The physical therapist identifies physical problems that might make living at home difficult. Exercises such as walking, climbing and rising from a chair or bed might be prescribed to regain strength, flexibility and sensation for movement. The physical therapy that begins in a hospital or nursing home might continue at home. A nutrition evaluation might look at factors that would interfere with eating, chewing and swallowing. One result might be a referral to a dentist for a denture fit. A good discharge plan will integrate long-term care and acute care; cover mental health, rehabilitation and prevention; integrate medical care with other services such as assisted housing and adult day care;
coordinate paid and unpaid and formal and informal care givers; and provide for monitoring on the kind of care being delivered.

No specific mention was made of assessing transportation needs or driving fitness or referral of patients to the DMV; however, Sonia Coleman, formerly an OT at National Rehab Hospital wrote that elderly drivers learn about driver rehab services provided by OTs and PTs when they are hospitalized for a condition that results in impaired driving ability (Coleman, 1994). According to Coleman, driver rehabilitation is available from occupational therapists (OTs), physical therapists, vocational counselors, speech therapists, optometrists, and psychologists. It is the OT's role to help a person be as independent as possible. OTs teach older drivers compensatory strategies for slowed reaction times. OTs and physical therapists help older drivers improve arm and leg strength so they can safely drive a car; they also train drivers to use adaptive equipment to continue driving with a physical disability. In addition, they guide elderly drivers to choose the best time of day to drive safely and to use public transportation. Vocational counselors help older drivers who work or are involved in volunteer activities to find positions that are close to home and do not require night driving. Other health professionals train elderly drivers to improve decision-making skills or offer vision training, eye exercises, and corrective lenses to improve eyesight.

Coleman goes on to say that unfortunately, healthy elderly drivers are seldom aware of these services, and evaluations to qualify drivers to receive services from medical professionals are expensive and not covered by medical insurance. When older drivers turn to less costly commercial driving schools, they often find they do not get the kind of help they need. Coleman suggested that meeting the rehabilitation needs of older drivers should begin with standardized driver education training for all health professionals. These trained health professionals would receive referrals from licensing agencies and evaluate each older driver's needs. Health professionals could recommend rehabilitation through specific health service providers, through an educational program like "55 Alive," or through a commercial driving school. Coleman believes that instructors at commercial schools should also be trained in the special needs of older drivers. Finally, Coleman called for insurance companies to cover the cost of driver rehabilitation programs. Coleman concluded that driver licensing agencies, health professionals, and commercial driving schools could work together to create an effective, affordable rehabilitation program for older drivers.

An example of how health professionals are participating in assessments of fitness to drive and referrals was provided by Debbie Perkins, a geriatric nurse practitioner at St. Mary's Hospital Senior Center in Richmond, VA. A detailed description of the activities conducted at this clinic was presented in Section IB2 of this *Notebook*. At this Center, a community-based team of professionals performs detailed comprehensive senior health assessments that focus on age-related factors that influence an older person's health and well being. The team includes a physician, nurse practitioner, pharmacist, and social worker; all have expertise in caring for older persons. Other professionals (e.g., occupational therapists, physical therapists, dieticians, audiologists, and other physician subspecialists) are consulted as necessary. The team's findings are used to develop recommendations and a care plan for patients, their families, and physicians. The goal of the center is to provide detailed information that is incorporated into regular primary medical care. Functional tests include a review of activities of daily living, and tests of mobility, gait and coordination. Clients may be referred to a neuropsychologist for more in-depth testing, including reaction time.

Driving history and fitness to drive are assessed as part of the health assessment at St. Mary's Hospital Senior Center. The client's previous driving record is reviewed, the family is asked if they have observed unsafe driving behavior, and questions are asked of the client and family about whether the patient gets lost while driving. The assessment outcomes are categorized as follows: (1) clearly safe to drive; (2) clearly unsafe to drive; and (3) possibly safe with intervention/needs more testing. For those who are deemed clearly safe to drive, a recommendation is made to the client's family to ride with the driver frequently to keep track of the client's performance, and to notice cognitive changes over time. For those who are deemed clearly unfit to drive, a "no driving prescription" is written and the client is reported to the DMV; the DMV will revoke a license. For those who need intervention, a referral is made to additional disciplines (e.g., ophthalmologists, physical therapists). There are two private pay driver evaluation programs in Richmond, VA that provide additional testing and restorative therapy. For drivers who need more testing, referrals also are made to the DMV for knowledge testing, on-road testing, or both (at no charge to the client). The Health Center does not perform driving evaluations. The Center is reimbursed by Medicare, and if a client has supplementary insurance (Blue Cross/Shield) the entire cost is usually reimbursed.

Conclusions/Preliminary Recommendations:

It is currently unknown what percentage of hospitals address fitness to drive when preparing a discharge plan of care; it may be that only hospitals with a driving rehab facility consider the issue of driving. It is also unknown to what extent hospitals provide information to the DMV/Medical Advisory Board. There may be patient information confidentially issues that need to be resolved before hospitals could make reports to a DMV. However, besides referring patients for remediation of driving skills or advising against driving, hospitals discharge planners could be a source of referrals to the DMV. The information could become part of the driver licensing file, to assist in future decisions regarding license renewal testing, renewal periods, restrictions, etc.

References:

- Coleman (1994)
- Internet search of geriatric discharge planning
- *pers. comm.*, Debbie Perkins, Geriatric Nurse Practitioner, St. Mary's Hospital Senior Health Center, Richmond, VA, 4/98

Senior health fairs may provide a venue for self-assessment procedures to be demonstrated and for the distribution of information (brochures) regarding fitness to drive. A wellness fair organized specifically for older drivers, or where there is a section for fitness-to-drive assessments could also provide information about OT programs for remediation/retraining and alternative transportation options for counties surrounding the fair location.

Recently, the Philadelphia Corporation for Aging sponsored an "Age Expo" at the Philadelphia Convention Center. This event was for "fun and information" for people age 50 and older, and included over 300 exhibits, plus health screenings. The Expo offered 20 different health screenings on site, that were free with admission. Information about fitness and nutrition were also presented as separate events.

Fitness Stage Schedule

WEDNESDAY, OCT. 21*

10 a.m. .... **"The Truth About Soy"**
Jefferson Health System's Outpatient Nutrition Services
Learn more about homeopathic nutrition and win great prizes!

11 a.m. .... **Acupuncture Demonstration**
Jefferson Health System's Center for Integrative Medicine
Learn more about the art and science of acupuncture

1 p.m. .... **"Stress Management: It IS a Laughing Matter"**
Betty Coletta, R.N., Main Line Health
Learn how to laugh your stress away!

2 p.m. .... **Muscle Balance Demonstration**
Main Line Health Alternative Medicine
Use this therapy to balance the musculoskeletal system

*Wednesday's Fitness Stage events presented by Jefferson Health System

THURSDAY, OCT. 22

10:30 a.m. .... **Theraband Exercises**
Ralston Wellness Center/University of Pennsylvania Institute on Aging

11 a.m. .... **"Tai Chi and Chinese Sword Dance"**
Chi Lok House of Phila.

11:30 a.m. .... **"Get Fit with Exercise"**
Sunshine Center

12 p.m. .... **"Chi-Kung and Modern Wushu Forms"**
Lilly L. Zhang, master instructor of Chinese martial arts

12:30 p.m. .... **"Yoga & Belly Dancing"**
Valerie from Yoga to Belly Dance

1 p.m. .... **"Get Fit While You Sit"**
Joyce Zeitz from Philly Health & Fitness

1:30 p.m. .... **"Low Impact & Chair Exercises"**
North City Congress

Practice Preventive Health Care at the PCA Age Expo

Blood pressure screenings are available free at the Expo, along with many other types of health screenings.

Take advantage of the following health screenings offered free with admission throughout Expo hours, unless otherwise noted:

- A Hearing Healthcare Center, Hearing Screenings – Booth #611
- Albert Einstein Healthcare Network, Diabetes Testing – Booth # 371 - 541
- Albert Einstein Healthcare Network, Glaucoma, Vision & Vision Field – Booth # 516
  (Visual Field screening only after 1 p.m.)
- Independence Blue Cross, Derma Scan – Booth #300 & 318
- HearX, Video Otoscope – Booth # 412
- Hearing Now Hearing Aid Center, Hearing Screenings – Booth # 372
- Pfizer, Blood Pressure – Booth # 393
- Pennsylvania College of Optometry, Visual Screening – Booth # 338 (Wednesday, 1 p.m. – 5 p.m. and Thursday, 9:30 a.m. – 3:30 p.m.)
- MercyCare Mobile Health, Flu Shots – Booth # 355
- Moore Eye Institute, Glaucoma – Booth # 501
- Moss Rehabilitation Hospital Bone Density, Assessment for Falls & Strokes – Booth # 421
- Temple Dental School, Dental Screenings – Booth # 349
- Temple Podiatry School, Foot Screenings – Booth # 348
- Partners in Healthy Living/University of Pennsylvania Health System: Sahara Clinical Bone Scanning, Blood Pressure, Flu Vaccine, Hand Grip – Booth # 366
- WYBE Public Television, Weigh-In – Booth # 602

Summary:

In New Brunswick, a program is currently in place for mandatory reporting by optometrists (Staplin and Lococo ,1998). According to the Ontario Highway Traffic Act, all physicians and optometrists are required to report to the Registrar of Motor Vehicles, any person over age 16 who has a condition that could impair the safe operation of a motor vehicle. The physician's report is confidential and the physician is immune from legal action. Also, Yukon Territory requires physicians and optometrists to report conditions to the Department (Petrucelli and Malinowski, 1992).

Conclusions/Preliminary Recommendations

Vision specialists should counsel their patients regarding the effects of eye disease and reduced visual function on the driving task. Indeed, older adults participating in a focus group study pointed to ophthalmologists as the group of physicians most likely to discuss driving with them.(Persson, 1993). States that do not require a vision test for license renewal would benefit from information that eye care specialists could provide, if reporting were mandated. Many visual impairments are remediable, so any license actions (restrictions) would need to be reviewed following visual correction or remediation.

References:

- Petrucelli and Malinowski (1992)
- Persson (1993)
- Staplin and Lococo (1998)

Summary:

Fourteen States/Provinces [California, Delaware (epilepsy), Georgia, Nevada (epilepsy), New Jersey, Oregon, Pennsylvania, Manitoba, New Brunswick, Northwest Territories, Ontario, Prince Edward Island, Saskatchewan, and Yukon Territory] currently require physicians to report medical conditions hazardous to driving to licencing agencies. All of these grant the physician immunity from legal action by the driver (Petrucelli and Malinowski, 1992).

The Pennsylvania Vehicle Code (Section 1518), mandates physician reporting; this has been in effect since the 1960's. Reporting is done on the basis of any condition that may impair the ability to drive safely for anyone over the age of 15. The medical conditions are formulated by the Medical Advisory Board. Physicians have immunity from civil and criminal liability, since reporting is mandatory. Failure to report can result in a physician's being held responsible as a proximate cause of a crash resulting in death, injury, or property loss caused by his or her patient. Also, physicians who do not comply with their legal requirements to report may be convicted of a summary criminal offense. Physician reports are held confidential, and may be used only for licensing decisions. Reporting has increased steadily (approximately 500+ percent), until 1990, when there were 10,000 referrals. In 1992, PennDOT conducted an information campaign to 46,000 physicians; this resulted in 40,000 reports in 1994. This number of referrals is by far the largest of any State, and increases by approximately 2,000 each year. When a report is made, restrictions to the person's driving privilege may be added or deleted, the person's license may be recalled or restored, the person may be required to provide more specific medical information or to complete a driver's examination, or no action may be taken. The PennDOT Physician Reporting Fact sheet states that approximately 72 percent of individuals who are referred have medical impairments significant enough to merit temporary or permanent recall of their driving privilege. Fifty-one percent of the recalls are due to seizure disorders, and 16 percent to other neurological disorders. An additional 9 percent of physician reports result in restrictions placed on the individual's driving privilege; 60 percent of these restrictions involve special equipment needs. This sheet also states that these reports cross the age spectrum, with 51 percent involving drivers under 45 years of age.

Aizenberg and Anapolle (1996) reported that in Oregon, 31 percent of reports to the DMV on older drivers come from health providers. This is greater than the percentage of reports from self-referral (29%), law enforcement (24%), family and friends (10%), and DMV personnel (4%).

According to Janke and Hersch (1997), at the time of their report, California was the only State that mandated reporting of dementia to the licencing agency.

In Saskatchewan, crash data were examined for 226,864 drivers for the period between 1980 and 1989 (Medgyesi and Koch, 1994). Of these, 2,448 were participants in the Province's Medical Review Program. Another 63,398 were identified who had not been reported to the Province, but were diagnosed with a medical condition. Drivers with a diagnosis of alcohol/drug dependence, cardiovascular disease, stroke, coordination/muscular control diseases, diabetes, seizure disorders or visual disorders showed consistently higher rates of at-fault involvement compared to controls matched on age, gender, place of residence, license class, and period of driving. Diagnosed drivers in the Medical Review Program (those drivers with alcohol/drug dependence; cardiovascular disease; cerebrovascular disease; diabetes; visual disorders; essential hypertension; and commercial class drivers with seizure disorders) demonstrated a lower incidence of at-fault crashes than those diagnosed drivers not in the program, suggesting that the program is effective in reducing driving risk. Program effects were not observed for coordination and muscular control disorders, which the authors state may reflect the ineffectiveness of the medical review program to improve the performance of drivers which are less impacted by better self management.

NHTSA (1992) guidelines state that physicians must be granted immunity from legal action arising out of reporting, whether reporting is compulsory or on a voluntary basis.

Conclusions/Preliminary Recommendations:

Mandatory physician reporting is an effective means of identifying potentially at-risk drivers. The data collected in Saskatchewan suggests that under-reporting of potentially dangerous (diagnosed) conditions continues to be a problem. This study also demonstrates how effective a medical review program can be at reducing the risk of crashes for drivers with medical problems.

References:

- Aizenberg and Anapolle (1996)
- Janke and Hersch (1997)
- Medgyesi and Koch (1994)
- NHTSA (1992)
- Petrucelli and Malinowski (1992)
- Staplin and Lococo (1998)

IC1(b)x. Physician Referral/Voluntary

Summary:

As of 1992, ten States and three Canadian Provinces (Connecticut, Florida, Illinois, Maryland, Minnesota, North Dakota, Ohio, Oklahoma, Rhode Island, Utah, Alberta, British Columbia, and Nova Scotia) permitted physicians to report potentially impaired drivers to the licencing agency. Of these, only North Dakota, Ohio, and Alberta do not grant immunity from litigation to physicians making these reports. Other jurisdictions allow the physician to report hazardous conditions to the licencing agencies, but only after the patient refuses to report himself or herself (Petrucelli and Malinowski, 1992; McEwan, 1997).

In Wisconsin, approximately 22 percent of the drivers referred to the DMV were referred by physicians, despite the fact that the State does not mandate such reports (Sterns, Sterns, Aizenberg, and Anapolle, 1997).

Conclusions/Preliminary Recommendations:

Reports from physicians, either on a mandatory or a voluntary basis, are an important source for identifying impaired drivers. Information must be provided to physicians about specific signs and symptoms. Furthermore, immunity from prosecution must be provided to physicians to encourage referrals of drivers whose impairments could compromise safe driving performance.

References:

- McEwan (1997)
- Petrucelli and Malinowski (1992)
- Sterns, Sterns, Aizenberg, and Anapolle (1997)

IC1(c)i. Distribution of Self-Evaluation Materials

Summary:

Dobbs (*in press*) provides a review of the literature highlighting the fact that many older drivers compensate for age-related declines in capabilities by reducing their annual mileage, as well as regulating when and where they drive. Drivers who correctly perceive that there is a change in competence can appropriately modify their driving behavior, by restricting or ceasing driving (depending on the level of decline), and seek remediation for abilities that can be retrained or compensated for by adaptive equipment.

The purpose of a *Self Evaluation Guide* under development for PennDOT (Decina et al., *in press*) is to raise older drivers' self-awareness about their driving habits, their physical and mental well-being, and to address concerns about specific driving difficulties that they may have. The *Guide* also provides ways for older drivers to test their abilities to make sure they are "up to par" in aspects of vision, attention, and motor coordination related to safe driving. Several of the GRoss IMPairments Screening (GRIMPS) tests [see *Notebook* section IC2a(i)] are included (arm reach, rapid-pace walk, foot tap test, head/neck flexibility), in addition to a contrast sensitivity test. The *Guide* offers strategies that may help older drivers compensate for the problems they experience as they age.

Janke (1994) reported that California plans to develop an older driver self-assessment kit as a means of making drivers more aware of the need to compensate/self restrict. The kits would include a questionnaire and a scoring key that would indicate to drivers what self restrictions might benefit them. She proposes that kits be sent to some subjects randomly selected from a sample of elderly drivers, whose subsequent driving records would be compared in a prospective study with those of subjects not receiving kits. Surveys could be made before and after mailing the kits to determine driving habits and practices, mileage, and (for the treatment group) the reported influence the kits had on their driving behavior. The proposed activity has not been implemented. California is, however, trying to implement an age-mediated point system in which drivers age 70+ who have 2 or more crash or violation points in a year would be sent the *AARP Skill and Assessment Guide* and would be asked to take the self tests included therein. No evaluation of the effect is planned (*pers. comm.*, M. Janke, 7/98).

Conclusions/Preliminary Recommendations:

Older drivers who do not suffer from cognitive impairment have the ability to assess their own capabilities, and choose strategies to remain safe on the road, or to know when to stop driving. A resource that provides advice about which capabilities are important to driving safely, how to test these abilities, what the score means, and where they can go and what they can do if they don't perform well (e.g., get pedal extenders or other adapted driving equipment from an occupational therapist; go to a physician or geriatric nurse practitioner to check number/interaction of medications; increase flexibility/endurance through exercise; contact local Area Agency on Aging for alternative transportation, wellness programs, educational programs, etc), is an important resource that serves the same function as a first-tier screen (i.e., GRIMPS) in a DMV or other institutional setting.

References:

- Decina, Staplin, Lococo, and Hughlett (*in press*)
- Dobbs (*in press*)
- Janke (1994)

IC1(c)ii. Automated Testing in Public Venues (e.g., Kiosks)

Summary:

Current innovative electronic technology provides feasible applications for providing information and education to the public (Decina, Staplin, Gish, and Kirchner, 1996). Recent innovative technology to communicate traffic safety issues to the public has been demonstrated by U.S. DOT agencies.

The National Highway Traffic Safety Administration (NHTSA) has determined that there is strong potential for using electronic media to facilitate learning of safe driving skills (Smith, 1994). NHTSA sponsored the development of an interactive traffic safety education program, "The Traffic Safety Box (TSB)," created for pre-drivers and drivers, which uses interactive technology and multimedia presentations. The program was originally developed for a kiosk, but then redirected to reach youth as a program accessible through CD-ROM technology. The TSB has an educational format with four learning modules: students take an informal pre-test, get repeated reinforcement of important messages, and take a post-test to measure what they learned in the exercise. The TSB can be incorporated into a week's lesson in driver education classes or used at a special events which focus on safety issues (NHTSA, 1998).

The Federal Highway Administration (FHWA) is using a computer-based, interactive touch screen kiosk which uses a full complement of multimedia to bring attention to the public traffic safety issues in a way that is more engaging than traditional publications or videotapes. The "Moving Safely Across America" kiosk provides users the ability to interact with and experience various aspects of highway safety, as well as test their understanding of these topics. The kiosk consists of three separate modules: Road Trip, which provides a virtual journey where users encounter four different situations where they must make decisions about highway safety; Road Challenge, which provides a fast-paced game where users must answer questions about highway safety in order to earn safety miles; and Safety Stops, which is a database of facts (FHWA, 1997).

Conclusions/Preliminary Recommendations:

Similar applications to help the older driver (e.g., self-assessment, safe driving tips, local mobility options) are quite feasible. Venues for kiosks can include malls and shopping centers, license renewal centers, and community centers. Venues for CD-ROM and other software applications can be accessible through PCs, as well as at libraries, academic institutions, and in the home.

References:

- Decina, Staplin, Gish, and Kirchner (1996)
- Federal Highway Administration (1997)
- National Highway Traffic Safety Administration (1998)
- Smith (1994)

IC1(c)iii. Outreach by Professional Associations (AAA, AARP, "Wellness Fair")

Summary:

Decina, Staplin, and Lococo (1997) identified several dozen safety publications, which are currently available to the public from state licensing agencies and other organizations (predominantly the American Association of Retired Persons (AARP), American Automobile Association (AAA), and AAA Foundation for Traffic Safety to help older drivers and their concerned family and friends. The material collected ranged from booklets and pamphlets, to less common items such as flyers, reference cards, newsletters, and even some videos. Most of the publications targeted older drivers themselves, and covered a wide range of topics, including: older driver safety; vehicle design and adaption measures; vehicle maintenance; environmental/road design and adaptions; driver improvement and rehabilitation; behavior change; occupant protection; aging and health; specific medical problems (i.e., vision, dementia); professional referral sources; licensing issues and procedures; transportation options; driving cessation; assessment tips; and counseling tips. Aging and health issues were common topics mentioned in the publications. These issues covered information on demographic trends, morbidity and health characteristics of the older population, and cognitive and physical changes that accompany the aging process. Other common topics were references to professional resources (i.e., physicians, optometrists); driver improvement and rehabilitation; and behavioral changes and safe driving practices to reduce collision risk.

Wellness fairs are a venue where people can learn safety techniques and practice skills. Organizations such as AARP and AAA could participate in wellness fairs, providing stations where older drivers could test their capabilities and obtain information about danger signs, safe mobility, and alternative transportation. Recently, the opportunity for older drivers to find out whether their driving "needed a tune up" was provided at the annual meeting of the American Occupational Therapy Association, in Baltimore, MD (4/98). The assessment was advertised in several local newspapers and was free to drivers. It was reported by Kim White of Sinai Rehab, that only 2 or 3 older drivers took advantage of this assessment opportunity. Driving is a touchy issue for many older persons, and they may not want to participate in an assessment for several reasons. They may not be ready to face the possibility that they are no longer safe; or they may not want anyone in the medical community to know their functional status for fear of referral to the DMV.

Doylestown Hospital (Doylestown, PA) mails a *Health and Wellness Directory* to area residents on a yearly basis that lists the Hospital's programs and community services. The information contained in the guide is compiled by the Community Relations Department at Doylestown Hospital, and includes services and programs for older adults, teens, health and fitness for maternity patients, support groups, etc. Senior programs include 55 Alive/Mature Driving classes, senior wellness/aerobics programs, adult day care, yoga, and foot care facts. A page from this Directory is presented at the end of this section. Another program, the AgeWell Center, is a joint program of Presbyterian Homes, Inc. and St. Luke's Hospital (also in Pennsylvania). A listing of special programs for older adults that were presented at an area mall is also provided. Many of the programs have special relevance to driving, but it is unknown whether the relationships between driving safety and health, exercise, medication use are highlighted for the participants, other than what would be presented in the 55- Alive Class. Health professionals need education about their specialties and driving risk, so that this information can be incorporated into their community program activities.

The Central Plains Area Agency on Aging in conjunction with Rehability (a national rehabilitation corporation specializing in physical therapy) developed a brochure called "Helping You Drive Safely Longer." A 20-minute video was also produced with this title [see *Notebook* section IC1(b)v]. Driving assessment clinics and exercise demonstrations were a part of this program so that groups of seniors at senior centers and nutrition sites could view the video, assess their driving ability using the tool in the accompanying brochure, and be shown personalized exercise routines by a physical therapist facilitating the clinic.

Conclusions/Preliminary Recommendations:

Older drivers must trust that their performance during professional-sponsored clinics and wellness fairs will be held confidential. Special care needs to be taken to determine where the clinic should be held for the best attendance and participation; and the approach should be seen as positive (e.g., aimed at helping seniors drive safely longer, as opposed to trying to determine who should not be driving). In addition, a successful outreach program and clinic must provide more than just tests to assess driving ability. The clinic should provide information about what to do when someone doesn't perform well, such as referral information for further testing/remediation of specific disabilities; how to compensate for diminished capability; exercises for improving performance; and information about local alternative transportation and peer support groups. Counseling is a necessary component to assessment activities performed in clinics and wellness fairs held in community settings.

References:

- Notebook section IB3
- Decina, Staplin, and Lococo (1997)
- *pers. comm.*, K. White, Sinai Hospital, Dept. of Rehab., Balto. MD, 4/20/98
- Central Plains Area Agency on Aging (1996)
- AgeWell Center; Bucks County Wellness Partnership (Doylestown, PA)
- AAMVA (1997) Communications Resource Guide

ESPECIALLY FOR SENIORS

Register for senior programs by calling 340-7777 unless another number is listed. Pine Run ElderReach is located at 875 N. Easton Rd. (at Saw Mill Road), Doylestown.

55 Alive/Mature Driving
Tuesday, March 17, and Thursday March 19
9:00 a.m.-1:00 p.m., Conference Room B
Wednesday, May 27 and Friday, May 29
9:00 a.m.-1:00 p.m., Conference Room C
Participants in this AARP program may be eligible for discounted car insurance. Preregistration required, space is very limited. Call 345-2121 to register. $8

Senior Wellness
Beginner classes:
Mondays & Wednesdays, 10:30-11:30 a.m.
Community Health Initiative, Plumsteadville
Intermediate Classes:
Mondays & Wednesdays, 11:00-noon
Pine Run ElderReach
Advanced classes:
Tuesdays & Fridays, 8:00-8:45 a.m.
Inpatient Physical Therapy Gym, West Wing, Doylestown Hospital
Pine Run ElderReach and Doylestown Hospital co-sponsor this specialized aerobic program for adults over 50. Physician permission required. Orientation and Assessment held 4 times/month. A $2/session donation is suggested.

Adult Day Care
Monday, March 16, 10:00 a.m.,
Wednesday, March 18, 7:00 p.m.
Pine Run ElderReach
What is adult day care? Why would you use it? Who can utilize this service? Our presenter will give a brief overview of the purpose of adult day care, describe a typical day, what kind of help is available and other services that may be available. FREE.

Yoga For Seniors
Tuesdays, April 7 through May 19
10:00-11:00 a.m., Pine Run ElderReach
Yoga promotes relaxation and stress reduction, while increasing flexibility and mobility. Not sure if you will like this form of exercise? Join us on Tuesday, March 31 at Pine Run ElderReach for a FREE demonstration and introduction to yoga. Registration deadline is March 26, classes begin April 7. A $3/ session donation is suggested.

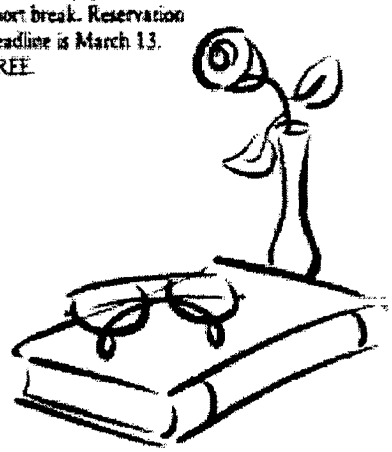
Long Term Care Insurance
Wednesday, April 22, 2:30-4:00 p.m.
7:00-8:30 p.m.
Thursday, April 23, 10:00-11:30 a.m.
Pine Run ElderReach
Learn about the IN's and OUT's of long term care insurance: what Medicare will not pick up; the difference between tax qualified and non-tax qualified plans; and much more. Participants will hear the latest information pertaining to this important topic and will have an opportunity to ask questions. FREE.

Adult Caregiver Training
Wednesdays, April 23 & 30
6:00-9:00 p.m., Pine Run ElderReach
This two part, six-hour program is designed to help you care for members of your family. The seminar will discuss common problems associated with caring for adults, and how to handle them. Participants can discuss individual problems with a health professional and practice "hands-on" skills needed to provide home care. Registration deadline is April 20.

Reverse Mortgages
Wednesday, May 6,
1:00-3:00 p.m., Pine Run ElderReach
Many older homeowners are turning to reserve mortgages to supplement their retirement income. This informative seminar will explain how the reverse mortgage works, who might benefit from it, and if it is right for your or your family. FREE.

Common Foot Problems of the Older Adult
Thursday, May 21
10:30-noon, Pine Run ElderReach
Learn foot care facts from a podiatrist who will discuss common problems, and the latest treatments including diabetic foot care
FREE

A taste of M& M's
Wednesday, March 17
1:00-3:30 p.m., Pine Run ElderReach
An information smorgasbord on Medicare, Medigap, Medicaid and managed care presented by Peggy O'Neill of the Aging Connection and Sally Cooper, Aging Information Specialist. Our presenters will speak from 1:00-2:15 p.m. followed by questions and answers after a short break. Reservation deadline is March 13.
FREE



The Bucks County Wellness Partnership

The Bucks County Wellness Partnership (BCWP) is a cooperative group representing the hospitals, agencies, schools, medical society and health department that serve our community. The partnership's goal is to provide quality lifetime learning opportunities and to encourage positive lifestyle changes through education, health promotion and disease prevention programs. Suggestions for future BCWP programs may be directed to **345-2267**.

Doylestown Hospital Speaker's Bureau

Need a guest speaker for your next meeting or seminar? Doylestown Hospital Speaker's Bureau can tailor a program that's right for your organization. Physicians, nurses, dietitians and other members of our healthcare team are available free of charge to discuss a wide range of topics. For more information, call **345-2267**.

Please visit us on the internet at http://www.dh.org

From: Doylestown Hospital's 1998 *Dialog: Health and Wellness Directory*- A Guide to Doylestown Hospital's Programs and Community Services.

AgeWell Center

A joint program of Presbyterian Homes, Inc. & St. Luke's Hospital

The following talks and programs will be offered at the AgeWell Center, Westgate Mall, Bethlehem. Call 954-3990 to register today! Reservations are required for most programs.

Special Programs For Older Adults

Diabetes Basics
Monday, April 13, 2 - 4 pm
Monday, May 11, 2 - 4 pm
Certified diabetes educators will discuss general diabetes care, medications and meal planning.

Managing Chaos & Stress
Wednesday, April 15, 10 - 11 am
Keith McClellan of Presbyterian Homes, Inc. will present suggestions on how to manage the stress of daily living and balance hectic schedules.

Self Medication Awareness Test
Friday, April 17, 10:30 - 11:30 am
Sharon Fehr, RPh, CVS, will describe the proper use of non-prescription medication.

Blood Pressure Screenings
Tuesday, April 21, 10 am - 12 noon
Wednesday, April 29, 6 - 8 pm
Wednesday, May 13, 10 - 12 noon
Tuesday, May 26, 10 am - 12 noon
An appointment is not necessary for these community blood pressure screenings.

Mobility Products
Tuesday, April 21, 1:30 - 2:30 pm
Bob Meyner of Hess Healthcare Services will describe various mobility products such as the stairwell elevator, seat-lift chairs and vertical platform lifts.

Congestive Heart Failure
Monday, April 27, 1:30 - 2:30 pm
Join Gyl Corcas, RN, as she describes the signs of congestive heart failure, the causes and how it is treated.

Discover Series

Did George Have Wooden Teeth?
Monday, April 6, 1:30 - 2:30 pm
Alvie Fennell will share a variety of fascinating and entertaining stories about famous historical figures and events.

The Lehigh Canal Today
Wednesday, April 22, 1:30 - 2:30 pm
Wouter de Nie of LCCC will describe the Lehigh Canal of today.

Senior Employment
Wednesday, April 29, 10:30 - 11:30 am
Walt Lukow from the Private Industry Council will describe subsidized jobs available to seniors.

Caregiver Programs

Passage Through Time: The Process of Aging
Wednesday, April 15, 7 - 8:30 pm
Join Ann Marie Szoke-Haial, CRNP, as she discusses normal age-related physical and mental changes. Tips will be given on how to help an elder adapt to these changes.

Caring for the Caregiver Support Group
Tuesday, April 21, 7 - 9 pm
Thursday, April 23, 10:30 am - 12 noon
Open to anyone caring for a parent, relative or friend. Group provides education, discusses support and coping mechanisms.

AgeWell Center
Promoting Healthy, Active Lifestyles
Westgate Mall
2341 W Schoenersville Road, Bethlehem
10 am – 8 pm Monday through Saturday
Noon – 5 pm Sunday
610-954-3990

Program Listing for AgeWell Center.

I.C. DEVELOP TOOLS NEEDED TO IMPLEMENT MODEL PROGRAMS

I.C.2. Test Procedures

(a) First-Tier Functional Screening

(b) Second-Tier Functional Screening

(c) Design and Methodology For On-Road Evaluations of Driving Competence

IC2(a)i. Gross Impairments Screening (GRIMPS) Battery of General Physical and Mental Abilities

Objective: To screen for gross impairments (GRIMPS) in physical and perceptual-cognitive functions important for safe driving, using a brief (~ 15 min) procedure that can be administered by DMV line personnel, or by other professionals or volunteers in diverse community settings, with limited training (less than 1 day), modest test materials costs, and without specialized test equipment. Outcomes of GRIMPS include self-awareness and awareness by friends and family of serious functional deficits that may, in turn, lead to diagnostic testing, remediation activities, mobility counseling, and/or limitations to driving. The rationale and justification for selection of tests presently included in GRIMPS is provided in section IA2 describing driving and functional assessment outcomes. Alternative procedures and/or upgraded protocols may be defined through pilot studies which evaluate current tests (Maryland Pilot Study).

Equipment and Materials: Furniture (desk or table, and two chairs, including at least one straight-backed chair); 10-ft long tape measure (for rapid-pace walk); colored duct tape (to mark 10-foot path if space is dedicated for GRIMPS); stop watch (for timed tests); cardboard clock face with high contrast between the numerals, the clock hands, and their background (to be used in head/neck flexibility test); lap seat belts (for use in head/neck flexibility test); laminated 55-inch by 8.5-inch chart to be hand-held or wall-mounted (for measuring abnormalities in visual scanning patterns); pencil; and data forms (for Trail-Making tests, Motor-Free Visual Perception test, and data recording forms). If GRIMPS is performed in a public space, including office environments, senior centers, etc., movable partitions should be used to provide a private testing area, approximately 11-ft long x 8-in wide. A "GRIMPS Kit" including all materials except furniture and partitions has been developed, and is available for distribution to test administrators. The "Kit" comes in a 3-ring binder; the binder itself serves as test equipment for the alternating foot-tap measure. The cost of all materials included in the "GRIMPS Kit" is $40.00.

Data Recording and Test Scoring: Driver's performance on GRIMPS is typically recorded on the prepared data form (1 page) at the time of testing, retained as a (single page) hard copy record, and transferred to an electronic file after the protocol is completed. An example data form is presented on the following page. Alternately, performance data can be entered on a PC at the time of testing. When GRIMPS is administered in an agency setting as *per* a given jurisdiction's policy, absolute and/or normalized measures of performance may be provided to drivers with an explanation of resulting licensing or referral action (if any). Similarly, performance norms with (preliminary) cutoff scores will support recommendations for follow up actions (e.g., referral) by GRIMPS administrators in an Area Agency on Aging, health care facility, social service facility, or other private or community setting. Norms developed through field tests will be provided to States/Provinces and other interested parties, and will be updated on a regular basis as more data become available.

Test Procedures: A private testing environment must be established, by using a separate office or partitioning a suitable space in a larger room. An enclosed area approximately 11' long by 8' wide is recommended. An opening should be provided at one end of the testing area (door optional) and a table and two chairs should be situated near the opposite end of the testing area. (Note: It is anticipated that space requirements for GRIMPS tests can be met in a driver's own home).

The test protocol begins when the examiner greets the driver and positions him/her just outside the opening to the testing area to deliver instructions.

Check one:
____ Volunteer
____ Renewal
____ MAB Referral

MARYLAND MVA GRIMPS DATA COLLECTION

NOTE: If examinee is in a wheelchair, or has lost a limb or body part check here ____.

License Number: ______________________________ **Test Date:** __________

 # 1. WALK: ____________ (sec) **(Check if used: ____ cane ____ walker)**

 # 2. FOOT TAP: __________ (sec)

 # 3. CUED RECALL: a. # correct: ______ b. times presented: ______

Check which set used: ____ bed, apple, shoe ____ desk, lemon, shirt ____ chair, banana, coat ____ table, peach, hat

 # 4. ARM REACH: a. Right: ______(pass/fail) b. Left: ______(pass/fail)

Pass = arm raised high enough, such that the elbow is above shoulder height Fail = elbow cannot be raised above shoulder height

 # 5. HEAD/NECK ROTATION: ______ (pass/fail)

Pass = the driver can turn far enough, in either direction, to read clock. Fail = the driver does not have enough flexibility to perform motion.

 # 6. MVPT: Example Answer is **A**

Circle the response given by the participant.

The letter in bold, capital, underlined font

is the correct answer. Count up all the wrong answers.

1. a **B** c d	5. a **B** c d	9. a b **C** d
2. **A** b c d	6. a b c **D**	10. a b c **D**
3. a **B** c d	7. **A** b c d	11. **A** b c d
4. a b c **D**	8. a b c **D**	

Total Wrong: ______

 # 7. DELAYED RECALL: # correct: ______ (Refer to word set checked in # 3.)

 # 8. SCAN TEST: Circle one: Correct/Normal Erratic Neglect

Correct/Normal = Definite pattern of response: clockwise, counter-clockwise, by rows, or by columns.
Erratic = All symbols identified, but in haphazard order.
Neglect = Two or more shapes not identified at all.

 # 9: Trails A Time: ______:______ (min) (sec)

 # 10: Trails B Time: ______:______ (min) (sec)

(OR write "NC" for time if not completed in 6 min)

Record ALL numbers on the Stopwatch
Put a period between the large numbers and the small numbers

Example: 3:5188 = 3 : 51.88 (min) (sec)

Trails B Intervals:
Note letter/number reached every 30 sec:

0:30 ____	2:30 ____	4:30 ____
1:00 ____	3:00 ____	5:00 ____
1:30 ____	3:30 ____	5:30 ____
2:00 ____	4:00 ____	6:00 ____

Rapid-Pace Walk

This is the first test, which is a measure of lower limb mobility. The measuring tape is laid on the floor, pulled out to its full 10-ft length, and locked open at this length. The subject walks next to the measuring tape, turns at the end, and walks back to the start position. The total walking distance is 20 ft. Alternatively, the adhesive tape can be pre-applied on the floor to mark the 10-foot path, in settings where dedicated space is allocated for conducting GRIMPS. The examiner will say, *"I want you to walk along side of this tape measure (tape line) to the end, turn around, and walk back here as quickly as you can."* (Demonstrate) *"If you use a cane or walker, you may use it if you feel more comfortable. I am going to time you. Go as fast as you feel safe and comfortable." "Ready, begin."*

Start timing when the subject picks up his or her first foot. Stop timing when the last foot crosses the finish line. Record the total time to traverse the 10-ft path up and back with the stop watch.

Norms: Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)

Statistic	Entire cohort of persons age 72+ living in the New Haven Community	Subset of active drivers
n	1007	348
mean (in seconds)	9.635	7.97
standard deviation	5.11	3.43

Guralnik, Simonick, Ferrucci, et al. (1994):
- mean for all subjects age 71+ (n=5097): 5.0 seconds
- mean for all men age 71+ (n=1785): 4.4 seconds
- mean for all women age 71+ (n=3312): 5.3 seconds

Subjects who took longer than 7 seconds to complete the rapid-pace walk were twice as likely to experience adverse traffic events (traffic crash, violation, stopped by police) in the year following testing as subjects who completed the walk in 7 seconds or less [relative risk, 2.0, CI 1.0-3.8]) (Marottoli et al., 1994). The Guralnik study found that those taking longer to complete a battery of three lower extremity tests (rapid-pace walk, chair stands, and standing balance) were 4.2 to 4.9 times as likely to have disability at four years than those with the best scores; tests were also predictive of nursing home admissions and mortality rates.

Cued Recall (Mini Mental Status Examination [MMSE] Test Item #3)

This is a test of immediate memory. Direct the driver to sit in the straight-backed chair at the table. When driver is seated, the examiner sits across the table and delivers the instruction, *"I'm going to say three, short words now as a memory test. Please repeat them back to me in the same order."* The examiner verbally announces three short, common but unrelated words, which serve as a memory set (BED, APPLE, SHOE), then again asks the driver to repeat them back.

The examiner records the number of memory set elements accurately repeated. If the driver cannot repeat all three elements in the set, the examiner should announce it again, up to a maximum of six times. The examiner also records the number of times the memory set was announced. After this is completed, The examiner delivers the instruction, *"I will ask you again later to remember these same three words and say them to me."*

Alternating Foot-Tap Test

This is an alternative measure of lower limb mobility, as required of a driver to move his or her right foot from the gas pedal to the brake pedal. The driver sits in a chair for this test. The test administrator opens the 3-ring binder and places it on the floor with the 3 rings oriented crosswise in front of the participant, and located at a distance of 16 to 24 inches from the front edge of the chair. This should provide a separation between foot tap locations of approximately 12 inches. Following instructions, the driver will touch his or her right foot to the floor 5 times alternately on each side of the opened binder, moving from one side to the other on every tap. The total number of taps will be 10. The driver must make sure to lift the foot sufficiently high to clear the rings of the binder.

Instruct the driver, *"Please place your right foot on the floor, next to the right side of this binder. Now move your left foot back out of the way, and move your right foot back and forth over the binder rings, alternately tapping each side of the floor next to the binder. Move your foot back and forth across the binder rings for a total of 10 taps, beginning when I tell you. I will time how quickly you can do this.* [Test administrator demonstrates foot tap motion]. *Ready? Go."*

The examiner records the time to complete the foot tapping task with a stop watch.

Norms (right foot-tap time): Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994):

Statistic	Entire Cohort Age 72+	Drivers Only Age 72+
	Right Foot Tap	Right Foot Tap
n	1055	352
mean	5.61 s	4.80 s
sd	2.48	1.56

Motor Free Visual Perception Test (MVPT) - Visual Closure Subtest

The MVPT is an individually administered, multiple-choice test of visual perception. The only response required from the subject is that he or she *point* to whichever one of four alternatives is correct. The subject is not allowed to trace any figures. The examiner should encourage the subject to look at all four alternatives before making a final decision. The MVPT is not a timed test, and the subject should be given a reasonable amount of time (15 seconds) to make a selection. The examiner scores the subject's response by marking the appropriate space on the accompanying scoring sheet. The visual closure subtest measures the ability to identify incomplete figures when only fragments are presented (see example on following page). This subtest should take no more than 3 minutes to administer.

Instructions for practice items for visual closure subtest: Point to the four alternative figures, saying, *"If we finished drawing these figures, which one would look just like this one?"* Now point to the stimulus figure. After the subject responds, point to the correct alternative saying, *"Yes (No), if we connected these lines, this one would look just like this."* Point to the stimulus figure.

Instructions for items 22-32: Point to the four alternative figures, saying, *"If we finished drawing these figures, which one would look just like this one?"* Now point to the stimulus figure. No confirmation or explanation is given.

For GRIMPS application, the examiner records number of incorrect responses. The cut-point for passing vs failing will be established after pilot study data (from the Maryland MVA) are analyzed.

Arm Reach

This is a test of upper limb mobility. The driver does this test while sitting in the chair.

Examiner asks the driver, *"Please raise your right arm as high as you can over your head. You may put your arm down... Now please raise your left arm as high as you can over your head."*

The examiner records whether or not driver could lift each arm above shoulder height. Drivers who can not reach above the height of their shoulders will "fail" this test.

Head/Neck and Upper Torso Rotation

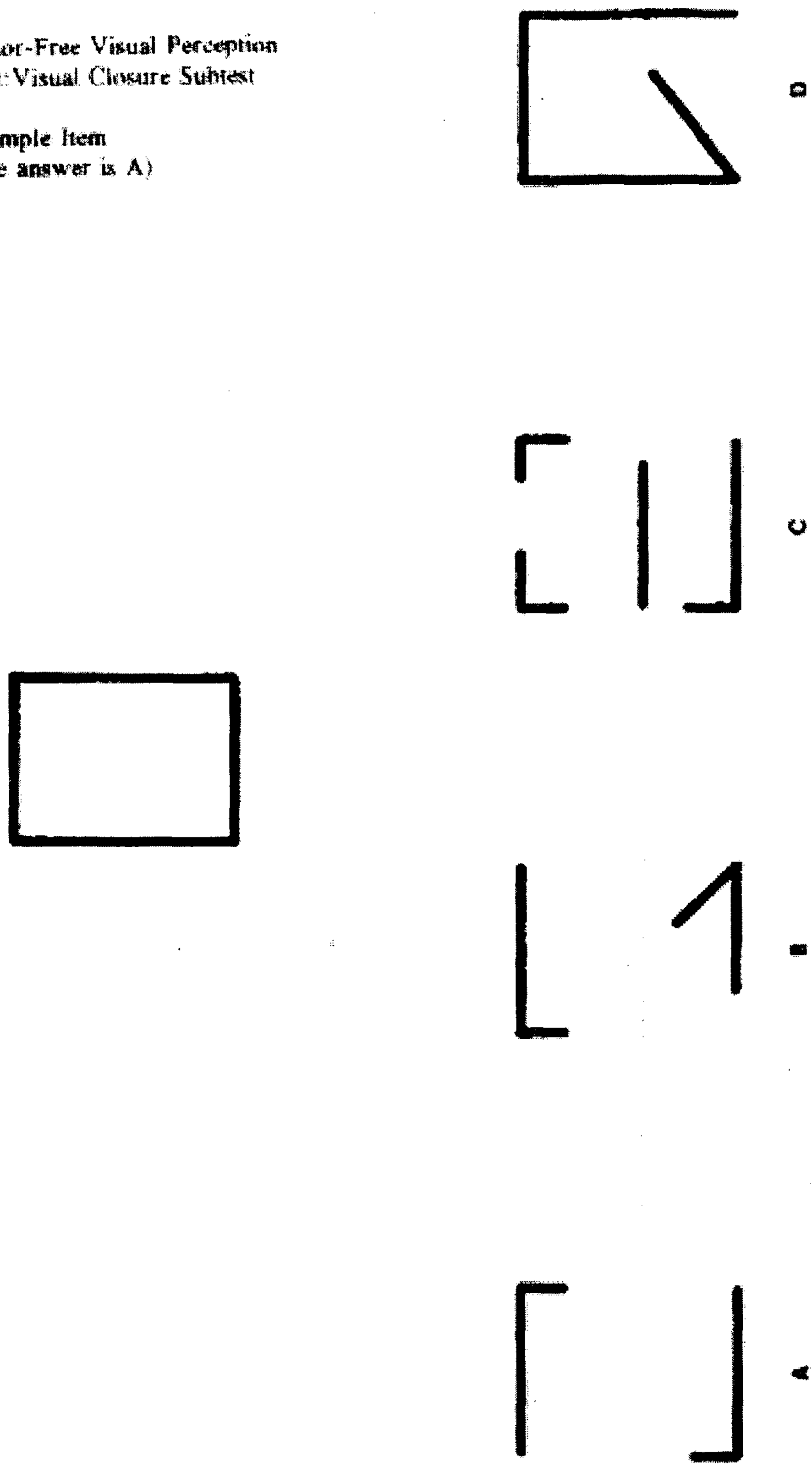
The driver does this test while seated in the chair. It is a measure of the ability of a driver to turn and look over his/her shoulder to see to the sides and rear of the vehicle when changing lanes or merging. The examiner should ask the driver to buckle the seat belt that has been attached to the chair, and to tighten it. The examiner should prompt the driver to check again to make sure the belt is as tight as it can be without discomfort. This part of the procedure is to ensure that the driver remains positioned in the chair, with his or her lower back pressed against the seat back, in the same posture that he or she would assume when sitting in the driver's seat of a car. The examiner stands **10 feet** behind the driver at a pre-marked location, and sets the clock hands to either 3:00 or 9:00 while the examinee is facing the opposite direction.

The examiner delivers the instruction, *"Just as you would turn your head and upper body to look behind you to back your car or change lanes, please turn and read the time on the clock face that I am holding behind you."*

The examiner records whether the driver can read the requested information. If the examinee can not turn far enough in one direction to read the clock, he or she should be asked to try turning the other way. The test is scored as *pass* (the driver can turn his or her head to read the clock) or *fail* (the driver does not have enough flexibility/mobility to perform this motion).

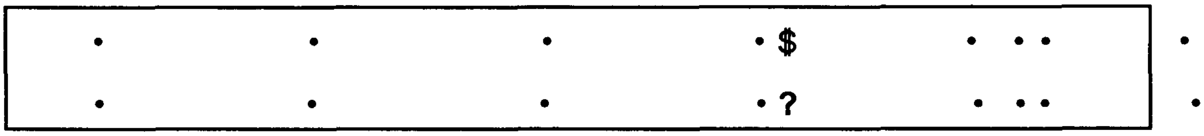
Motor-Free Visual Perception
Test: Visual Closure Subtest

Example Item
(The answer is A)



Scanning Task

The scanning test is presented on a 55-in by 8.5-in laminated sheet that displays 10 common symbols. The symbols are arranged in 2 rows of 5 columns, as shown below.



The driver is seated 3 to 5 feet from the stimulus sheet, only after the following instructions have been delivered. The examiner states, "*without moving your head, scan the poster and report to me the symbols you see. If you do not know what a particular symbol is called, describe what it looks like.*" The examiner notes the order in which the driver reports the symbols.

A normal scan pattern of a cognitively-intact individual may be any of three: (1) rectilinear (left to right/top to bottom); (2) clockwise; or (3) counterclockwise. Subjects with impaired visual scanning capabilities demonstrate disorganized, random, and/or abbreviated or truncated strategies (frequently missing items on one side of the board). Those with hemi-neglect often show an asymmetrical pattern, initiating visual search from the right side rather than the left and confining all search efforts to the right side. Also, whereas subjects with normal visual attention never overlook or repeat a stimulus on the test, those with inattention may commit both of these errors. Scan patterns for GRIMPS will be scored as one of three categories:

1. Normal: Clockwise, counter-clockwise, by rows, by columns.
2. Erratic: All symbols identified, but in haphazard order.
3. Neglect: Two or more shapes not identified at all.

Trail-Making Test: Part A (abbreviated) and Part B

This is a paper-and-pencil test of general cognitive function. Specific functional capabilities targeted by this assessment tool include: visual search and sequencing (Part A); and information speed and attention switching (Part B). Both parts require effective psychomotor coordination. Part A involves connecting, in order, 25 encircled numbers randomly arranged on a page. (For this application, an abbreviated Trails A test is used, containing only 8 numbers, to reduce the amount of time allotted for GRIMPS). Part B includes both numbers (1-13) and letters (A-L), and requires connecting the two in alternating order (1 to A , to 2, to B, etc.). The score on either test is the overall time (seconds) to complete the connections. The last item completed at each 30-second interval is also recorded by the examiner. Mistakes are pointed out by the test administrator and are corrected as they occur; their effect is to increase the overall time required.

The instruction delivered by the examiner is, "*Now I will give you paper and pencil. On the paper are the numbers 1 through 8, scattered across the page. Starting with 1, draw lines to connect each number to the next higher number. I will time how fast you can do this. Ready? Go.*" The examiner records time-to-complete.

The examiner then states, *"On this sheet of paper the numbers 1 through 13 and the letters A through L are mixed up in the same way. This time, start with 1, then draw a line to A, then draw a line to 2, then to B, then 3-C, 4-D, and so on, alternating back and forth between numbers and letters until you finish with the number 13. Again, I will time how fast you can do this. Ready? Go."* The examiner records the last item completed at each 30-second interval, plus total time-to-complete. The Trails B test sheet is shown on the following page.

Norms for Trails B

Stutts, Stewart, and Martell (1998): The means by age group for time to completion (in seconds) for Trails B from the study were 78.8, 85.8, 93.7, and 106 seconds, for age groups 65-69, 70-74, 75-79, and 80+ respectively. Stutts et al. (1998) state that average completion times for the two Trail-Making Tests were below (i.e., better than) published age norms of Heaton et al., 1991 and Davies, 1968, and suggest a relatively healthy and/or well educated sample.

Richardson and Marottoli (1996): Age and education-specific normative data were provided for 101 independently living active drivers, free from neurologic and psychiatric disease. Mean time to complete (and standard deviations) were as follows:

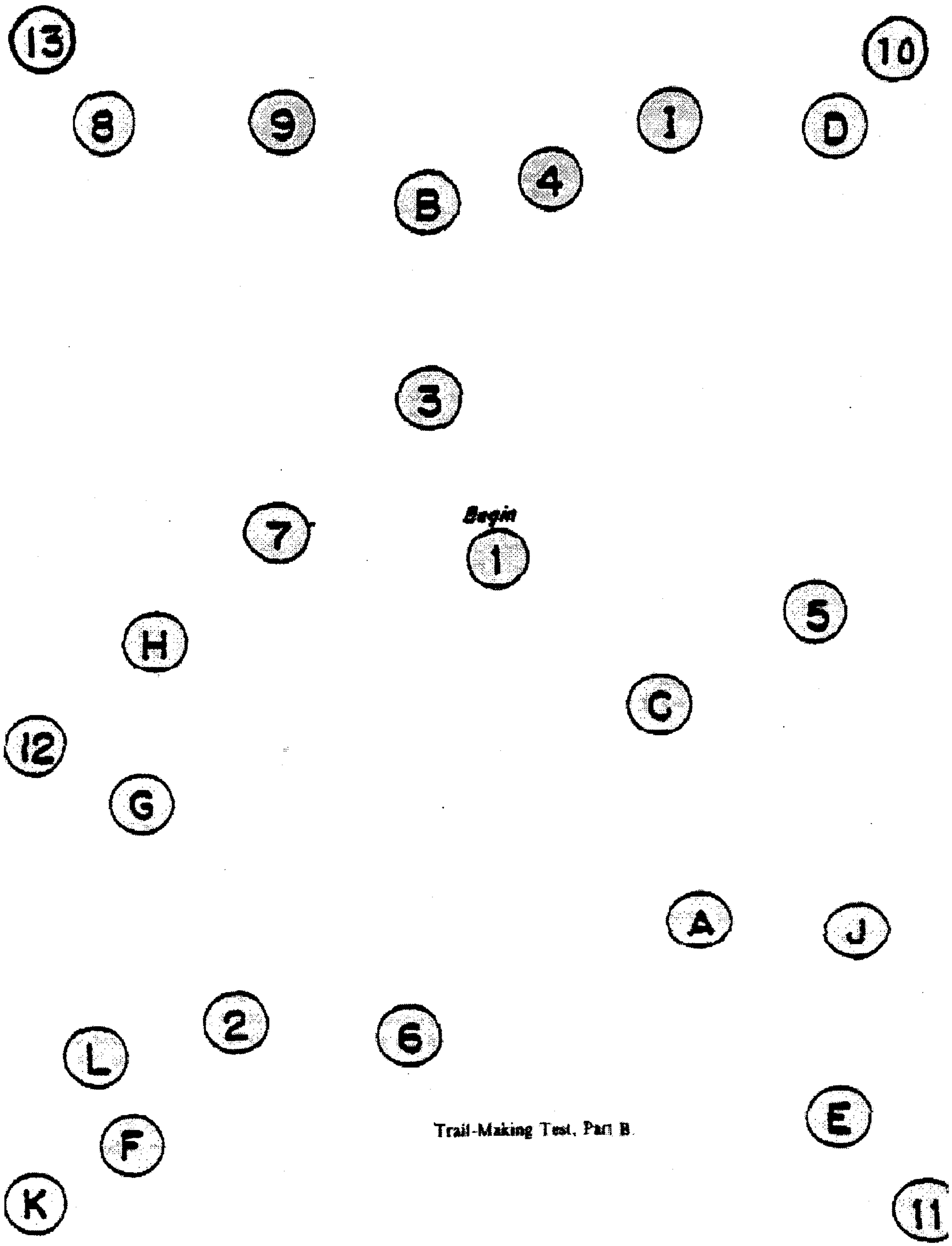
- age 76-80/education $<$ 12 years (n=26) = 197.17 seconds (71.03);
- age 76-80/education $\geq$ 12 years (n=24) = 119.17 seconds (33.47);
- age 81-91/education $<$ 12 years (n=18) = 195.47 seconds (69.70);
- age 81-91/education $\geq$ 12 (n=33) = 137 seconds (55.93).

Also in this paper were means and standard deviations interpolated from conversion tables provided by Heaton, Grant, and Matthews (1991):

- age 75-80/6-8 years of education = 184.5 (92.5);
- age 75-80/9-11 years of education = 157.5 (78.5);
- age 75-80/education $\geq$ 12 years of education = 122.5 (55.5).

Davies (1968):

Age 60-69 (n=90)	Age 70-79 (n=90)
90th percentile = 64	90th percentile = 79
75th percentile = 89	75th percentile = 132
50th percentile = 119	50th percentile = 196
25th percentile = 172	25th percentile = 292
10th percentile = 282	10th percentile = 450



Trail-Making Test, Part B.

Trail-Making Test, Part B.

<u>Delayed Recall (MMSE Test Item # 5)</u>

This is a test of working memory. The examiner asks, *"Please tell me again the three words you repeated earlier."* Examiner records the number of words recalled correctly, and announces that the test is completed.

<u>Vision Tests (Optional)</u>

If GRIMPS is administered in a motor vehicle agency setting, drivers' visual capability will be tested using the established protocol for the jurisdiction. Typically, only a static acuity measure and a gross measure of the horizontal peripheral field size will be obtained.

For other settings, it is recommended that the GRIMPS administrators add measures of standard and low contrast acuity to the other tests described above. Stimuli for each test are presented on 5.5 in by 5.5 in test card that serves as a "wall chart" when viewed from a distance of 5 ft. (Note: the distance has been adjusted for GRIMPS administration). The chart is printed on folded stock so that it is also self-standing. The charts are obtained from the AARP (1992) "Older Driver Skill Assessment and Resource Guide: Creating Mobility Choices." Permission to use these charts has been granted from AARP.

Place **Chart 1** (the high contrast side) on a convenient surface in a brightly lit location <u>5 feet</u> from the test participant, at eye level. The correct letters are printed below. As the person reads each line, circle only WRONG answers.

Ask the participant: "*Please tell me the letters printed on the top line.*"

Then ask the participant to read each successive line. The smallest line of letters without any errors is the acuity score. Record both the line number and the corresponding acuity score.

Now turn the chart around so that **Chart 2** (the low contrast side) is facing the participant (the chart should still be placed at eye level in a brightly lit location, <u>5 feet</u> from the test participant).

Tell the participant "*This chart measures your ability to see low contrast objects. Low contrast objects are harder to see than high contrast objects. You need to be able to see low contrast objects when you drive, like worn or faded lane lines, curbs, medians, pedestrians, and other vehicles. These things are harder to see in poor visibility conditions like fog, or at dusk and dawn.*"

Ask the participant: "*Please tell me the letters printed on the top line.*"

The correct letters are printed below. As the person reads each line, circle only WRONG answers. Then ask the participant to read each successive line, and record the participant's responses. The smallest line of letters without any errors is the acuity score. Record both the line number and the corresponding acuity score. Also record the difference between the line number obtained on Chart 1 and Chart 2.

NOTE: Scores for the low contrast chart will probably be 1 or 2 points lower than for the high contrast chart. The greater the difference between the two scores, the greater is the caution the participant must take when driving in low light conditions. A participant may be advised to limit night driving, and should see his or her eye care specialist to rule out eye diseases such as cataracts.

Chart 1: High Contrast			Chart 2: Low Contrast		
Line	Acuity	Letters	Line	Acuity	Letters
1	20/100	O R S	1	20/100	R H K
2	20/80	Z H N	2	20/80	H N V
3	20/60	H S R	3	20/60	N K S
4	20/50	S Z K	4	20/50	Z R H
5	20/40	V R N	5	20/40	K V S
6	20/30	Z S H	6	20/30	R Z N

Chart 1

O R S

Z H N

H S R

S Z K

V R N

Z S H

Chart 2

High contrast acuity chart (top) and low contrast acuity chart (bottom). (Reprinted with permission from AARP's *Older Driver Skill Assessment and Resource Guide: Creating Mobility Choices*)

IC2(a)ii. Vision Screens (commercially available[3])

Static Contrast Sensitivity

Wall Charts/Cards:

Pelli-Robson Test of Static Contrast Sensitivity
Clement Clarke, Inc., 3128 East 17th Avenue, Columbus, OH 43219, (800) 848-8923.
Chart measures 25 x 34 in, and comes with scoring pad (100 sheets) and instructions for use.

Pelli, Robson, and Wilkins (1988) designed a 48-letter test of contrast sensitivity at one spatial frequency. The contrast between letters and background decreases as one moves down and toward the right of wall-mounted chart, viewed at distance of 1 meter (about 40 inches) under normal room illumination (white area approximately 85 cd/m^2). The letters from left to right and from top to bottom progressively fade out, as if they must be read in thicker and thicker fog. Letters (in groups of 3) range from 90 percent contrast (upper left) to 0.5 percent contrast (lower right). Drivers should be made to guess, even when they believe that the letters are invisible. The examiner should allow several seconds for the faintest letters to appear, but don't let the driver give up until he or she has guessed incorrectly 2 of the 3 letters in a triplet, as the reliability of the results depends on this. The driver's sensitivity is indicated by the faintest triplet for which 2 of the 3 letters are named correctly. The log contrast sensitivity for this triplet is given by the number on the scoring pad nearest to the triplet. The instructions indicate that three measurements should be taken: left eye, right, eye, and both eyes together. If all three measures are taken, test time is approximately 8 minutes. Binocular log contrast sensitivity is normally 0.15 higher than monocular.

Vistech Consultants Vision Contrast Test System (VCTS 6500)

Vistech Consultants, Inc., 4162 Little York Road, Dayton, OH 45414-2566, (937) 454-1399.

[Note: First Generation of tests is available from Vistech; Second generation/revised charts (exclusive arrangement with Dr. Ginsburg) are available through Stereo Optical.]

First Generation: includes chart, instruction manual, evaluation forms, light meter, laminated instruction sheet and answer key.

VCTS 6500 - Far distance wall chart; measures 27 in x 37 in; 10 ft viewing distance.

VCTS 6000 - Portable near vision chart; measures 5 in x 7 in; 18 in viewing distance.

VCTS 6500 Chart contains 5 rows of sine wave gratings (1.5, 3.0, 6.0, 12, and 18 cycles per degree) and 9 columns of "patches" containing bars that vary in contrast. The bars are either oriented straight up and down, slanted to the right, or slanted to the left. The driver starts at

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[3]Decina, Staplin, and Spiegel (1990) provide a review of vision screeners commercially available as of July 1988. They stated that at that time, Stereo Optical Company, Titmus Optical Company, and Keystone/Mast have provided most of the screeners to driver licensing agencies. Because vision screeners have many similarities, only a subset are presented here.

the first row, and "reads" across, telling the examiner in which of the three directions the bars are oriented. The contrast decreases in each row from left to right. The highest numbered patch that can be correctly seen in each row of the chart is the observer's contrast sensitivity for that spatial frequency. Observer views chart from a 10 ft distance, under normal room lighting (30-70 footlamberts).

Smith-Kettlewell Institute Low Luminance (SKILL) Card

The Smith-Kettlewell Eye Research Institute, 2232 Webster Street, San Francisco, CA 94115, (415) 561-1620.

Available from the Smith-Kettlewell Institute, who requests a donation for the chart.

This is a test for assessing visual function under the conditions that "stress" the visual system; the combination of low contrast and low light level. It is designed to measure spatial vision under conditions of reduced contrast and luminance using normal office lighting. Its developers state that it is sensitive to alterations in visual function due to optic neuritis, glaucoma, and age-related maculopathy, and that it is closely correlated with reading performance in patients with early age related maculopathy and with driving performance in the elderly.

This letter chart is viewed at a distance of 40 cm (16 in). From the top of the chart to the bottom, each line of letters is smaller than the line preceding it. One of the SKILL Card charts shows black letters on a white background (high-contrast letters); the other card shows black letters on a dark gray background (low contrast letters on a low-luminance background). Guessing is encouraged. Instructions for use and scoring are included, as well as score sheets and age norms. The SKILL score is the acuity loss (number of letters) between the light and dark sides.

Vision Screening Devices:

Vistech Consultants Multivision Contrast Tester (MCT 8000)

Vistech Consultants, Inc., 4162 Little York Road, Dayton, OH 45414-2566, (937) 454-1399.

Multivision Contrast Tester measures near and far distance contrast sensitivity, three types of glare (central, peripheral, and radial), near and distance acuity.

The Cataract Functional Disability Test, performed with the MCT 8000 documents the degree of functional disability a patient is experiencing as a result of a cataract.

OPTEC 1000 DMV

Stereo Optical Company, 3539 North Kenton Avenue, Chicago, IL 60641 1-800-334-9500, 312-777-2869.

Slide packages vary according to requests from various state DMVs; Optec can design and develop new tests as the need arises.

Slides may include 4 tests: Snellen letter and number acuity, color perception, stereo depth perception, traffic sign recognition, muscle balance phoria. A set of 2 contrast sensitivity slides (Vistech consultants sine wave gratings) is also available. The Optec 1000 DMV can also accomplish perimeter testing (nasal and temporal at 55, 70, and 85 degrees) and night vision testing.

Static Acuity

Standard Wall Charts (Snellen Letter Chart and Sloane Letter Chart):

Snellen "E" Charts

(Available from Prevent Blindness America, 500 E. Remington Road, Schaumburg, IL 60173; 1-800-331-2020).

20-ft. distance: Tumbling "E" symbols on one side, other letters on reverse. Printed on a durable, tear-resistant latex sheet, with eyelets for easy hanging. Chart comes with practice "E" card and *Guide to Testing Distance Visual Acuity*. Measures 9 in x 23in.

10-ft. distance: Smaller chart for shorter distance. Other specifications same as above. Measures 9 in x 18 in.

Sloan Low Vision Letter Chart for 6 Meters (20 ft)

(Available from Good-Lite Co. 1540 Havannah Avenue, Forrest Part, IL 60130; 708-366-3860).

Two-sided chart (10 in x 18 in) where one side contains 4 rows of letters from 20/200 to 20/100 acuity, and the other side contains 8 rows of letters from 20/100 to 20/20. Two test charts per set.

ETDRS (Early Treatment Diabetic Retinopathy Study) Chart:

(Available from Prevent Blindness America, 500 E. Remington Road, Schaumburg, IL 60173 1-800-331-2020).

ETDRS Distance Chart: This durable eye chart utilizes all 10 Sloan letters (C, D, H, K, N, O, R, S, V and Z) to test vision at 10 feet. Each line consists of five optotypes, standardizing the number of letters that must be correctly identified to pass any line (three out of five). Three sets of letters on the lower lines can help prevent memorization. Made of durable plastic, with hole for hanging. 18 in x 18 in; folds to 9 in x 18 in. (Shipped directly from the manufacturer.)

ETDRS Near Chart: This innovative new chart, developed especially for Prevent Blindness America, includes an occluder on a 16-inch cord for testing near vision. Printed on both sides for discouraging memorization and screening each eye with a different but equally difficult test. Five optotypes per line standardizes passing at three out of five on each line. Made of durable plastic; utilizes all 10 Sloan letters (C, D, H, K, N, O, R, S, V and Z). Measures 9 in x 7 in.

IC2(a)iii. Road Sign/Knowledge Test

Summary:

According to information presented by Janke and Hersch (1997), only four U.S. jurisdictions and two Canadian provinces require an age-based knowledge test for driver license renewal. This includes the District of Columbia, Illinois, Indiana, New Hampshire, Alberta, and Ontario. Six other jurisdictions require knowledge tests for all license renewals (regardless of age). This includes California, Hawaii, Kansas, Louisiana, Michigan, and Utah). Janke and Hersch (1997) analyzed test results for 1,501 California driver license applicants ages 65 and older who failed to complete the license renewal process during their initial visit to the DMV. Some drivers fail the knowledge test several times, despite having an opportunity to review the material in the Driver Handbook between tests. While 47.4 percent passed it on the first attempt, the failure rate for older drivers renewing their licenses is higher than that for the population as a whole.

In Oregon, if a driver is referred to the DMV for reexamination, he or she is offered an appointment with a Driver Improvement Counselor, who is "an experienced former driver examiner who has received special training and whose role is to advise, recommend, critique, and persuade, rather than to merely test the driver" (Janke, 1994). One component is an oral knowledge test consisting of seven questions. Six are prescribed and one may be chosen from the State's regular oral test. The six prescribed questions are:

(1) You are preparing to make a left turn from a two-way street. Your car should be in what position?
(2) At an intersection where there are no stop signs or traffic lights to control traffic, you must yield to the car on which side of you?
(3) You are coming toward an intersection with a two-way street. In which direction should you look first?
(4) You are in a "left turn only" lane and you want to go straight ahead. What should you do?
(5) Tell the correct way to change lanes.
(6) Tell what it means when a school bus is stopped and its red lights are flashing.

Several researchers have evaluated the effectiveness of traffic sign knowledge tests and rules of the road tests in predicting crashes or impaired driving performance. In a study of 3,238 drivers ages 65 and older who applied for renewal of North Carolina driver's license, Stutts, Stewart, and Martell (1996) found that performance on the knowledge test declined significantly as a function of increasing age (time to complete test increased with increasing age). The correlation between knowledge test score and number of crashes was significant. This test required the driver to identify and explain the meaning of 12 traffic signs based on their color and shape (e.g., yellow diamond with + would be identified as a warning sign for a crossroad ahead). The signs were displayed six at a time in the viewing equipment used for vision testing. The test is not normally timed for license renewal, however, for the research, examiners recorded how long (in seconds) it took license applicants to complete the test. Applicants were not told they were being timed; the number of errors remained the only criteria for passing or failing test. Three or more errors automatically dismisses a license applicant.

Tarawneh, McCoy, Bishu, and Ballard (1993) found that the driving knowledge test score was significantly correlated with driving performance (correlation coefficient =0.27, p=0.0053). Better performance on the knowledge test was associated with better on-road driving performance. The

knowledge test was a 50-question, multiple choice test designed to determine the driving knowledge pertinent to the types of crashes in which older drivers in Nebraska were over-involved. Questions pinpointed contributing circumstances (failure to yield, disregard signal, improper turn signal, improper turn, following too close, and improper lane change) and crash type (right angle, rear end, side swipe, head on, left turn, other turn, right turn, and pedestrian). The percentage of the questions answered quickly was used as the measure of driving knowledge.

In another study, Cushman (1992) found that the group of subjects who failed an on-road driving exam had significantly lower mean scores on the written (multiple choice) knowledge test and the road sign identification test compared to the group of subjects who passed the on-road driving exam. The road (driving) knowledge test was a multiple-choice, paper-and-pencil test consisting of 21 questions assessing knowledge of rules of the road. It additionally required subjects to identify and describe the meaning of 16 road signs (what the required driver action was).

Hunt, Morris, Edwards, and Wilson (1993) employed a traffic sign recognition test that required the identification of the following four standard symbols: traffic merging, no right turn, no left turn, and no U turn. These symbol signs were chosen because they are frequently encountered in everyday driving situations. Subjects were asked to explain the meaning of each symbol. Each item was scored individually to determine if one type of sign posed greater difficulty than the others. All five subjects with mild dementia who failed the road test also performed poorly on the pre-driving traffic sign recognition test. The correlation between the pass/fail outcome on the road test and performance on the Traffic Sign Recognition test was significant at the $p < .0002$ level. The authors noted that visual form detection may be impaired in mild senile dementia of the Alzheimer type (SDAT), while visual acuity remains intact; this may contribute to the difficulty some subjects experienced with sign recognition, since the signs were symbols (form) rather than letters (acuity).

In a research study of 102 older drivers referred to the DMV for a reexam and 33 paid volunteers, the correlation between knowledge test errors (standard California renewal knowledge test) and weighted errors on the road test was significant for the combined referral and volunteer group and for the referral group only (Janke and Eberhard, 1998; Janke and Hersch, 1997). The Driver's Examination on California Vehicle Code and Safe Driving Practices contains 18 multiple choice questions, each with 4 choices. A renewal applicant must score at least 15 (3 errors or less) to pass the test. There are 5 different versions of the test, with questions developed from information presented in the 1997 *California Driver Handbook*. One or two questions relate to the meaning of signs and pavement markings depicted on the test form, others ask about the legal BAC limit, visual scanning practices, the meaning of signals, what to do if involved in a crash, etc.

Janke and Eberhard (1998) and Janke and Hersch (1997) also reported on a supplementary test of traffic sign knowledge and perception. This two-part written traffic-sign test presented pictures of traffic signs and asked whether it meant that the driver should perform a certain action (e.g., "watch for hazards"). A second part presented several traffic sign shapes embedded in complex abstract drawings, and subjects were to indicate the number of sign shapes of a particular type hidden in the drawing. Using the sample of subjects mentioned above, sign test errors correlated significantly with weighted errors on the road test for the combined referral and volunteer group, but not for the referral group only.

Janke and Hersch employed another traffic sign recognition test in a study of 101 licensed drivers ages 72 to 90. This was a paper-and-pencil test consisting of 12 factually oriented questions requiring a subject to check an alternative corresponding to the meaning of each pictured sign, and one judgmentally oriented question, where an intersection displays a "no left turn" and two "do not enter" signs on the through path, and the subject must check the alternative corresponding to what they could do (turn right). The correlation between traffic sign errors and weighted error score on the drive test was not significant. Janke and Hersch (1997) recommend that jurisdictions employ knowledge testing for license renewal. They stated that an *adequate* knowledge test given to all renewal applicants may be sufficient to screen out most cases of cognitive impairment and that it should be possible to modify present tests to make them not only tests of crystallized knowledge, but dementia screens. For example, diagrams of traffic situations could be incorporated in the tests in which drivers would be required to state what they should do if they were driving Car A, and then what they should do if they were driving Car B. The switching of attention and point of view required in such a task might prove to be especially difficult for a person with cognitive impairment.

A test such as that described above is given in Pennsylvania to drivers who have been convicted of violations of the PA Vehicle Code resulting in six or more points. Part of this Special Point Exam tests drivers' judgment about safe versus unsafe driving decisions, and accounts for two-thirds of the total score. The crash situations in the study guide and on the test are taken from reports of real crashes. In each crash situation there are a number of diagrams that show traffic conditions, vehicle movements, and traffic signs and signals in the crash area. Examinees are required to integrate all of this information to respond correctly. A description of what happened is under each diagram. An example of this kind of test question is shown on the following pages.

Conclusions/Preliminary Recommendations:

Performance on simple tests of traffic sign recognition and rules of the road has been shown to correlate significantly with poor driving performance and also with cognitive impairment. More complex test questions requiring drivers to visualize multiple perspectives, project their own and/or other vehicles' movements, or integrate a number of traffic situational factors show promise as protocols tailored to detect cognitive impairment.

References:

- Cushman (1992)
- Hunt, Morris, Edwards, and Wilson (1993)
- Janke and Eberhard (1998)
- Janke and Hersch (1997)
- PennDOT Special Point Examination Driver's Handbook
- Stutts, Stewart, and Martell (1996)
- Tarawneh, McCoy, Bishu, and Ballard (1993)

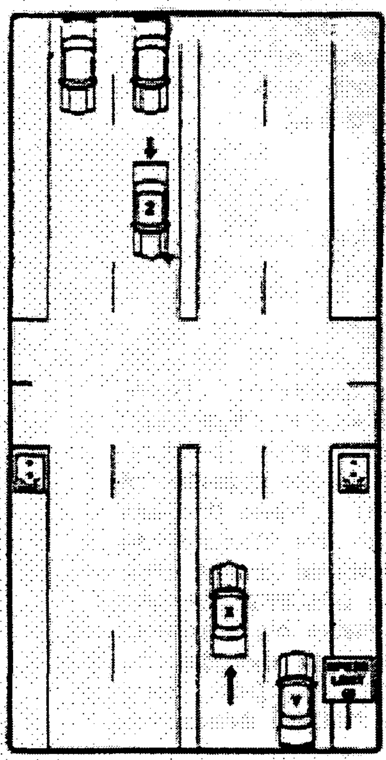
Example B: Look at the accident shown in Diagrams B1, B2, and G3. Answer the following question **as if you are Driver X.**

QUESTION: The "critical decision point" for your choice to go through the intersection on the yellow light was before the time when Car Z actually started to turn in front of you.

True _V__ False ___

The answer to Example B is TRUE. When you first saw the light turn yellow, you had not yet entered the intersection. Your choices were to "go for it" or to slow down and try to stop. This decision should have considered both the movement of Car Z and the fact that Car Y in the lane next to you had you "boxed in." There would be no room to maneuver if a conflict developed with Car Z. In this situation, "driving smart" means that you recognize at least two things that increase the chances of an accident. First, both you and Driver Z need to pass through the same point to get through the intersection before the light turns red. Second, the signal turning from green to yellow may lead Driver Z to assume you will stop. At this point he is more likely to make his turn, and less likely to yield to you. This does not excuse the unsafe decision of Driver Z to turn across your path, but it shows how your decision could have helped avoid this accident.

B1



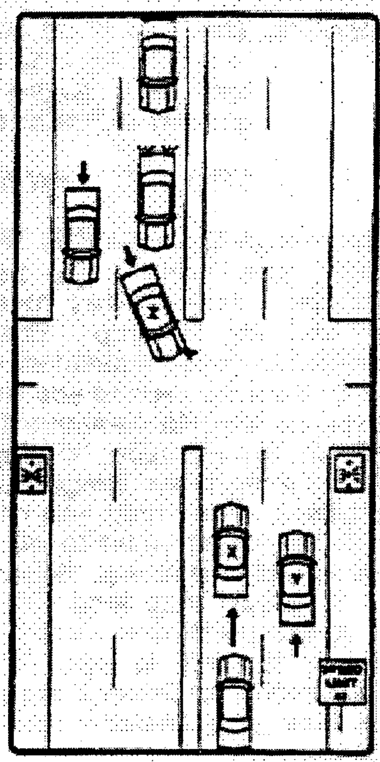
In the first diagram:

Driver X sees a green light ahead while coming to an intersection on a four-lane city street.

Driver Y is in the right lane, next to and a little behind Driver X.

Driver Z is approaching the intersection from the opposite direction and is signalling to turn left.

B2



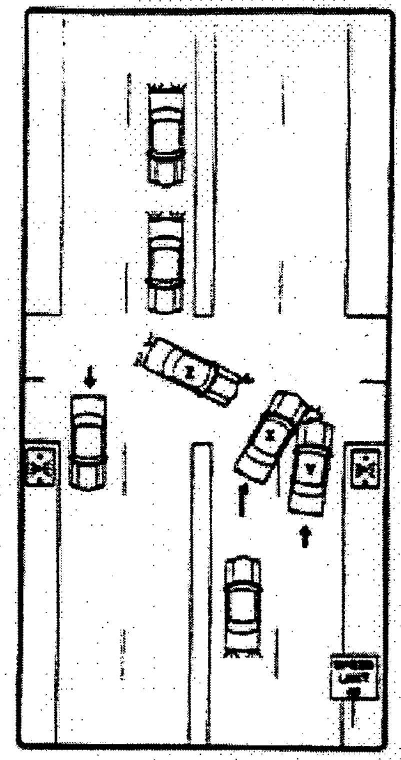
After another second or two:

Driver Z has just entered the intersection as the light turns yellow.

Driver X is about to enter the intersection, hurrying to get through before the light turns red.

Driver Y keeps pace with Driver X, heading toward the intersection.

B3



The accident occurs when:

Driver Z abruptly comes to a stop sticking part way into the path of Car X.

Driver X swerves to the right to avoid Car Z, still hurrying to get through on the yellow light.

Driver Y cannot react fast enough to keep from crashing into the side of Car X.

Visual Attention (Selective Attention/Divided Attention)

Visual Attention Analyzer, Model 2000 (Useful Field of View)

Visual Resources, Inc., 333 West Wacker Drive, Suite 700, Chicago, IL 60606; phone: (773) 248-0883; fax: (773) 248-0885; email: kristi@ufov.com; contact: Kristi Berg.

A model 2000 Vision Attention Analyzer is used to measure the detection, localization and identification of suprathreshold targets in complex displays, and has been shown to be predictive of the performance of daily activities such as driving a car. The size of the UFOV is determined by manipulating three variables: target presentation duration, the competing attentional demands of the central and peripheral task, and the salience of the peripheral target. Three subtests provide a measure of the percentage reduction of a maximum 35 degree radius field. During the first subtest (which measures processing speed capability and vigilance), a test participant is required to identify a centrally located object which varies in duration, by pressing an icon of a truck or a car (whichever was presented) on the touch-screen display after the target is presented. The second subtest (which measures divided attention capabilities) requires the same identification, in addition to locating a simultaneously presented peripheral target of varying eccentricity. A third subtest (which measures selective attention capabilities) requires the same two responses required for subtests 1 and 2; for this subtest, the peripheral target is embedded in distractors. The composite measure of UFOV reduction is recorded as a percentage ranging from 0 to 90 percent, and the basis for the loss can be determined by considering the percentages of loss on the three subtests.

The Visual Attention Analyzer is currently available in several models and options. All are fully automated. UFOV testing is also available on disk through Visual Resources, Inc., and The Psychological Corporation.

Auto-Trails

Frank Schieber, University of South Dakota, 414 E. Clark Street, Psychology Department, Vermillion, SD 57069. Phone: (605) 677-5295; Fax: (605) 677-6604.

This procedure is a modified and automated version of Reitan's (1958) Trail Making Test (Part A). It presently runs in DOS mode, although it is being upgraded for a Windows environment. The software may be obtained for free from Dr. Schieber; however, the user must supply a touch screen and interface card. In this test, 14 numbers are presented on a computer monitor. They are arranged randomly against the still (static) background of a traffic scene as observed by the driver through the windshield. The subject must touch the numbers (touch screen display) in ascending order as rapidly and accurately as possible, consistent with the clinical "Trails" protocol. Timing is done by the computer.

Dynamic Trails Test *[DynaTrails]*

The Scientex Corporation; 1722 Sumneytown Pike, P.O. Box 1367; Kulpsville, PA 19443
Phone: (215) 412-4912; Fax: (215) 412-4911; e-mail: 75142.515@compuserve.com

Scientex has developed software to present a derivative of the *Trails B* procedure using a computer touch screen. A moving driving scene, stored on the hard drive as an MPEG file, is presented in the background. Test stimuli (numbers and letters) are overlaid on the driving scene. A data file of the subject's performance is generated which records the following data: the time after start at which each number and letter stimulus is pressed (including error responses); the exact coordinates on the screen where each response was made; and subject identifying information as entered on a set-up screen by the experimenter/test administrator. This is a Windows-based application.

This software product may be made available at cost, but with restrictions on copying or redistributing it, to qualified researchers and motor vehicle agency officials. For more information contact *Scientex* at the location above.

Channel Capacity (Information Processing)

WayPoint

WayPoint Research, Inc., 538 Burlington Road, Suite B, Atlanta, GA 30307, (404) 982-0011.

WayPoint is a brief, paper-and-pencil test, where subjects connect alternating numbers and letters in sequence. The test was developed to identify high-risk drivers (truck drivers, bus operators, etc).

Six exercises are presented in pamphlet form. The first 4 exercises contain 8 numbers and 7 letters which are to be connected in alternating number-letter order by means of a continuous pencil line; the last two exercises contain 5 numbers and 4 letters to be connected in the same way. Some exercises have small pictures used as irrelevant distractors. Subjects are instructed to keep going if they make a mistake. Performance on each exercise is timed with a stopwatch.

WayPoint can be administered one-on-one or in a group. It uses a (proprietary) Windows-based scoring program to assess crash risk (high or low), and a narrative about the person's strengths and weaknesses. The scoring system calculates channel capacity or information processing rate, accuracy, focus, vigilance (sustained attention), and search (the ability to find details in a visually noisy field). Based on these 5 interacting factors, a driver falls into one of 60 different categories. Associated with each category is a driving style and collision risk factor, which is a 5-point scale that expresses the likelihood of both "preventable" and "non-preventable" collisions.

Mini-Mental Status Examination

Summary

The MMSE is an 11-item (30 point) screening instrument for dementia (Folstein, Folstein, and McHugh, 1975) that contains test items in 6 general cognitive domains: orientation (items 1 and 2); registration, or learning and remembering new information (item 3), attention/calculation (item 4a: spelling "world" backwards or item 4b: counting backwards by 7 from 100), recall (item 5), language (items 6-10), and visuospatial perception/praxis (item 11: copying a figure of 2 intersecting pentagons). It requires approximately 10 minutes to administer. The 11 items are progressive and are to be asked in the order presented on the following page.

When given to 69 patients, the test was able to separate the three following diagnostic groups.

- Dementia: n=29, mean age = 80.8, mean MMSE score = 9.6, sd=5.8, range = 0-22
- Depression with cognitive impairment: n=10, mean age = 74.5, mean MMSE score = 19.0, sd = 6.6, range = 9-27
- Depression: n=30, mean age = 49.8, mean MMSE score = 25.1, sd= 5.4, range = 8-30.

For 63 normal elderly persons with an average age of 73.9 years, the mean MMSE score was 27.6, (sd=1.7, range = 24-30). Standardization of the test by administration to 63 normal elderly subjects and 137 patients indicated that the score of 20 or less was found essentially only in patients with dementia, delirium, schizophrenia or affective disorder, and not in normal elderly people or in patients with a primary diagnosis of neurosis and personality disorder.

The MMSE has been used extensively in older driver research studies, as summarized below.

In a study of 283 community-dwelling individuals ages 72 to 92 (mean age = 77.8), Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994) found that persons with borderline cognitive impairment (MMSE score of 23-25) were more likely to have adverse events (traffic crash, violation, or stopped by police) in the year following examination than those with higher or lower scores (relative risk = 2.0, 95% CI = 1.1-3.7). The authors examined the components of the MMSE individually and by cognitive domain (orientation, memory, attention, language, and visuospatial ability), and found that the item most closely associated with adverse events was impaired design copying [24% of persons who could not correctly copy the intersecting pentagons had events compared with 8% of those who could (relative risk = 3.0, CI = 1.6-5.6)].

Johansson (1997) conducted a matched-pair, case-control study, with close (1 year) age matching in Sweden. The case subjects included 37 drivers age 65 and older (mean age = 75.5) with temporarily-suspended licenses due to crashes (23 drivers) or other moving violations (14 drivers). The control subjects included 37 drivers age 65 and older with no license suspensions. The case subjects (suspensions + crashes) had significantly lower MMSE scores (p=.019), lower immediate memory task performance (p=.010), and poorer performance on the cube copying task (p=.010) compared to matched controls.

Mini-Mental Status Exam

1. What is today's Date? (Month, Date, Year)
   What is the Day of the Week?
   What Season of the Year are we in?

(Score one point each for correct month, date, year day of the week and season, to a total of 5 points) ________

2. Can you tell me your address?
   What town do you live in?
   What county are we in?
   What state are we in?

(Score one point each for address number, street town, county and state to a total of 5 points) ________

3. Name three objects (house, bus, dog)
   Allow one second to say each. Give one point for each correct answer after the first trial. Repeat up to 6 trials to learn, if not learned by sixth trial, stop) ________

4. Spell "world" backwards or serial 7s.
   (Score one point for each letter in correct order or for each correct subtraction) ________

   (Use second line if you do both "world backwards and serial 7's) (________)

5. Ask the person to repeat the three objects from Item 3. Score one point for each correct object remembered. ________

6. Have the person name a pencil and watch
   (Score one point for each item correctly named.) ________

7. Repeat the following phrase: "No ifs, ands or buts."
   (Score one point if done correctly) ________

8. Follow a 3-stage command: "Take paper in right hand, fold in half and place on floor."
   (Score one point if command is followed) ________

9. Read and obey the following: "Close Your Eyes."
   (Score one point if done correctly) ________

10. Write a sentence
    (Score one point for a complete sentence) ________

11. Copy the Interlocking Pentagons
    (Score one point if done correctly) ________

Total Score
0 - 30 possible if only one of Item 4 used,
0-35 if both of Item 4 used ________

In a study of 101 licensed drivers (39 females and 62 males) ages 72 to 90 (mean age = 78.3), MMSE correct responses were not significantly correlated with road test weighted errors. However, MMSE correct responses did significantly correlate with concentration errors on the road test ($r=0.09$, $p=0.359$). MMSE "error areas," the number of cognitive domains represented on the MMSE on which at least one error was made, correlated 0.27 ($p=0.006$) with road test weighted errors and 0.29 ($p=0.003$) with concentration errors (Janke and Hersch, 1997).

In a study of 30 licensed drivers ages 61 to 89 (mean = 72.2), the correlation between MMSE score and in-traffic score was 0.72, and was significant at the $p<.01$ level (Odenheimer, Beaudet, Jette, Albert, Grande, and Minaker, 1994). Subjects were recruited by word-of-mouth from studies of normal aging ($n=17$), medical and dementia clinics ($n=9$), and from the community ($n=4$). Adjusting for age resulted in no change in the correlation. Although there was a strong correlation between the MMSE and driving performance, the MMSE alone was deemed inadequate to predict driving performance. The MMSE scores of the four subjects who failed the road test were 4, 16, 21, and 24. Of the subjects who passed the road test, the lowest MMSE score was 14.

Tarawneh, McCoy, Bishu, and Ballard (1993) studied 105 drivers licensed in Nebraska, who were between the ages of 65 and 88 (mean age = 71.4). In this study, the MMSE showed a significant correlation to performance on an on-road driving test (correlation = 0.24, $p<0.01$).

A consensus statement was generated by 22 researchers who met in Borlange Sweden, aimed at providing advice to primary care physicians concerning the assessment of cognitive status in relation to driving (Lundberg, Johansson, Ball, Bjerre, Blomqvist, Braekhus, Brouwer, Blysma, Carr, Englund, Friedland, Hakamies-Blomqvist, Klemetz, O'Neill, Odenheimer, Rizzo, Schelin, Seideman, Tallman, Viitanen, Waller, and Winblad, 1997). Although consensus could not be reached concerning the issue of a cut-off score on the MMSE, it was determined by the majority (with some reservation) that some cut-off levels can be cautiously proposed in the context of decisions concerning future driving.

- Cut-off scores must be considered as being relative, forming a small part of the basis of making decisions about driving, and secondary to a clinical evaluation.
- MMSE scores 10, accompanied by a diagnosis of dementia, indicates a sufficiently low level of cognitive functioning to justify recommending immediate cessation of driving.
- MMSE scores of 11-17, accompanied by a diagnosis of dementia, suggests severe cognitive impairment; the patient should be referred for specialized assessment unless the clinician feels that it is unnecessary.
- MMSE scores of 18-23 indicates mild impairment; decisions concerning possible assessment should be based on the functional level of the patient. If the functional level is stable, then a periodic follow-up is recommended. If functional deterioration is present, then specialized assessment is recommended.
- For patients without diagnosis of dementia, scores of 17 or less and scores of 18-23 with accompanying signs of functional deterioration should be indications for specialized assessment.
- Some participants could not accept this suggested use for the following reasons:
  - Risk of designating false positives; low scores are related to illiteracy, aphasia, depression, and resistive behavior; may not correctly assess mental status of patient.
  - MMSE does not assess poor judgment and impulse control; persons with scores above the cut-off may be inappropriately viewed as safe drivers.
  - Use may be wasteful adding nothing more to evaluation of competence than clinical observation of general cognitive functioning.

References:

- Folstein, Folstein, and McHugh (1975)
- Lundberg, Johansson, Ball, Bjerre, Blomqvist, Braekhus, Brouwer, Blysma, Carr, Englund, Friedland, Hakamies-Blomqvist, Klemetz, O'Neill, Odenheimer, Rizzo, Schelin, Seideman, Tallman, Viitanen, Waller, and Winblad (1997)
- Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)
- Johansson (1997)
- Janke and Hersch (1997)
- Odenheimer, Beaudet, Jette, Albert, Grande, and Minaker (1994)
- Tarawneh, McCoy, Bishu, and Ballard (1993)
- Drachman and Swearer (1995)

Mattis Organic Mental Syndrome Screening Examination (MOMSSE)

Summary:

The MOMSSE is a brief mental status examination (Mattis, 1976) consisting of items testing:

- General fund of information (e.g., How many weeks are in a year?).
- Verbal Abstraction (e.g., How are a poem and statue alike?).
- Attention (forward and backward digit span).
- Memory (orientation, verbal memory, reproduction of design from memory).
- Language (e.g., test for objects, body parts, double and triple commands, reading silently and aloud).
- Construction (draw a clock, cube copying).

It is comprised of a sample of several WAIS subtests, a Benton geometric figure, and some items from the Eisenson Test of Aphasia. It requires 15 to 20 minutes to administer.

Owsley, Ball, Sloane, Roenker, and Bruni (1991) employed the MOMSSE in a study of 53 drivers ages 57 to 83 (mean age = 70). Each of the 14 subtests was scored from 0 (normal) to 2 (impaired), and an overall composite score was calculated by adding subtest scores. Composite scores ranged from 0 to 28 (0 = excellent mental status; 28 = severe dementia). Individuals with high MOMSSE scores (n=8) experienced 3.8 times more crashes on average than those with MOMSSE scores less than 10 (n=45). For intersection crashes only, subjects with MOMSSE scores greater than 10 (n=8) had a total of 9 intersection crashes, and those with scores less than 10 (n=39) had only 7 intersection crashes between them. On the basis of the number of subjects in each group, individuals with higher MOMSSE scores had 6.3 times more intersection crashes than those with lower scores. Mental Status (score on MOMSSE) was found to be significantly related to number of crashes (r=.36). When crashes were categorized by type, most were found to be intersection problems. MOMSSE scores were found to be better predictors of intersection crashes than crashes in general (r=.41). MOMSSE and UFOV together predicted 29 percent of the variance in intersection crashes, and 20 percent of the variance in crashes in general.

In a study of 294 subjects ages 56 to 90 (mean age = 71 years), Ball, Owsley, Sloane, Roenker, and Bruni (1993) found a significant correlation between MOMSSE score and crash frequency (r=.34, $p<.01$). Data were tested with the LISREL VII structural modeling program to evaluate independent variables in terms of whether they directly influence the dependent variable (crashes), or if they operate indirectly through other variables. In this study, UFOV and mental status were the only variables that had a direct effect on the crash-frequency variance. Mental status was found to have a small, but significant direct effect on crash frequency, and a larger indirect effect on crash frequency through

UFOV. Together, UFOV and mental status (MOMSSE) account for 28 percent of the variance in crash frequency. Mental status had sensitivity (.61) and specificity (.62) values that were "markedly" less than those for UFOV (.89) and (.81), respectively.

References:

- Ball, Owsley, Sloane, Roenker, and Bruni (1993)
- Mattis (1976)
- Owsley, Ball, Sloane, Roenker, and Bruni (1991)

Short Blessed Test (6-item version of the Blessed Information-Memory-Concentration Mental Status Test)

Summary:

Originally a 26-item test (Orientation-Memory-Concentration) of cognitive impairment, it was shortened to a 6-item test, and has been shown to reliably discriminate among mild, moderate, and severe cognitive deficits. It is also easily administered by a nonphysician. The 6-item test predicted the scores on the 26-item validated mental status questionnaire in two patient groups in a skilled nursing home (n=322), patients in a health-related facility (n=42 and n=170), and in a senior citizen center (n=52). There was a positive correlation between scores on the 6-item test and plaque counts obtained from the cerebral cortex of 38 subjects at autopsy (Katzman, Brown, Fuld, Peck, Schechter, and Schimmel, 1983).

This test requires identification of current year and month, identifying time within one hour, counting backwards from 20 to 1, saying months in reverse order, and repeating a name and address that the test administrator has told the subject just before asking the current time. Weighted scores on the test range from 0 (no errors) to 28 (maximum errors). Scores of 0-8 indicate normal or minimal cognitive impairment; 9-19 moderate impairment; and 20 and above severe impairment.

Item	Max Error	Score	Weight	Weighted Score
1 What year is it now?	1	____ x	4	____
2 What month is it now?	1	____ x	3	____
Memory phrase: Repeat this phrase after me: John Brown, 42 Market Street, Chicago				
3 About what time is it? (within 1 hour)	1	____ x	3	____
4 Count backwards 20 to 1	2	____ x	2	____
5 Say the months in reverse order	2	____ x	2	____
6 Repeat the memory phrase	5	____ x	2	____

from the cerebral cortex of 38 subjects at autopsy (Katzman, Brown, Fuld, Peck, Schechter, and Schimmel, 1983).

This test requires identification of current year and month, identifying time within one hour, counting backwards from 20 to 1, saying months in reverse order, and repeating a name and address that the test administrator has told the subject just before asking the current time. Weighted scores on the test range from 0 (no errors) to 28 (maximum errors). Scores of 0-8 indicate normal or minimal cognitive impairment; 9-19 moderate impairment; and 20 and above severe impairment.

Item	Max Error	Score	Weight	Weighted Score	
1 What year is it now?		1	____	x 4	____
2 What month is it now?		1	____	x 3	____
Memory phrase: Repeat this phrase after me: John Brown, 42 Market Street, Chicago					
3 About what time is it? (within 1 hour)	1	____	x 3	____	
4 Count backwards 20 to 1		2	____	x 2	____
5 Say the months in reverse order		2	____	x 2	____
6 Repeat the memory phrase		5	____	x 2	____

In a study of 13 healthy elderly control subjects (mean age = 73.5), 12 subjects with very mild dementia (mean age = 72.5); and 12 subjects with mild dementia (mean age = 73.4), the correlation between the pass/fail outcome on an on-road driving evaluation and performance on the Short Blessed Test was significant at the $p < .001$ level (Hunt, Morris, Edwards, and Wilson, 1993).

The Short Blessed Cognitive Test was also employed in a study of 3,238 drivers ages 65 and older, who applied for renewal of their North Carolina driver's license (Stutts, Stewart, and Martell, 1996, 1997). Results of single variable models for the association of each cognitive test measure with recent prior crash involvement using continuous test scores (Chi Square Tests) showed that the Short Blessed test was not significant. Multivariate Poisson Regression Models were employed to control for effects of age, race, driving exposure, etc, and included Trails A, Trails B, and Short Blessed test. All three models fit the data adequately, although the Short Blessed was the least significant of the variables with an associated p-value of 0.48 (odds ratio= 1.10, 95% confidence interval= 1.01-1.19 for association of cognitive test with recent prior crash involvement). The researchers stated that the Short Blessed test was less sensitive to reduced cognitive function than the two Trails tests employed in this research, even though it is supposed to be relatively sensitive to milder levels of impairment. The short answer format may make it less appropriate for driver's license settings, compared to the more performance-based Trail Making and AARP Reaction Time Tests.

References:

- Hunt, Morris, Edwards, and Wilson (1993)
- Katzman, Brown, Fuld, Peck, Schechter, and Schimmel (1983)
- *Stutts, Stewart, and Martell (1996, 1997)*

Cognitive Assessment Screening Test (CAST)

Summary:

The CAST is a paper-and-pencil self-administered cognitive test, designed for use in general physicians' offices to screen geriatric patients for dementia (Drachman and Swearer, 1995). CAST was designed to require little (or no) examiner time, little examiner training, and sensitivity and specificity that are comparable to the best existing screening tests. Elderly patients with some high school education (a static representative of over 70 percent of the adult population) can complete the test in approximately 15 minutes without supervision in a physician's waiting room. The test is shown on the following 3 pages

The test has three one-page sections (Parts A, B, and C). Part A consists of 10 questions with 28 scored responses; Part B consists of 5 more-demanding questions, with 12 scored responses; and Part C has 13 self-report questions that assess the examinee's perception of a decline in memory and competence. The combined score of Parts A and B is used to determine whether performance falls within the normal range, or below the threshold for dementia. The subjective report of Part C identifies individuals who are concerned about age-related cognitive decline.

When tested in a "real world" population of elderly unscreened individuals followed in a medical geriatric clinic, a cut-off score of 36 had a sensitivity of 88 percent and a specificity of 100 percent. The test is viewed as an initial sort into 2 groups: elderly patients with probable dementia, and patients whose cognitive function is probably normal. The authors advise that patients who fall below the cut-off should be further evaluated with more extensive psychometric testing.

References:

• Drachman and Swearer (1995)

COGNITIVE ASSESSMENT SCREENING TEST (CAST)

Part A

1. Name____________________, ____________________
(Last) (First) (Initial)

Address____
(Street)

____________________, ____________________
(City, town) (State) (ZIP)

2. Today's Date:____________, ________ Telephone (___)____________
(Month) (Day) (Year)

3. Age:__________ Birthdate________________, ________
(Month) (Day) (Year)

4. Highest grade in school______________________________

5. What is the name of this place?__________________________

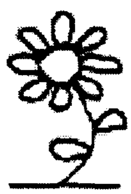
6. Who is the : President of the U.S.?______________________
Previous President?_________________________
Governor of your state?______________________

7. On what continent is Brazil?____________________________

8. Copy this sentence in your own writing:
This is a lovely day in the month of May.

→ ____

9. **Copy the figure:**



10. **Draw a Person:**

11. Describe the person you have drawn:________________________

____

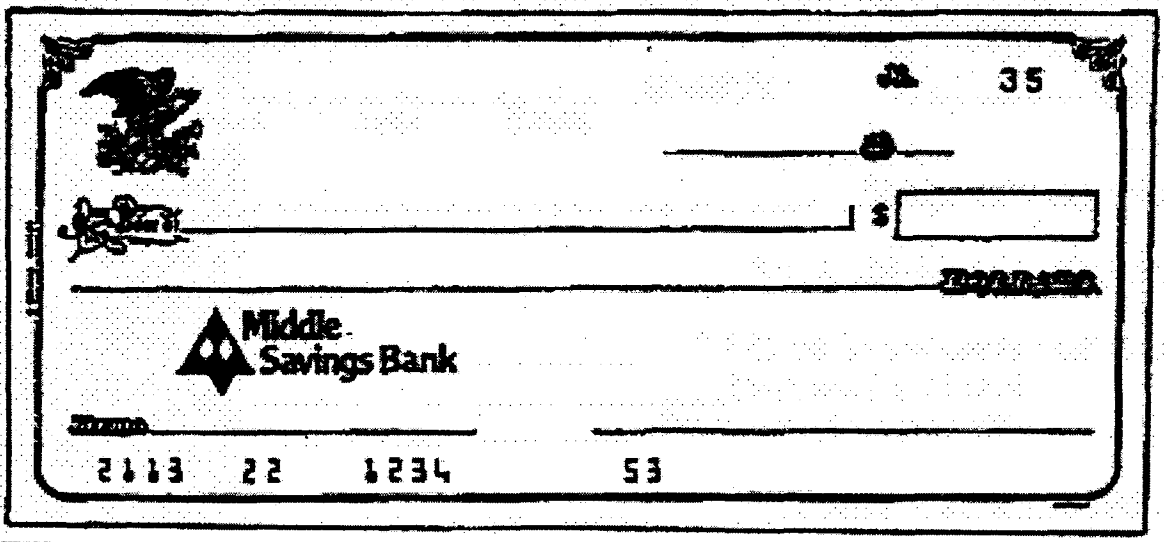
____

Part B

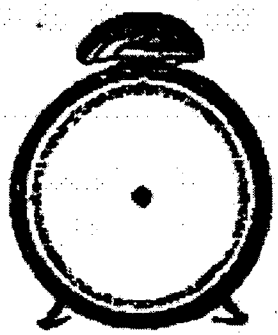
1- Add the following numbers:

$112.59
37.64
5.97
82.50

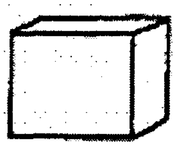
2- Fill out the following check to <u>American Telephone Co.</u> for <u>$137.68</u>:



3- Fill in the <u>numerals</u> on this clock, and set the <u>hands</u> to <u>1:45</u>:



4- Copy this figure-



5- The Vice President of the U.S. is: ______________________

The Senators of your state are: ______________________

____

Part C

1. Are you increasingly forgetting important things, that are interfering with your normal activities (eg, the day, date; recent conversations)-more than others your own age? Yes___ No___

2. Are you losing track of things that you used to know well, like family events, and news events or sports? Yes___ No___

3. Are you often unable to find even common words or familiar names, so that you find it difficult to have a normal conversation? Yes___ No___

4. Are you having trouble understanding what people say, or what they mean, though your hearing is good? Yes___ No___

5. Are you having trouble following the plots of books, TV shows or movies? Yes___ No___

6. Have you become lost or confused when driving or walking in a familiar place? Yes___ No___

7. Are you having increasing trouble carrying out everyday activities, such as paying bills, writing checks, cooking meals, doing simple repairs? Yes___ No___

8. Are you unable to keep up your hobbies or activities because they have become too confusing (card-games, Bingo, sewing, woodwork)? Yes___ No___

9. Are you becoming overwhelmed by simple tasks that you used to complete in a short time? Yes___ No___

10. Are others (spouse, children) taking over personal activities that you ordinarily would do (shopping, cleaning, banking, writing cards)? Yes___ No___

11. Have you lost interest in going places, doing things, seeing people that you previously enjoyed? Yes___ No___

12. Do you or others think that your personality, character or behavior have changed? Yes___ No___

13. If you have noted changes - have they been increasing over time? Yes___ No___

7 Minute Screening Test for Alzheimer's Disease

Summary:

The 7 Minute Screen is a simple paper-and-pencil test designed to assist health care professionals in the identification of patients who should be further evaluated for Alzheimer's Disease. The test was developed by Dr. Paul Solomon, Professor of Psychology at Williams College and Co-Director of the Memory Clinic at Southwestern Vermont Medical Center, and his colleagues to address the under diagnosis of Alzheimer's Disease that can occur in a brief office visit, particularly in the early-to-moderate stages of AD. The goal was to create a unique testing battery that could be rapidly administered by office personnel following a brief training session (about 1 hour), be scored objectively, and not be sensitive to education level. The screen is the first in a two-step process, where the second step would be a full diagnostic evaluation for those "flagged" by the screen.

This test was recently applied to 120 people, and was found to be 90 percent accurate in the identification of individuals with Alzheimer's Disease. It identified 13 of 13 people known to have early Alzheimers, in the study where examiners were blind to diagnosis (Solomon, Hirschoff, Kelly, Relin, Brush, DeVeaux, and Pendlebury, 1998).

The subjects were sixty successive referrals to the Memory Disorders Clinic at Southwestern Vermont Medical Center, Bennington, who were diagnosed as having probable AD (mean age = 77.6, range = 66-89) and 60 community-dwelling volunteers of comparable age (mean age = 77.5, range = 67-91), sex distribution, and education. The main outcome measure was comparison of the probability of dementia on the 7 Minute Screen with the criterion standard of clinical diagnosis established by examination and laboratory studies. The secondary outcome measures were test-retest and interrater reliability (correlation coefficients), and time for administration.

The mean time of administration was 7 minutes 42 seconds. Mean scores for patients with AD and control subjects on all four individual tests were significantly different (for each, $P<.001$). When the four tests were combined in a logistic regression, the battery had a sensitivity of 100 percent and a specificity of 100 percent. A series of 1,000 repeated random samples of 30 patients with AD and 30 control subjects taken from the overall sample of 60 patients with AD and 60 control subjects had a mean sensitivity of 92 percent and a mean specificity of 96 percent. The battery was equally sensitive to patients with mild AD, as demonstrated by correctly classifying all 13 patients with AD using Mini-Mental State Examination scores of 24 or higher. Neither age nor education was a statistically significant factor when added as a covariate. Test-retest reliabilities for individual tests ranged from 0.83 to 0.93. Test-retest reliability for the entire battery was 0.91. Interrater reliability for the entire battery was 0.92.

Several large scale studies (up to 2,000 patients) are underway in primary care practices across the U.S. Information obtained from Janssen Pharmaceutica Research Foundation (the screening kit distributor) states that some primary care physicians have incorporated the 7 Minute Screen as a part of their annual physical for patients over the age of 65.

The test includes 4 quizzes that probe a patient's ability to recall words and images seen moments before, along with finding a solution to a simple clock problem. Reminder words are provided if needed. According to Dr. Solomon, few people can recall all of the categories, but a normal person will benefit from the reminder words. A person with Alzheimer's Disease will not find the reminder words helpful (The Morning Call, March 13, 1998).

The test battery:

Step 1. Patient is asked to state the correct year, month, date, day of week, and time. Perfect score is zero; maximum score is 113. Points are added for errors (e.g., 5 points are added for each month off, 1 point for each date off, 10 points for each year off, 1 point for each day off, 1 point for each 30 minutes off).

Step 2. Pictures of objects in 1 of 16 categories are presented to the patient, 4 at a time. The patient must respond with the name of the object when the examiner supplies the category. For example, the examiner says, "There is a piece of fruit on this page. What is it?" The patient would look at the page, and reply "Grapes." After the patient names each of the four objects, the examiner removes the four pictures and asks the patient to respond with the name of each of the four objects when the examiner supplies the category name. If the patient recalls all four items correctly, the examiner moves on to the next four items. If the patient makes a mistake on one or more items, the page of four items is shown again, with the cued recall and then the delayed recall. After all 16 items are displayed and recalled the examiner asks the patient to recite the months in reverse order, but the task is not scored. Then, the patient is asked to recall as many of the objects as possible. Reminder words such as "article of clothing" for the "shoe" object are provided by the examiner. Perfect score is 16.

Step 3. Patient is asked to draw a clock face, with numbers and to place the clock hands to read 20 minutes to 4:00. A point is given for correct numbers, their position, and for placement and length of clock hands. Perfect score is 7.

Step 4. Patient is asked to name, within 60 seconds, as many objects as possible within a single category, such as "vegetables." Scoring is one point for each correct response. Most people easily name 12 or more objects. The maximum score is 45 (for calculation purposes).

The screening kit contains a scoring calculator; the examiner enters the score for each test. The calculator performs a complex logarithmic process, and provides immediate output to assess a patient as normal or at low or high probability of Alzheimer's Disease.

The 7 Minute Screen Kit consists of a training video, testing materials, a scoring calculator, and score sheets (for recording performance for placement in a patient's record). Also included is a sheet that lists recommended laboratory and radiologic studies if a patient tests positive and a reprint of the *Archives of Neurology* article (Solomon, Hirschoff, Kelly, Relin, Brush, DeVeaux, and Pendlebury, 1998) that describes the validation of the Screen. The Screening kit is free of charge and is available to qualified health-care professionals. Distribution of the materials needed to administer and score the 7 Minute Screen is supported by Janssen Pharmaceutica Research Foundation. Two website addresses are provided with the materials: www.7minutescreen.com and http://phin.org.

References:

- Newspaper article: Alzheimer's Screening Test Developed, The Morning Call, March 13, 1998
- Solomon, Hirschoff, Kelly, Relin, Brush, DeVeaux, and Pendlebury (1998).
- 7 Minute Screening Kit
- Janssen Pharmaceutica Research Foundation, Janssen at Washington Crossing, 1125 Trenton-Harbourton Road, P.O. Box 200, Titusville, NJ 08560-0200.

Automated Psychophysical Test (APT)

Summary:

This program is in the public domain and is available without cost from: A. James McKnight and A. Scott McKnight, National Public Services Research Institute, 8201 Corporate Drive, Suite 220, Landover, MD 20785, (301) 731-9891 ext.101. It requires a 486 or better IBM-PC platform.

The APT is a computerized test of 22 visual, attentional, perceptual, cognitive and psychomotor abilities:

Sensory
- Static Visual Acuity: to differentiate stimuli in high contrast images
- Low Contrast Acuity: to differentiate stimuli in low contrast images
- Dynamic Visual Acuity: to differentiate stimuli in moving images

Attentional
- Range of Attention: to respond to presentation of parafoveal images (similar to "Useful Field of View")
- Simple response: single response to the presence of images
- Choice response: alternative responses to the form of images
    - Simple image
    - Complex image
- Selective Attention: to shift attention from one characteristic of an image to another
- Divided Attention: to share attention between images presented simultaneously

Perceptual
- Perceptual Speed: to identify quickly a target image within an image field
- Motion Detection: to detect direction of motion near the motion threshold
- Field Dependence: to discern a figure within cluttered background ("embedded figures")

Cognitive
- Information Processing: to perform mental operations with information
    - Digit matching: to identify number series matching target series
    - Figure matching: to identify figure matching target figure
    - Missing pattern: to identify the pattern missing from an otherwise complete series
- Short Term Memory: to recall information immediately after presentation
    - Digit matching: to identify number series matching previous target series
    - Figure matching: to identify figure matching previous target figure
- Delayed Short Term Memory: to recall information after intervening tasks
    - Digit matching: to identify number series matching previous target series after performing intervening tasks

Psychomotor
- Simple Reaction Time: to respond quickly to appearance of a stimulus
    - Abstract image: to respond to appearance of a square
    - Meaningful image: to respond to appearance of brake lights
- Choice Reaction Time: to respond quickly to the nature of a stimulus
    - Abstract image: to respond directionally to the direction of arrows
    - Meaningful image: to respond directionally to the pattern of brake lights
- Visual Tracking: to track a laterally moving image in order to stop it at a designated point

Design features intended to facilitate its use by the elderly include the use of *sound* to give instructions, thereby permitting subjects to respond to visual stimuli as instructions are given rather than presenting instructions and test stimuli in sequence; use of a *joy stick* response system in which all responses correspond to directions on the screen, eliminating the need to learn response codes and minimizing response errors; and a *sequencing system* that allows subjects to repeat instructions as desired, as well as automatically repeating them after obvious errors or long delays. Familiarity with computers is not a factor in performance, as asymptotes are reached in a few trials of any exercise. To test the full range of abilities listed requires 30 to 60 minutes.

The individual exercises making up each APT measure are scored in terms of time and error. The *time* score on any exercise is the mean time on the individual exercises where the responses are correct. No times are recorded for incorrect responses. Those failing to respond within the time limit are assigned a score equal to the longest time of those correctly completing the exercise in order to prevent time scores from being unduly influenced by long latencies. For most exercises, *error* is a dichotomous measure to be scored correct or incorrect, and score on the measure is the proportion of responses that were incorrect. Two exceptions are visual acuity, where the correctness measure is the level of acuity and the visual tracking where it is the distance error averaged across exercises. Since visual tracking is also a component of the attention-sharing measure, results for that measure include both incorrect responses and distance error.

The APT was used in a study of 360 drivers age 62 and older who were currently licensed and driving (McKnight and McKnight, 1998). The subjects were divided into 2 groups:

"Incident-Involved." 249 drivers referred to licensing agencies for reexam by police, family, courts, physicians, and licensing personnel. The mean age was 80.6 years. Sixty percent of the group was male. Subjects with physical problems such as stroke, severe arthritis, or loss of consciousness were excluded.

"Incident-Free."111 drivers not previously referred for reexamination, obtained by solicitations through senior citizens groups. The mean age was 75.2 years. Sixty percent of the group was male.

The dependent variable was the presence or absence of a deficiency in driving performance, operationalized as observed incidents of deficient driving resulting in referrals to State licensing authority for reexamination. The correlations between unsafe driving incidents and performance on the APT is shown below. All correlations are positive, meaning that time and error were positively related to driving performance deficiency. All correlations given are significant at the .05 level while those in excess of .23 are significant at the .01 level (2-tail in both cases).

Correlation of Ability Measures with Unsafe Driving Incidents

Ability	Time	Error
Sensory		
Static Visual Acuity	.28	.18
Low Contrast Acuity	.21	.17
Dynamic Visual Acuity	.19	.19

Ability	Time	Error
Attentional		
Range of Attention		
Simple response	.20	
Choice response		
Simple image	.30	.28
Complex image	.33	.23
Selective Attention	.29	.33
Divided Attention	.15	.33/.36[d]
Perceptual		
Perceptual Speed	.28	.22
Motion Detection	.24	.35
Field dependence	.12	.23
Cognitive		
Information Processing		
Digit matching	.17	.40
Figure matching	.21	.30
Missing pattern	NS	.38
Short Term Memory		
Digit matching	.31	.28
Figure matching	NS	.20
Delayed Short Term Memory		
Digit matching	.28	.32
Psychomotor		
Simple Reaction Time		
Abstract image	.24	
Meaningful image	.30	
Choice Reaction Time		
Abstract image	.33	.23
Meaningful image	.30	.37
Visual Tracking		.31[d]

[d] = distance measure

Scores were aggregated across measures to obtain a measure of overall ability to compare with driving performance. In doing so, scores for all measures, both time and error, were standardized so that all would be equally weighted. With the composite measure, it was possible to establish a "passing" score such that 80 percent of the incident-involved drivers fell below it and 80 percent of the incident-free drivers exceeded it. A less demanding passing score found one-third of the incident-involved drivers failing but none of the incident-free drivers.

The authors describe two forms of implementation for the screening process. First, in its full form it could be administered to all individuals whose driving performance or general behavior give due cause to suspect age-related declines in ability that could pose a threat to themselves and the motoring public. In addition to the license referral process involved in the present study, the test might be administered by physicians, occupational therapists, and others working with elderly populations. Based upon the data that have been, and are still being gathered, it will be possible to reduce the number of exercises that must be administered to obtain acceptably reliable measures of the various abilities making up the test, allowing it to be completed in between 20 and 40 minutes, depending upon the ability of the individual.

The second form of administration might be as part of the regular license renewal process. Its integration into license renewal would permit detection of many deficient drivers who are not identified through the reexamination referral process or through private medical specialists without requiring special, age-based license testing. To be practical, the current APT would need to be modified to reduce testing time (~5 minutes in length) for the bulk of drivers. This could be accomplished through development of an adaptive testing method by which the great majority of license renewals, having no serious deficiencies, could be quickly identified and screened out of further testing. More complete testing would be confined to those with an elevated probability of serious deficiency.

References:

- McKnight and McKnight (1998)

Cognitive Behavioral Driver's Inventory (CBDI)

Summary:

The CBDI is a test battery that includes computerized and standardized psychometric tests (Engum, Pendergrass, Cron, Lambert, and Hulse, 1988). The standardized, nonautomated tests include the following: WAIS-R Picture Completion Test; WAIS-R Digit Symbol Test; and Trail-Making Test Parts A and B.

The computerized items are presented on an Atari 800 computer. *Test software is adapted from* Bracy's (1982, 1985) Cognitive Rehabilitation Programs (BCRP) for brain-injured and stroke patients, marketed through Psychological Software Service, Inc. (PSS). Computerized tests include:

- Visual Reaction Differential Response - The computer screen is bisected by a vertical line; a small dark square appears in random locations with random inter-trial interval. A subject pushes the joystick toward the side of the screen on which the square appears. Dependent variables are response time, variance, errors, and latencies in each visual quadrant. This test measures attention, concentration, reaction time.
- Visual Reaction Differential Response Reversed - Same as above, but a subject must push the joystick in the opposite direction. Measures attention, concentration, reaction time, dynamic cognitive processing, simple decision making. A radio, placed in a backroom provides auditory distractors.
- Visual Discrimination Differential Response II - Three squares are presented on the screen. The subject fixates on the center square and moves the joystick toward the square that turns the same color as the center square. Measures rapid decision-making and stimulus discrimination/response differentiation.
- Visual Scanning III - Two columns of alpha characters are shown, one on each side of the screen. Starting in the left column, a character group is highlighted, and the subject must find the matching character group in the right column and move the cursor to it. This procedure repeats for 20 trials using alternative sides for the initial stimulus. Measures ability to shift attention from one stimulus set to another and back.

Vision is also measured in the research using the Keystone Driver Vision Tester (far visual acuity, color vision) and the Keystone Perimeter Field of Vision (measures up to 90 degrees on each side of fixation point).

The 10 tasks yield 27 response measures. A score termed "General Driving Index" (or "GDI27") was defined as the mean standard score of all 27 items.

A road test is given to assess basic vehicle control operations, attitudinal variables (subjectively evaluated), reactions under pressure or stress, and cognitive variables such as ability to follow directions, safety awareness, ability to find one's way around a designated circuit, and problem solving.

The CBDI was employed in a study of 92 brain- or spinal-cord injured patients from the Center for Outpatient Rehabilitation in Knoxville, TN: 61 percent had suffered a stroke, 21 percent had suffered traumatic brain injury, and 6 percent had suffered spinal cord injury (Engum, Pendergrass, Cron, Lambert, and Hulse, 1988). The internal consistency reliability of the CBDI was 0.95 (Cronbach's alpha). The correlation between performance on the CBDI (GDI27) and road test performance was significant (χ^2=86, Cramer's V=0.97, $p<.0001$). Of the 44 patients who passed the CBDI, 42 passed the road test (95.5%). Of the 48 patients who failed the CBDI, only 6 were allowed to take the road test. All 6 patients "convincingly" failed the road test.

In another study of 121 brain-injured patients (cerebral vascular accident and traumatic head injury victims) at Fort Sanders Regional Medical Center in Knoxville, TN, two scores were calculated for each patient: (1) the overall General Driver's Index (GDI27) defined as the mean standard score of all 27 variables; and (2) the short form Abbreviated Driver's Index (ADI10), defined as the mean standard score of those 10 items with the highest corrected part-whole correlations. The 10 best items with corrected part-whole correlations (which measure how closely a given item correlates with all other items excluding itself) were:

- Trails B Time
- WAIS Digit Symbol (N correct)
- Visual Reaction Differential Response: joy stick to square (ave. time, Q1 time, and Q3 time)
- Visual Reaction Differential Response Reverse: joy stick away (ave time, Q1 time, Q3 time, and Q4 time)
- Left Visual Scanning III (time)

Both the GDI27 and ADI10 have a mean of 50 and a standard deviation of 10, with scores above 50 indicating greater levels of disability (Engum, Lambert, Womac, and Pendergrass, 1988). Patients were given the CBDI and then an on-road driving test. Results are as follows. The short form ADI10 scores and long form GDI27 scores were very closely related [r(GDI27, ADI10)=0.97 ($p<.001$)]. Above average scores on the CBDI (>50 indicates more deficit) were more likely to occur in patients who failed the road test, while below average scores (< 50 indicates less deficit) were more likely to occur in patients who passed the road test. Sixty-three of 121 patients passed the on-road exam. Patients who passed had average GDI27 and ADI10 standard scores of 45. Patients who failed the on-road exam had average standard scores of 55.

An indeterminate region with standard scores ranging from 47-52 has an overlap of passing and failing distributions. A patient with a standard score in this "zone of uncertainty" is almost equally likely to have passed or failed in the examiner's opinion. Patients who obtained a standard GDI27 score of 47 or below passed the on-road test 100 percent of the time. Patients who obtained a standard GDI27 score of 53 or above failed the on-road test 100 percent of the time. The following decision-making criteria are suggested: standard scores of 46 or less are clearly passing; standard scores of 47-52 are borderline; and standard scores of 53 or greater are clearly failing. Borderline test scores on the CBDI are not definitive and an examiner should judge these cases with information independent of the CBDI, such as a road test, behavioral observations, or other neuropsychological tests.

In a double-blind validation study using 175 brain-injured patients (Engum, Lambert, Scott, Pendergrass, and Womac, 1989), the relationship between CBDI performance (pass, borderline, fail) and the on-road evaluation outcome (pass, fail) was significant ($r=0.81$, $p<.0001$). Of the 42 patients who received a favorable "pass" decision based on CBDI performance, 40 passed the on-road exam. Only 7 of the 39 patients who received an unfavorable "fail" rating on the CBDI passed the on-road test. Patients who passed the road test passed significantly more CBDI items (mean = 17.1) than those who failed the road test (mean = 6.3). Patients who failed the road test failed significantly more CBDI items (mean = 11.7) than those who passed the road test (mean = 1.7). Patients who passed the road test produced much less scatter or within-subject variability (mean = 16.76) in their responses than those who failed the road test (mean = 82.33).

The researchers conducted another study to determine whether the CBDI would discriminate between 3 discrete groups: (1) those brain-injured persons whose residual cognitive impairments preclude them from driving; (2) those brain-injured individuals who have recovered sufficient cognitive function that they should be allowed to resume driving; and (3) normal control subjects without brain damage (Engum and Lambert, 1990). Subjects underwent examination on the CBDI and were then are assessed on the road. The 215 rehabilitation patients had a mean age of 47.8 years; the 41 control subjects had a mean age of 31.15 years. Five summary scores were calculated from the CBDI:
(1) GDI27 - the average of the patient's 27 CBDI item scores; (2) within subject variance; (3) number of items passed; (4) number of items borderline; and (5) number of items failed. All 5 summary scores, plus 25 of the 27 item scores significantly discriminated the 215 brain-injured patients from the 41 normal controls ($p<.05$). The 109 patients who passed the road test performed significantly better on all 27 items of the CBDI, and 4 of the 5 summary scores than the 54 patients who failed the road test ($p<.01$). The sole exception was for the number of borderline items, which was unrelated to road test performance. After removing the confounding effects of age, 20 of 27 item scores and 4 of 5 summary scores continued to differentiate patients from controls. Five of the seven that failed to differentiate pertained to number of errors (various Visual Reaction and Scanning tests). Average GDI27 performance for controls (42.09) was superior to that of patients passing road test (45.75), which was, in turn, superior to patients who failed road test (54.23).

References:

- Engum, Pendergrass, Cron, Lambert, and Hulse (1988)
- Engum, Lambert, Womac, and Pendergrass (1988)
- Engum, Lambert, Scott, Pendergrass, and Womac (1989)
- Engum, Lambert, and Scott (1990)

DrivAble Testing

Summary:

The (cognitive) competence screen is presented on a touch screen computer, and takes 20-30 minutes to administer (DrivAble Testing, Ltd., 1997). Tasks require multiple mental abilities and integration and shifting among these abilities. Tests include:

- a selective attention task;
- an assessment of judgment/decision making using a Gap Task (designed by research team);
- visual attention, using a version of UFOV (Ball et al., 1994);
- a spatial working memory task;
- a simple and choice reaction time test; and
- Weaver's Driving Video (selected and revised driving scenarios).

Two competence scores are generated: The high cut-off score identifies the performance level necessary to accurately predict that the driver would pass the road test; the low cut-off score identifies the performance level below which accurate predictions of failing road-test performance can be achieved. The road test would only need to be administered to those who score in the mid range on the competence screen (and, depending on the jurisdiction, for those who fail the competence screen but want a road test as due process).

A road test was administered by 2 experienced driving instructors from the Canadian Automobile Association. Testing was conducted in a mid-sized American car equipped with dual brakes. Definition and scoring of errors was as follows:

- Hazardous or potentially catastrophic driving errors: errors committed by drivers who are no longer competent to drive (e.g., wrong-way on a freeway, stop at green light), and would result in a crash if examiner did not intervene or traffic did not adjust.
- Discriminating driving errors: potentially dangerous errors that signal declining driving skill (e.g., poor positioning on turns and straight aways, observational errors).
- Non-discriminating driving errors: errors made equally often by good and bad drivers, reflecting bad habits as opposed to declining ability (e.g., rolled stops and speed errors). Drivers are not penalized for non-discriminating errors. Discriminating errors are documented and scored in terms of their severity (5, 10, or 51 points). Hazardous errors were renamed as Criterion errors and the commission results in an automatic fail. A combined criterion of one or more criterion errors and/or discriminating point total exceeding criterion, results in a failure on the road test.

In the test development research 279 drivers were assessed across three groups: 176 patients who were referred to a clinic with suspected decline in mental abilities (the majority were diagnosed with Alzheimer's) with a mean age of 72 years; 70 mature healthy drivers who volunteered for the research, with a mean age of 69 years; and 33 young healthy controls who also volunteered, ranging in age from 30 to 40 years, with a mean age of 36 years. Subjects in the development research were used to develop road test procedures and scoring. The majority of the drivers who failed the road test received low scores (poor performance) on the cognitive screen; the majority of the drivers who passed the road test received high scores (good performance) on the cognitive screen.

Validation research included 431 drivers. The cut-off scores identified in the original research for the competence screen were 94 percent accurate in predicting actual pass/fail performance on the road test. Only 33 percent of those tested had Competence Screen scores falling below the high and low cut-off scores. Analysis of the road test errors revealed the same categories of errors and verified the effectiveness of the road test for revealing the errors among unsafe drivers. Using the joint criterion, all of the young normal drivers passed the road test, approximately 95 percent of the mature control group drivers passed the road test, and only 25 percent of the cognitively impaired (patient) group passed the road test.

The Competency Screen resulted in a 5 percent error in predicted road test performance: it predicted a pass for 29 of the 33 drivers who passed the road test, and predicted a fail for 33 of the 34 drivers who failed the drive test. The screen reduced the number of drivers who needed to be tested by 67 percent. Only 33 percent of the drivers in the sample received an indeterminate score on the competence screen: 54 percent of the indeterminate drivers passed the road test and 45 percent failed the road test.

References:

• DrivAble Testing Ltd (1997)., Suite 200, 18208 102 Avenue, Edmonton, Alberta, Canada, T5S 1S7. Phone: (403) 413-1909; fax: (403) 413-8916
• Dobbs (1997)

The Neurocognitive Driving Test (NDT)

Summary:

The NDT is a new computerized task designed to provide an ecologically valid measure of driving ability based on Michon's Hierarchical Model of Driving Behavior. It has recently been administered at Moss Rehab Driving School, a branch of the Moss Rehab Hospital Philadelphia, Pennsylvania (Schultheis and Chute, 1998). The NDT is divided into five sections as follows, with a total performance score calculated using variables from each section:

I. Self Evaluation: Includes 5 questions involving self-rating of driving skills.

II. Pre-Driving Questions: Includes 12 multiple choice and open-ended questions, with both linguistic and graphic stimuli designed to target an individual's ability to correctly identify important information needed prior to engaging in driving (i.e., check gas in car, have correct paperwork).

III. Reaction Time Task: Includes a total of 24 counter-balanced trials, 12 measuring simple reaction time (6 left-foot trials and 6 right-foot trials) and 12 measuring choice reaction time.

IV. Driving Scenario Task: Includes the presentation of 4 driving scenarios, which the subject "drives" through with the use of an attached steering wheel and foot pedals. They include: (1) Following Signs; (2) Emergency Situation; (3) Following Verbal Directions; and (4) Following Written Directions.

V. Visual Task: Includes a visual task, designed to assess an individual's left and right visual fields for gross field cuts or visual inattention. The subject is asked to stare at a small black box in the center of a blank screen. When the task begins, a small dot flashes at various locations on the computer screen. If the subject sees the dot, he/she is required to respond by stepping on the right (green) foot pedal.

All participants were between 18 and 60 years of age, with a minimum of one year of driving experience and no prior medical or psychiatric history. The subjects included 15 brain-injured (BI) adults and 26 healthy adults. The BI adults were 10 men and 5 women with a mean age of 38.6 years (range= 21-59 years) and mean education level of 14.3 years. Their mean number of years of driving experience prior to their injury was 21.0, and at the time of testing only four individuals had not returned to driving. The 26 healthy adults included 18 males and 8 females, with a mean age of 27.7 years (range= 18-45 years) and a mean education level of 14.5 years. All subjects had a valid driver's licenses at the time of testing. The mean number of years of driving was 10.7.

All brain-injured subjects were administered both a hospital-based driving evaluation and the NDT. The hospital-based evaluation included performance of various off-road and behind-the-wheel evaluations. Subjects were then separately rank ordered based on their overall performance rating in the hospital evaluation and on their NDT Total Performance score. A comparison of the rank ordering was conducted using a Spearman Rank Order Correlation. Healthy subjects received only the NDT. Mean and standard deviation of healthy-subject performance was calculated for comparison with performance by BI subjects.

A positive correlation ($p = 0.743$), was found between the rank order generated by the hospital-based evaluation and the rank order generated by the NDT for BI subjects. Of the 15 BI subjects, the NDT accurately predicted 10/11 subjects who passed the hospital-based evaluation and

placed the four individuals who failed the hospital evaluation at the lower end of the rank order. The subject ranked lowest by the NDT was the lowest ranked passing subject by the hospital evaluation.

A comparison of NDT total performance between BI and healthy subjects was calculated by a simple factorial ANOVA covarying for age, and revealed a significant difference between BI subjects who passed the hospital evaluation and normal subjects ($p = .034$). Additionally, it was observed that BI subjects who failed the hospital evaluation exhibited poorer NDT performance then both normal subjects and BI subjects who had passed.

This first concurrent validity study involved 15 BI subjects, who were administered the NDT and a comprehensive hospital-based evaluation. The results demonstrate a significant correlation between the rank order of driving ability generated by the hospital driving evaluation and the rank order of driving ability generated by the NDT Total score. This comparison demonstrates the ability of the NDT to determine the rank order of driving ability, as determined by a presently accepted measure of driving ability (e.g. hospital-based evaluation). The correlation of the two rank orders suggests that both programs are targeting similar skills, which at present serve as the criterion to whether an individual is able to return to driving after a brain injury.

References:

• Schultheis and Chute (1998).

IC2(b)iii. Ophthalmological/Optometric Examination

Definitions

An *optometrist* is a health care professional trained and state licensed to provide primary eye care services. These services include comprehensive eye health and vision exams; diagnosis and treatment of eye diseases and vision disorders; the detection of general health problems; the prescribing of glasses, contact lenses, low vision rehabilitation, vision therapy, and medications; and the counseling of patients regarding their surgical alternatives and vision needs as related to their occupations, avocations, and lifestyle. Doctors of optometry provide 70 percent of primary eye and vision care services in this country and far outnumber any other eye care practitioners (American Optometric Association, 1996)

The optometrist has completed pre-professional undergraduate education in a college of optometry, leading to a doctor of optometry (O.D.) degree. Some optometrists complete a residency. All States require at least 15 hours of continuing education each year for license renewal. All 50 States and DC have legislation authorizing doctors of optometry who have satisfactorily completed specific education courses and examinations to use pharmaceutical agents in the evaluation and diagnosis of conditions of the eye and visual system. Also, all 50 States have legislation authorizing doctors of optometry to use drugs to treat certain eye conditions. Doctors of optometry work closely with other professionals by consulting with family practitioners, pediatricians, neurologists, ophthalmologists, dermatologists, and others when treatment is required outside the scope of their practices. This consultation process is two-way, and as the health care delivery system continues to change, this interprofessional consultation and concurrent care will become more important.

An *ophthalmologist* is a medical doctor (MD or osteopath) who is educated, trained, and licensed to provide total care of the eyes (medical, surgical, and optical), including: performing comprehensive medical eye examinations; prescribing corrective lenses; diagnosing diseases and disorders of the eye; and using the appropriate medical and surgical procedures necessary for their treatment. Retinal specialists are ophthalmologists with extra training and experience in treating disease affecting the retina such as diabetic retinopathy.

Vision Examinations: Content and Frequency

Because primary care physicians provide only a vision screening (distance acuity, questions on seeing difficulties, and a check with an ophthalmoscope), people are advised by the AOA to get a thorough eye exam every year or two from an optometrist that will include:

- A review of family and personal health history, including any problems the individual is having with vision;
- Tests to determine how well the individual can see at near and far distances;
- Tests to determine nearsightedness, farsightedness and astigmatism (a refraction) and if there is a problem, a lens prescription to correct for it;
- A check of eye coordination and eye muscle function;
- Tests of ability to change focus easily from near to far and vice versa and to maintain clear focus for reading and other close work;
- An eye health examination, involving a number of tests (in some cases, the eyes may be dilated for this part of the exam).

AOA recommends that people ages 10 to 40 see an optometrist every 2 to 3 years; people ages 41 to 60 every two years; and people age 61 and older every year (AOA, 1996). Individuals age 61 and older have an increasing risk for the development of cataracts, glaucoma, and macular degeneration and other sight threatening or visually disabling eye conditions as well as systematic health conditions. Additionally, people age 65 and older who are diagnosed with diabetes or hypertension; those who have a family history of glaucoma or cataracts; and those taking prescription or nonprescription drugs with ocular side effects should follow their optometrist's advise on how often they need professional care.

Eye Diseases

Diabetic Retinopathy. Diabetic retinopathy is a complication of diabetes mellitus, caused by the deterioration of the blood vessels nourishing the retina (American Academy of Ophthalmology, 1984). These weakened blood vessels may leak fluid or blood, develop fragile brush-like branches, and become enlarged in certain places. The risk of developing diabetic retinopathy is high for patients who have had diabetes for a long time. Approximately 60 percent of patients having diabetes for 15 years or more have some blood vessel damage in their eyes. Diabetic eye disease remains the leading cause of blindness in the U.S. for adults between the ages of 20 and 74 years. Pregnancy, high blood pressure, poor control of diabetes, ethnic influences, and smoking may worsen this condition in diabetic patients.

Though gradual blurring of vision may occur, sight is usually unaffected by background retinopathy (early stage that does not progress in 80 percent of diabetic patients), and changes in the eye can go unnoticed unless detected by a medical eye condition. When bleeding occurs in proliferative retinopathy, the patient has hazy or complete loss of sight. Though there is no symptom or pain, this severe form of diabetic retinopathy requires *immediate medical attention.*

To detect diabetic retinopathy, an ophthalmologist painlessly examines the interior of the eye using an instrument called an ophthalmoscope. The interior of the eye may also be photographed to provide further information. If diabetic retinopathy is noted, a second method of examination may be used to see which blood vessels are bleeding or leaking fluid. A fluorescent dye is injected into the patient's arm. It travels through the bloodstream and passes into the blood vessels of the retina. Photographs are taken rapidly of the dye as it leaks through the retina's blood vessels. This treatment is called fluorescein angiography.

The most significant treatment is the use of ophthalmologic laser surgery to seal or photocoagulate the leaking blood vessels. This treatment does not require an incision and may be performed in an ophthalmologist's office. If diabetic retinopathy is detected early, photocoagulation by ophthalmologic laser surgery may stop continued damage. Even in advanced stages of the disease, it can reduce the chance that a patient will have severe loss. However, photocoagulation cannot be used in all patients. Depending on the location and extent of diabetic retinopathy, and if the vitreous is too clouded with blood, a surgical treatment called vitrectomy can be performed. The blood-filled vitreous is removed from the eye and replaced with a clear artificial solution. About 70 percent of vitrectomy patients notice an improvement in sight. Successful treatment depends on early detection with monitoring and treatment by an ophthalmologist, in addition to the patient following diet and medication recommendations. Although physical activity presents few problems with background retinopathy, it can increase bleeding in proliferative retinopathy. Exercise for patients with proliferative retinopathy should be moderate, and straining or leaning over with the head down should be avoided.

Macular Degeneration. The retina is the delicate layer of tissue that lines the inside wall of the back of the eye. The macula is a very small area in the center of the retina. If the macula is damaged, the central part of the images are blocked/blurred. The images around the blurred area may be clearly visible. Macular degeneration does not result in total blindness, but it makes reading or close work difficult to impossible without special low vision optical aids. Although macular degeneration most often occurs in older people, aging alone does not always result in central visual loss. The most common form of macular degeneration is called involutional macular degeneration; this form accounts for 70 percent of all cases and is associated with aging (American Academy of Ophthalmology, 1984).

Many patients do not realize they have a macular problem until blurred vision becomes obvious. An ophthalmologist can detect macular degeneration in the early stages by viewing it with an ophthalmoscope, if periodic eye exams are part of the patient's health care. The examination will also include a grid test in which the patient looks at a test page similar to graph paper; this checks for the extent of sight loss spots. A color vision test may be employed, as color vision dimming is also a symptom of macular degeneration. A fluorescein angiogram may also be done, as described earlier.

There is no cure for the most common involutional form of macular degeneration. Low vision optical aids help improve vision. Many types of magnifying devices are available: spectacles, hand or stand magnifiers, telescopes, and closed circuit television for viewing objects are some of the available sources. Aids are either prescribed by an ophthalmologist or by referral to a low vision specialist or center. People over age 50 and people with a family history of retinal problems should have periodic eye exams that check for macular degeneration.

Glaucoma. Glaucoma is one of the leading causes of blindness in the U.S., affecting 2 out of every 100 persons over age 35 (American Academy of Ophthalmology, 1983). When diagnosed early, blindness from glaucoma is almost preventable. Glaucoma occurs when the drainage system of the eye gets blocked and fluid pressure within the inner eye increases, causing damage to the optic nerve. Most adult glaucoma patients have "chronic open-angle glaucoma" which is a partial blockage that causes a gradual increase of pressure within the eye. According to the American Academy of Ophthalmology (1983) it is seldomly accompanied by symptoms, "stealing vision so quietly that the patient is unaware of trouble until the optic nerve is badly damaged." Factors increasing the risk of damage include a family history of glaucoma, and general health problems such as diabetes, arteriosclerosis, or anemia.

Early diagnosis can be made in the course of a periodic eye examination, by an ophthalmologist who determines the pressure of the eye during a painless procedure. The fields of vision will be tested for shrinkage or blind spots, and an ophthalmoscope will be used to examine the optic nerve.

Glaucoma is usually controlled by eye drops given 2 to 4 times per day or by pills in various combinations, to decrease pressure either by assisting outflow of fluid from the eye or by decreasing the amount of fluid entering the eye. If medications are poorly tolerated or ineffective in controlling pressure in open-angle glaucoma, surgery can be performed to form a new drainage canal in the eye.

The American Academy of Ophthalmology recommends that persons over age 35 be checked for glaucoma every 2 or 3 years.

Cataract. A cataract is a clouding of the normally clear and transparent lens of the eye, that usually develops gradually over many years (American Academy of Ophthalmology, 1984). It may cover only a small part of the lens; if sight is not greatly impaired, there may be no need to remove the cataract. Alternatively, if a large portion of the lens becomes cloudy, sight can be partially or completely lost until the cataract is removed. Depending on the size and location of the cloudy area in a lens, a person may or may not be aware that a cataract is developing. As cataracts develop, there may be hazy, fuzzy, and blurred vision. Double vision may also occur when a cataract is beginning to form. The eyes may be more sensitive to light and glare making night driving difficult.

Most cataracts are caused by a change in the chemical composition of the lens, resulting in a loss of transparency. These changes can be caused by aging, injuries to the eye, certain diseases and conditions of the eye and body, and heredity or birth defects. The normal process of aging may cause the lens to harden and turn cloudy. These are called senile cataracts and are the most common type, occurring as early as age 40. The American Academy of Ophthalmology recommends that persons over age 40 with a family history of cataracts have their eyes checked periodically to detect signs of eye disorders, including cataracts.

A cataract usually cannot be detected by looking at the outside of the eye; proper instruments are required. Surgery is the only effective way to remove the cloudy lens. Once the cloudy natural lens of the eye is removed, the patient needs a substitute lens to focus the eye. These may include special cataract glasses, hard or soft contact lenses, or interocular lenses (IOLs) that are permanent lenses implanted inside the eye by surgery, in place of the natural lenses.

References:

- American Optometric Association (AOA): Definition of Doctor of Optometry
- AOA (1996): Vision Screening vs. Vision Examination
- American Academy of Ophthalmology (1984): Macular Degeneration
- American Academy of Ophthalmology (1984): Diabetic Retinopathy
- American Academy of Ophthalmology (1983): Glaucoma
- American Academy of Ophthalmology (1984): Cataract

Iowa Driving Simulator (IDS)

The IDS is a realistic ground-vehicle simulator that provides 190 degrees in the forward field of view and 65 degrees in the rear view. Multiple roadway types, traffic signals, traffic conditions, and vehicles can be displayed. These vehicles interact with the driver and each other according to a particular set of rules dictated by the experimental driving scenario. Acceleration speeds of up to 1.1g produce a majority of the movement cues experienced during normal driving. The steering wheel, accelerator, brake pedal, and gearshift positions are read by the host computer to give feedback to the driver and allow him/her to control the driving simulation.

This simulator was used in a study of 39 licensed drivers (21 with Alzheimer's Disease and 18 controls without dementia) to determine fitness to drive for neurological patients (Rizzo, Reinach, McGehee, and Dawson, 1997). The study had three goals: (1) to test the hypothesis that drivers with AD are more at risk for crashes than controls of similar ages without dementia; (2) to determine what specific driver safety errors preceded a crash; and (3) to determine how such unsafe events are predicted by visual and cognitive factors sensitive to decline in aging and AD. Each participant "drove" approximately 18 miles on a simulated 2-lane highway with interactive traffic. Four events associated with potential crashes were interspersed with uneventful highway segments. In event 1, the participant drove at 55 mph and encountered a slower moving tractor-trailer truck traveling uphill at 35 mph. In event 2, the participant suddenly encountered a lead vehicle stopped at a 4-way intersection waiting to turn left. In event 3, the participant drove at 55 mph and encountered a slower moving lead vehicle traveling at 35 mph along a flat segment of highway. The participant had to slow and travel at the leading vehicle's speed for 2 seconds before the lead vehicle increased its speed to 55 mph. In event 4, the participant encountered the same lead vehicle slowing down to turn left at a 4-way intersection. Driver performance errors were classified into 1 of 3 possible categories: unplanned lane deviations; dangerously close headways (less than 0.6 seconds); and abrupt braking. Near misses occurred when the driver had to take evasive action to avoid a collision.

Six participants (29%) with AD experienced simulator crashes versus none of the 18 controls. Drivers with AD were more than twice as likely to experience close calls. Plots of critical control factors in the moments preceding a crash revealed patterns of driver inattention and error. In one type of crash, the driver was looking directly out the front of the windshield but took no action (looking without seeing). Other crash types involved participants who reacted too late or evaded a primary hazard only to experience a second collision. Only one crash occurred on a straightaway segment; this driver lost control of the vehicle while distracted. Analysis of the crash circumstances, taking into account vehicle speed using the General Estimates System, showed that several of the crashes in the study (15 of 21) would likely have been fatal. Thirty-six drivers had near misses (14 of the 19 AD participants and 6 of the 17 control participants).

The authors conclude that high-fidelity driving simulation provides a unique new source of performance parameters to standardize the assessment of driver fitness. By increasing the exposure of older drivers and drivers with dementia in high-fidelity simulated collision avoidance scenarios, the experimenters were able to infer crash risk through direct observation of events that might have taken months to infer from real-life events. Detailed observations of crashes and other safety errors provide unbiased evidence to aid in the difficult clinical decision of whether older or medically impaired individuals should continue to drive.

Doron Precision Systems

P.O. Box 400; Binghamton, NY 13902-0400; (607) 772-1610.

L-300 Series Driver Analyzer: Cue Recognition Subtasks. Cue Recognition is a three-part test administered via a noninteractive driver simulator system (Doron Precision Systems' L-300 Series Driver Analyzer). A familiarization session allows for RT testing (press the brake in response to lights flashing in a certain configuration on the console). Cue Recognition presents car icons generally facing away from the subject and rapidly and suddenly changing their positions on a wide projection screen. When an "action cue" occurs (icon faces forward or to the side) the subject is to release the accelerator, and within 5 seconds, brake or turn the wheel in the appropriate direction. For Cue 1, the action cue is a car facing toward the subject; the subject must brake. For Cue 2, the action cue is a car that faces to the left or right; the subject must turn the steering wheel in that direction. Cue 3 contains a mix of Cue 1 and Cue 2 trials. Release of the accelerator from stimulus initiation is timed, and the score is output in distance traveled at 55 mph from stimulus presentation to accelerator release. Speed of braking or wheel turn is irrelevant.

Cue Recognition was employed in a study of 102 subjects (ages 60 to 91) referred to CA DMV for reexamination, and 33 paid volunteers ages 56 to 85 (Janke and Eberhard, 1998; Janke and Hersch, 1997). The purpose of the study was to determine which of the several psychophysical tests administered were able to predict the on-road driving performance of the test sample. Results showed that Cue 1, Cue 2, and Cue 3 average distances, total errors, and average RT (Doron orientation exercise) correlated significantly with a weighted error score on a road test as follows:

- Total Errors: $r = .4382$, $p < .000$
- Average RT: $r = .3297$, $p < .005$
- Cue 1 distance: $r = .4777$, $p < .000$
- Cue 2 distance: $r = .4656$, $p < .000$
- Cue 3 distance: $r = .3584$, $p < .002$

A subset of the referred subjects were cognitively impaired; they performed significantly more poorly on Cue 2, Cue 3, reaction time, and total errors than the cognitively nonimpaired referrals.

L-300 R/A (Rehabilitation and Assessment) Simulator. This system is designed to evaluate a driver's readiness and capability to operate a motor vehicle safely. The driver analyzer films allow a therapist to evaluate a person's cognitive skills as well as their physical abilities and limitations. It may be used to: (1) identify deficiencies that rule out an individual as a candidate for driving; (2) evaluate if an individual needs adaptive equipment, and if so, what type; and (3) determine what therapy or training would help the individual improve his/her operation of a motor vehicle, in cases where the individual has limitations. The simulator may also be used as a training and rehabilitation tool, allowing for behind-the-wheel training under non-threatening, realistic driving situations. A disabled person may be trained using wide angle sound and motion films, in the necessary perceptual, judgmental, and procedural skills needed for driving. A printout is used for evaluation of performance. The simulator has been used in the Driving Program at Spring Hill Rehabilitation in San Antonio, TX (Doron Brochure, Q and A with Kim Redding, O.T.). At this facility, patients with neurological problems including head injuries and stroke are targeted for assessment (those who have cognitive and perceptual deficits) as are physically impaired clients. The visual aspect of the evaluation is helpful to clients with visual scanning, visual attention, or visual field impairments, according to Ms. Redding. The information obtained from the simulator setting is beneficial in providing insight to clients regarding how their deficits affect driving. The simulated environment helps OTs evaluate crash avoidance and threat recognition skills in a safe environment. On the road, therapists have little idea how clients will respond to stressful, threatening situations. In the simulator, the amount of visual stimuli a client receives can be controlled: for example, a client with a head injury may perform well in low stimulus situations, but in unfamiliar locations where fast decisions are critical, they may not do as well.

MultiCAD, Scientex Corp.

MultiCAD ia a PC-based tabletop testing system that uses a combination of video clips of driving scenes and computer-generated images to maintain a high level of face validity for everyday driving situations. The *MultiCAD* protocol displays dynamic, suburban arterial driving scenes on a 27-inch screen capable of accepting both video (NTSC TV standard) and computer graphics (SVGA) inputs. A brake and accelerator pedal assembly is used for stop-and-go decisions and brake reaction measures. The *MultiCAD* battery contains multimedia (audio and visual) instructions, presented on-screen through pre-recorded video of a "talking head." Tests that measure drivers' responses to actual traffic scenes are described below. Study results were presented in section 1A2h of this *Notebook* (see Staplin, Gish, Decina, Lococo, and McKnight, 1998).

Angular Motion Sensitivity. This test uses *MultiCAD* to measure drivers' ability to rapidly detect changes in the relative motion of their own versus other vehicles. A video of suburban driving scenes is used which presents a driver's eye view of travel along an arterial route with light traffic, following a lead vehicle (that the subject is told to pay attention to) at varying distances. Subjects are required to depress the brake in the *MultiCAD* assembly whenever the vehicle directly ahead in the same lane applies its brakes or at any other time it would be advisable to stop or slow down under actual driving conditions (e.g., an adjacent-lane driver encroaches into the lane of travel). The lead vehicle brake lights are illuminated when it slows in 12 of the 15 angular motion sensitivity trials. For three other angular motion sensitivity trials, the lead vehicle's brake lights are disabled during filming of the video, so that the subject is required to detect the change in headway without the additional brake light cue. These three trials are intermixed with the trials in which the brake lights are illuminated.

Measures of effectiveness are: (1) mean brake reaction time across 12 trials, to slowing/stopping lead vehicle with brake light activation, for correct responses; (2) percent error for these trials (e.g., percent of the trials where the vehicle ahead slows and the brake lights are clearly visible, but the subject did not press the brake pedal); (3) mean brake reaction time across three trials, to slowing/stopping lead vehicle with no brake light activation, for correct responses; and (4) percent error for these three trials.

Useful (Functional) Field of View. This divided attention test uses *MultiCAD* to measure drivers' ability to remain vigilant and respond in a timely and appropriate manner to events that occur directly ahead in the travel path, while also detecting unexpected events of a safety-critical nature that occur in the areas of peripheral vision. After angular motion sensitivity data are obtained, the same driving video continues to use the lead vehicle target as a "foveal task" (i.e., located centrally along the driver's line of sight). At predetermined intervals in relation to a (lead vehicle) brake light stimulus, vehicles and pedestrians are introduced unexpectedly in the periphery of the driver's forward vision, offset at angles of approximately 15 degrees and 30 degrees to the left and right sides. The motion of these peripheral targets brings them into potential conflict with the driver within several seconds' travel time.

For threats intersecting from the periphery at approximately a 15-degree angle of eccentricity (2 trials), the measures of effectiveness are: (1) mean reaction time for correct response to (a) a vehicle pulling out from behind a building on the right side of the scene and (b) a vehicle backing out of a parking space from behind a (blocking) U-Haul van on the left side of the scene; and (2) percent error for these two trials.

For threats intersecting from the periphery at approximately a 30-degree angle of eccentricity (1 trial), the measures of effectiveness are: (1) mean reaction time for correct response to a pedestrian stepping off the curb and entering the driver's path; and (2) percent error.

Easy Driver

Schiff and Oldak (1993) used a computer-video display and recording system called *Easy Driver*™ which runs from a Macintosh microcomputer and a standard large-screen color TV monitor, with a dual pedal control unit (brake and accelerator). Drivers view driving scenarios while they operate brake and accelerator pedals to drive at preferred speeds under various conditions, and to brake in response to events occurring in the video. The scenarios include traffic events in which drivers may respond to the onset of brake lights in a lead vehicle or rapid closures of gaps between vehicles, intrusions of other vehicles and pedestrians (high and low illumination conditions), stop signs and traffic signals, and tennis balls (small, high contrast target) or basketballs (large, low contrast target, used in day and in dusk conditions) rolling into the road in suburban residential areas (indicating possible incursion of child). Drivers proceed at their own pace in several scenarios including highway driving in excellent road conditions in light traffic, wet snow/rain, heavy rain, and night driving with oncoming headlight glare. A left turn scenario to tap "go/no go" decisions (gap acceptance) has been filmed but was not used as part of the research study, because varying the speed of approach affected the speed of the oncoming vehicles, although this scenario may be useful in a fixed speed format. A simple RT task is also included in the program. Assessment time is 15 minutes. Study results were presented in section 1A2h of this *Notebook*. Of particular interest, as noted by the study authors, is that "many persons over age 75 and 2 individuals with cataracts failed to see small objects (e.g., basketball or tennis ball bouncing across the street) portending a possible emergency event (child running into the road)." One of the best predictors of crash risk for older drivers was a dusk scenario in which a basketball (low contrast target) bounces in front of the driver's car. Responses to the corresponding daylight event were unrelated to crash risk, specifically denoting the lighting condition as critical. The authors note that these measures might be used for diagnostic and counseling purposes in various public and private settings, such as AAA auto club centers, community centers, AARP programs, motor vehicle bureaus, hospital rehabilitation centers, and driver training schools or classes. The original digital video-computer system has been modified to permit use of standard TV monitors, thus reducing the cost and increasing the resolution. The system runs on standard Macintosh microcomputers (desktop or laptop).

STISIM (Systems Technology, Inc.) Simulator

13766 Hawthorne Blvd., Hawthorne, CA 90250. Phone: (310) 679-2281; Fax: (310) 644-3887.

STISIM is a PC-based interactive simulator designed to represent a range of psychomotor, divided attention, and cognitive tasks involved in driving. The simulation includes vehicle dynamics, visual and auditory displays, and a performance measurement system. Driving tasks are programmable with Scenario Definition Language (SDL) that allows the user to specify an arbitrary sequence of tasks, events, and performance measurement intervals. The visual display scene can be presented with conventional computer monitors or projectors. The scene includes a roadway, horizon scene, secondary task displays, intersections, traffic control devices, and interacting traffic. The events in the SDL allow the user to specify various driving tasks that permit measurement of psychomotor, divided attention, situation awareness, and other cognitive behavior. Steering and speed control behavior can be measured on straight and curved road sections. Subsidiary peripheral signals can be presented that divide the driver's attention and require a horn or turn indicator response. The specification of lead and opposing vehicles requires the driver to make passing decisions while signal light timing can be specified to require stop/go decisions.

Cross traffic and pedestrians can be specified to intersect the driver's path. Situation awareness can be tested by including interactive traffic/pedestrians and a side view mirror representation of an adjacent vehicle that interferes with lane changing. The simulator has been used in driver behavior research associated with impairment (alcohol, drugs, and fatigue), visibility, traffic control devices, intersection complexity, decision making, vehicle control, and IVHS.

University of Illinois/Atari Interactive Driving Simulator

In their research, Szlyk, Brigell, and Seiple (1993) utilized an interactive driving simulator (developed in collaboration with Atari Corp.), that is composed of a seat, steering wheel, gas and brake pedals, and an automatic transmission. The visual display consists of three 24-inch color monitors displaying a total 160° horizontal viewing field and a 35° vertical viewing field of a computer-generated environment to a driver sitting 22 inches from the center screen. Stimuli are computer-generated images of a simulated roadway with traffic, signs, and painted roadway lines. The video scene is updated 20 times per second. Simulator performance measures of effectiveness in the research included: (1) mean speed (in mph); (2) average slowing and stopping to traffic signals; (3) number of lane boundary crossings; (4) mean break pedal pressure; (5) mean gas pedal pressure; (6) number of simulator crashes; (7) lane position; (8) steering angle; and (9) vehicle angle to the road. Six staged driving simulator challenges required visuocognitive/motor skills to avoid a crash; three of these were intersections with cross traffic. Eye and head movement were recorded for each subject. Self report of crashes over the previous five years was also collected for each subject.

The test participants in the study by Szlyk et al. (1993) included 6 patients (2 females and 4 males) with hemianopic visual field deficits, ages 53 to 80 (mean = 71 years); 7 older controls with normal vision (3 females and 4 males) ages 62 to 83 (mean = 70 years); and 31 younger controls (16 females and 15 males) with normal vision age 21 to 64 (mean = 40 years). Results of the study included the following: (1) significantly more lane boundary crossings for the older patient group, but no significant differences between the older and younger control groups for this performance measure; (2) greater variability in lane position among the older patient group with no consistent differences in absolute lane position between the two control groups; (3) greater deviations in steering angle by both groups of older drivers compared to the younger control group, but no significant differences between the older patient and older control group on this measure; (4) no significant differences between the three groups in their vehicle angle to the road performance measure; (5) longer slowing times by four older controls and three older patients when compared to the younger controls, but no differences in mean slowing times between the two older groups, due to a large variability among individuals; (6) prolonged stopping times by both older driver groups when compared to the younger control group; (7) slower average speeds exhibited by both older groups when compared to the younger group, but no differences in mean speed between the older patients and older control subjects; (8) lower average pedal pressure and greater variability in accelerator pedal pressure by both older groups in comparison to the younger group, but no differences between the two older groups on this measure; (9) no significant differences between mean brake pedal pressure among the three groups, but greater variability in brake pedal pressure for both older groups when compared to the normally sighted younger controls; and (10) simulator crashes occurred only for two subjects in the older normally-sighted group. Real-world crash reports were obtained for a 5-year period. Two of the four older subjects who had real-world crashes also had the longest slowing times, the longest stopping times, and the most crashes in the driving simulator.

driVR System

Imago Systems, Inc. Virtual Reality Technology; Suite 228, 181 Keefer Street, Vancouver, BC, Canada, V6B 6C1; Phone: (604) 681-9288; Toll free: 1-888-613-3311; Fax: (604) 681-8705; email: imagovr@ibm.net

The driVR system provides objective data that can be used by a clinician during assessment, training or rehabilitation of driving skills. It was developed to incorporate cognitive and behavioral factors that affect driving performance, such as attention, visual tracking, tactical decision making, and strategic planning. It measures operational and tactical performance during "virtual driving events" such as road sign recognition, lane tracking, speed, obstacle avoidance, hazard recognition and reaction time. The driVR system incorporates the latest in virtual reality technology and 3D graphics software. The simulator runs on a Pentium PC and includes a virtual reality headset and interactive driving controls. The user operates the vehicle and drives around a realistic 3D environment using steering and brake/accelerator controls. Upon completion of the course, objective real-time data is presented in the form of detailed test results (profiles or ratings of driving skills and risk behavior). When not using the simulator, the computer can be used for other tasks.

The single use full license on the software can be purchased or leased through Imago Systems. It is recommended that purchasers buy their own PCs or upgrades from a reputable supplier on which to run the software. System requirements can be obtained from Imago Systems.

The results of a study conducted by Liu and Miyazaki (*in press*) at the University of Alberta supports the use of age-specific norms and provides some evidence for validity. There are components of the driVR test that can discriminate between normal subjects and head-injured subjects (the Follow Traffic Route and Performance at Stop Signs). The authors state that DriVR should be used as an adjunct to current assessment tools, and not as a replacement until further research is conducted. It is planned that research will continue to determine the correlation between driVR and on-road driving performance, as well as further psychometric testing. Clinical validation of driving segments within the driVR has been achieved through research at the University of Alberta; however it is not yet published.

Elemental Driving Simulator

Life Sciences Associates, One Fenimore Road, Bayport, NY 11705-2115. Phone: (516) 472-2111, Fax: (516) 472-8146.

The EDS is a personal computer-based quasi-simulator for use by professionals in driver rehabilitation with cognitively at-risk persons (e.g., older drivers, persons returning to driving after a head injury or stroke). The EDS helps address the issue of whether the individual possesses sufficient information processing capabilities to drive safely (Gianutsos and Campbell, 1988, 1991). It is comprised of an IBM-compatible PC, a 10-inch diameter steering wheel controlling a 150K linear potentiometer with turn signal, and a momentary contact foot pedal. The software is written in compiled QuickBASIC, and is fully menu driven. Testing requires about 20 minutes, although 30 minutes should be scheduled to allow for sufficient practice by the poorest performing segment. The system is elemental in its technical simplicity and in its simulation of the elements of driving-related cognitive abilities. The assessment protocol begins with a self-appraisal of cognitive abilities related to driving: steering control, speed of reaction, self-control (impulsivity), field of view, consistency, and adjustments to changes and complexity. Each of these areas is then assessed in increasingly complex simulated steering tasks. Phase

1 is a preview tracking task which requires the subject to steer a simulated vehicle which moves at a fixed pace in the center position of the driving lane. Measures of lateral position are taken 8 times per second. In Phase II, a two-choice RT test is added to the steering task, where as the road advances, a small, one-character stimulus face appears unpredictably on either side of the roadway. The subject must turn the signal lever on the steering column toward the face as soon as possible, while maintaining a steady position in the center of the road. Reaction times are stored along with the steering measures. In Phase III, a contingency is introduced into the reaction time test such that when the face is flashing ("hazard"), the subject must signal away from it, and when it is steady, the subject must signal toward the face.

Gianutsos (1994) employed the EDS in a study of 50 control subjects (average age = 41 years) who were assessed to obtain baseline data to establish population norms; 1,145 community-residing older drivers (average age = 69 years); and 82 drivers seeking driver rehabilitation related to a central nervous system (CNS) disorder (average age = 37 years). The rehab sample received a comprehensive driving evaluation that included medical and driving history, vision screening, EDS, Doron simulator, and a road test. A pass or fail decision was made about each individual. The performance of the 50 control group drivers was more consistent and substantially better than that of 1,145 community-residing older drivers and the group of 82 drivers seeking driver rehabilitation related to a CNS disorder. As a group, the older drivers performed almost as poorly in terms of steering ability, two-choice reaction time, and in complex reaction time as the rehabilitation patients who failed their driving exam. The failers were always worse than the passers, however the difference in performance was significant only for steering unsteadiness.

Case examples have shown also that observations of actual on-road performance are consistent with conclusions based on the EDS; persons who perform poorly on the EDS have been observed to exhibit lane drifting, poor steering control, failure to make head checks, impulsivity, and difficulty in making adjustments during a 1.5 hour drive.

The EDS was employed in a study of 1,475 ITT Hartford Insurance Co. policyholders for whom past driving histories were available through insurance records, divided into two groups based on the presence or absence of recent at-fault crashes (Brown, Greaney, Mitchel, and Lee, 1993). Driver age ranged between 50 and 80+. Insurance and motor vehicle department records provided information about the following variables: at-fault crashes, non-fault crashes, non-crash claims, violations and convictions, miles driven, age, gender, and marital status. Performance on the EDS yielded a low but significant correlation with at-fault crashes ($r = -.09$, $p \leq .05$). Sample selection bias (policy holders with poor functional capabilities may have declined to participate) and testing under noisy conditions (hotel sites) may have contributed to the low correlations. Additionally, a higher correlation may have been attained if an important procedure had been followed in test administration (according to the test developer). The EDS should be administered as a one-on-one test with a test administrator trained in its use. Each phase should be preceded by sufficient practice to ensure that the subject is comfortable with the task. The theory is that driving is a highly practiced task, and the subjects should be encouraged to continue in the practice mode until they feel they have reached their best level of performance. Also, this approach contributes to the clinical acceptance, as people believe they have been given the fairest possible chance.

Driving Advisement System (DAS)

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The DAS is a more comprehensive protocol that uses the same IBM compatible system as the EDS. The DAS is a one-hour long protocol designed for advising persons who seek to resume driving following brain injury, caused by head injury or stroke. Its procedures address the complexity of information processing, and breaks responses down into a decision and an execution component. As the task demands increase in complexity; the choice component of reaction time is expected to increase, but not the execution component. Momentary contact switches are activated by three pedals, laid out on a floor plate with a middle gas pedal, a left brake pedal, and a right horn pedal; the horn and brake pedal are equidistant from the gas pedal. A steering wheel senses rotation of approximately 270°. There are five parts to the appraisal: self appraisal; a pursuit tracking task ("On the Road"); a simple reaction time procedure ("Brake"); a choice reaction time task ("Decide"); and a reversing choice reaction time task ("Inhibit").

- In the self-appraisal portion, ratings are obtained for eight parameters: reaction time, decision speed, movement speed, speed of adaption, consistency, concentration, field of vision, and impulse control. After each parameter is explained carefully, the subject uses the steering wheel to move a marker that represents his/her present status on a display in comparison to "other safe drivers."

- In the pursuit tracking task, the display contains an abstract representation of a road with a small rectangular block representing the vehicle, which can only be moved laterally. The road itself changes, creating an illusion of movement. The subject's task is to hold down the gas pedal to keep the vehicle moving along the road and to use the steering wheel to maintain the vehicle in the center of the road. Modifiable parameters include speed of progress, roadway width, roadway curviness, length of course, and amount of preview of the roadway above the vehicle.

- In the simple reaction time test, the subject holds down the accelerator until the letter "B" appears either in the right or left signal box. Then, s/he moves the foot from the gas to the brake as quickly as possible, and replaces the foot on the gas to resume driving. Resumption time (brake to gas), choice time (appearance of B to release of gas), and execution time (release of gas to press of brake) are measured in 100ths of a second. False alarms are also recorded on trials where the gas pedal is released before the "B" appears. Performance is compared to comprehensive driving evaluations in driving rehab centers, and may include an on-road exam.

- The choice reaction time test builds on the simple reaction time test by adding an equal number of "H" (horn) and "B" (brake) stimuli, in an unpredictable sequence. The object is to be as quick as possible without making errors in pedal activation.

- The reversing choice reaction time test builds on the procedures used in the choice reaction time segment. On a random half of the trials, a sign appears in the center of the screen that says, "pedals reversed." When this happens, the person must press the brake pedal when an "H" appears, and press the horn pedal when a "B" appears. The program switches unpredictably between the "ordinary" mode and the "pedals reversed" mode, demanding rapid adjustment.

The DAS was employed in a study of 60 licensed drivers ages 18 to 86, who were deemed to be safe drivers and free from serious neurological impairment (standardization sample) and 60 traumatic brain injury and cerebrovascular accident survivors (Gianutsos, Campbell, Beattie, and Mandroita, 1992). The findings indicate that execution times of the standardization group in "Brake," Decide," and "Inhibit," do not increase with increasing task complexity and substantiates that these times are reflective of motor functioning and not mental processing. In contrast, the choice times increased with increasing complexity. The DAS measures correlated with an on-the-road assessment (pass/fail criterion) in a group of 60 traumatic brain injury and cerebrovascular accident survivors slightly better than the Porto Clinic Glare (a device used in predriving assessments typically conducted in occupational therapy settings, that screens visual acuity, visual fields, depth, glare recovery, color vision, and reaction time in approximately 20 minutes).

References:

- Brown, Greaney, Mitchel, and Lee (1993)
- Gianutsos and Campbell (1988, 1991)
- Gianutsos, Campbell, Beattie, and Mandroita (1992)
- Gianutsos (1994)
- Imago Systems, Inc.
- Janke and Hersch (1997)
- Liu and Miyazaki (*in press*)
- *pers. comm.*, Linda Hirsekorn, Imago Systems, 7/22/98
- Rizzo, Reinach, McGehee, and Dawson (1997)
- Schiff and Oldak (1993)
- Staplin, Gish, Decina, Lococo, and McKnight (1998)
- Szlyk, Brigell, and Seiple (1993)

IC2(b)v. Comprehensive Physical Examination

Summary:

A recent *Consumer Report's* article (1998) reported on an analysis of data from the National Ambulatory Medical Care Survey that is conducted annually by the National Center for Health Statistics. The survey data were provided by physicians on approximately 35,000 patients. Extrapolating the results to the entire U.S. population, their analysis found that only 30 percent of people ages 45 to 64 get a yearly checkup, and only one-half of those age 65 and older get an annual checkup. The analysis points out that history-taking time is well spent, citing a report by the Mayo clinic, that history-taking identified 10 times as many health problems as a urinalysis and five times as many as a complete blood count. In addition, counseling is an important part of a comprehensive exam; however, physicians are not educated on how to do effective counseling for healthy people. The article reported that every checkup should contain counseling regarding diet, exercise, smoking, and injury prevention. But, *Consumer Report's* analysis found that dietary counseling is given only to 1 in 5 patients, and injury prevention counseling is presented to only 1 in 100. Interesting to note is that the article did not specifically cite driving as part of the history-taking or counseling components of a physical exam.

Stutts (1998) cites research indicating that physicians and other members of the medical community can be influential in older drivers' decisions to reduce their driving exposure. In a focus group study, most older adults agreed that if their physician advised them to stop driving and their family concurred, they would stop. However, only 27 percent of the participants (15 of 56) said that advice from a physician had affected their decision to stop driving, and only 32 percent (18 of 56) said that their physician had discussed driving with them (Persson, 1993). They pointed to ophthalmologists as the group of physicians most likely to discuss driving with them.

Uniformity does not exist among the states with regard to medical qualifications of drivers. It is often up to the individual physician to become familiar with the medical classifications of drivers and the physical examination forms used by their State. The Texas Medical Association (*The Physician, the Older Patient, and Driving Safety*) states that, "The physician has much of the responsibility for determining medical competence to drive. This implies that the physician has four duties: (1) to be aware of such medical conditions; (2) to detect these conditions in their patients; (3) to discuss with their patients any limitations on driving imposed by the medical condition; and (4) if necessary, report the patient's condition to the appropriate state agencies." In Pennsylvania, the driver licensing bureau sends physicians the specific laws and regulations formulated by their Medical Advisory Board, as well as a information on the purpose of physician reporting. Pennsylvania has an initial reporting form that is completed by the physician after completing a physical examination of the patient. This form has four sections, including: (1) patient information and date of examination; (2) diagnosis of disorder or disability (i.e., a checklist for loss of, or impairment of function in an appendage; unstable diabetes; cerebral vascular disease; cardiovascular disease; loss of consciousness and cause; neurological disorder; mental deficiency or marked mental retardation; mental or emotional disorder; alcohol abuse; drug or controlled substance abuse; vision deficiency; and other medical conditions; (3) seizure disorder and waiver requirements; and (4) name, address, telephone, signature, and state physician license number of provider.

In a recent literature review, Carr (1998) identified several different recommendations by physicians and researchers on what to assess for older drivers during a physical examination. Reuben (1993)

suggested that an office-based assessment should focus on static visual acuity, hearing, the presence of arthritis, and dementia. Underwood (1993) recommended the following assessments: static visual acuity and fields, auditory, cognitive including mental status examination, functional status, musculoskeletal, sleep disorders, alcohol screening, and a medication review. Marottoli and Drickamer (1993) suggested that the motor abilities of muscle strength and a range of motion for neck and extremities should be measured. Carr (1998) suggested that brief physiological or functional measures can be administered cost-efficiently and are reliable in an outpatient setting. He identified several functional measures that should be assessed by a primary care physician, including: driving performance history; vision; hearing; reaction time; attention; visuospatial skills; judgment; muscle strength; and joint flexibility. He also identified several medical conditions, as well, which should be assessed, including: cardiac disease; risk of heart attack; diabetes; pulmonary disorders; alcoholism; use of sedating medications; dementia; cerebrovascular disease; risk for stroke; arthritis; visual impairments; and hearing impairments. Marottoli (1993) states that physicians should include driving issues as part of their functional assessment. They should ask the patient (and family) whether there have been problems with driving, such as getting lost or having moving violations or crashes. The Texas Medical Association lists specific questions a physician may pose to a patient that may help identify a driver who is at risk:

- Do you still drive? Where and when do you drive?
- How many physicians are you currently seeing? For what conditions?
- How many medications are you taking? What are they? (Include over-the-counter drugs)
- Have you noticed any changes in your eyesight recently?
- Any recent falls or weakness?
- Have you experienced any loss of consciousness? Any dizziness? Any drowsiness?
- Have you experienced any confusion or memory loss?
- Have you experienced any hearing loss? Since when?
- Have you experienced any problems with mobility? (Such as difficulty turning your head?)
- Have you had any medical conditions such as a heart attack or stroke which makes movement of the arms and legs difficult? If yes, what type of vehicle are you driving?
- Are you willing to follow my advice about driving?

Finally, the physician should take an active role at this time during the physical examination to assess risk for injury and promote injury prevention (e.g., use of seat belts) in a motor vehicle; and address the possibility of driving cessation or restriction for the patient. For the latter, empathy, sensitivity, along with counseling to discuss alternate methods of transportation are important and necessary.

Several sections in this *Notebook* seem particularly relevant for use by physicians in assessing fitness to drive. To detect gross functional impairments in an office setting, the procedures described in Section IC2(a)i: GRIMPS battery of general physical and mental abilities, would be a logical starting point. Also, Section IC3(b)i describing Rehabilitation Procedures: physician/occupational therapist review, provides more information about specific diagnoses, their effects on driving, and potential remediation.

A Guide to Physical Examination (Bates, 1983) provides a comprehensive description on conducting a physical examination.

Conclusions/Preliminary Recommendations:

Physicians have frequent contact with older persons and have the ability to perform functional assessments of the abilities required for safe driving. Simple assessments of physical, visual, and cognitive abilities along with asking the right questions (such as those listed above) can provide the information required for counseling older drivers about reducing their driving risks. In addition, early detection of problems allows for treatment/rehabilitation by specialists (e.g., ophthalmologists, OTs, PTs, driving schools, to whom the physician may refer a patient) so that older persons can maintain their ability to drive.

References:

- Bates (1983)
- Carr (1993)
- Carr (1998)
- "Checkups: Are you getting what you need?" *Consumer Reports* (1998)
- Marottoli and Drickamer (1993)
- Marottoli (1993)
- Persson (1993)
- Reuben (1993)
- Stutts (1998)
- Underwood (1992)

IC2(b)vi. Functional Abilities and Driving Evaluations

Summary:

Hunt (1993) states that "many individuals who have had strokes, amputations, painful joints, or visual problems assume that they can no longer drive." Occupational therapists (OTs) assess and treat people whose ability to carry out life tasks has been impaired by disease, injury, birth defect, or the aging process. OTs have developed programs to evaluate the driving abilities of people with disabilities and healthy older individuals. These programs have two goals: to provide a decision about an individual's capacity for driving; and to identify factors that may respond to training in those individuals who have the capacity to drive. Although the specific methods for evaluation vary in different programs, evaluations generally consist of a predriving assessment using psychometric tests and an in-car, on-the-road driving test. The predriving evaluation usually consists of an interview, motor evaluation, cognitive evaluation, and sensory evaluation. A major focus of the interview is to gain insight as to why the client's driving ability requires evaluation, and to determine whether a client recognizes his or her limitations. Often when there is cerebral damage from a head injury, stroke, dementia, or multiple sclerosis, patients are unaware that they have cognitive, judgment, visual, or perceptual deficits; clients who fail to recognize their limitations do not compensate. Hunt (1993) provides examples of questions used to elicit client information:

- Has your illness left you with any physical problems?
- Are you able to perform all your everyday activities as you did prior to your illness?
- Why do you think your doctor wanted your driving skills to be evaluated?
- Do you have any fears about driving?
- Is your thinking as clear as it was 2 years ago?
- If you are driving now, have you gotten lost on an often-traveled route?

These questions provide some baseline information to be compared with test results, and discrepancies also provide evidence regarding why a training program may not be appropriate for a particular client. Hunt's hierarchy of driving assessments (Hunt and Weston, *in press*) is presented on the following page.

A description of five evaluation programs follows, highlighting specific tests and methods used in the predriving and driving assessments.

Ohio "Older Driver Evaluation Program"

This evaluation, conducted by the Ohio State University Medical Center, is physician driven in that a physician is contacted prior to an evaluation to obtain medical and pharmacological history, and a physician signs all of the consultations. Evaluations last 3 hours, require 2 visits, and cost $330. A physician oversees the program, which is staffed by an occupational therapist, a geriatric clinical nurse specialist, and an on-the-road evaluator. If Medicare or private insurance will not cover the evaluation, fees can be collected on a sliding scale through funds provided by the Franklin County Office on Aging. The point was made that county money can be used for many things that might not otherwise be covered by Medicare or Medicaid.

Before the first visit, a geriatric nurse conducts an analysis of the client's medications and interaction effects. Often this starts needed communication among a client's physicians. During the first visit,

Hierarchy of Driving Assessments

SELF-ASSESSMENT

Insight into deficits	Self-limit driving activities	Receptive to alternative options for transportation		

FAMILY-ASSESSMENT

Reports older driver becoming lost on familiar routes	Observes other drivers honking at older driver	Recognizes that other drivers employ evasive actions to avoid crashes	Has been nervous or fearful as a passenger

VISUAL ASSESSMENTS

Visual acuity	Contrast sensitivity	Color vision	Depth perception	Visual fields

VISUAL PROCESSING AND COGNITIVE ASSESSMENTS

Useful field of view (Owsley eta al. 1998)	Trailmaking Parts A and B (Reitan, 1958)	Traffic symbol recognition (Hunt et al. 1993; Carr et al. 1998)	Short Blessed Test (Katzman et al. 1983)

PHYSICAL ASSESSMENTS FOR OPERATING THE VEHICLE CONTROLS

Pain	Strength	Endurance	Joint movement	

KNOWLEDGE OF ALTERNATIVE TRANSPORTATION

Cognitive ability to use independent alternative transportation	Accommodations for physical disabilities	Safety and comfort level of utilizing strangers to provide transportation	Availability of family and friends

ROAD TEST

Closed course to establish orientation to the testing vehicle	Progressive traffic interaction	If driver passes, re-evaluate if clinical assessments show impairments (Hunt et al., 1997b)

POTENTIAL FOR REHABILITATION

Seizure free	Stabilization of neurological condition	Plan for degenerative diseases by prescribing adaptive equipment that will accommodate loss of abilities.	

DRIVER'S TRAINING

Any adaptive driving equipment must be accompanied by training and re-evaluation

RE-EVALUATION

Those with progressive medical disease (e.g. dementia of the Alzheimer's type, multiple sclerosis, transient ischemic attacks, diabetes, glaucoma) must be re-evaluated every 6-12 months

From L.Hunt and K.Weston, *Assessment of Driving Capacity*, in P. Lichtenberg (Ed.), Handbook of Geriatric Assessment, Chapter 21. In Press.

which lasts 1½ -2 hours, the client completes a self-report questionnaire to obtain information regarding disease, driving habits, and sleep habits; a hearing screening is conducted; and a battery of cognitive, vision, and mobility tests is conducted. The cognitive tests consist of the MMSE, Trails A and Trails B. The vision test utilizes the Optec 2000 Vision Screener, and assesses static acuity, depth perception, visual fields, and acuity under glare. The mobility portion assesses range of motion, strength, and endurance.

The second visit consists of reaction time and recognition subtests using the Doron Simulator L225, and on-road assessments, first in the parking lot and then in traffic. The results of the assessment are given to the referring physician, and a copy is sent to the older adult. A consultation letter never goes to the Bureau of Motor Vehicles, however. The individuals responsible for this program feel strongly that the evaluation is part of the health care system. It is the physician's responsibility (moral obligation, as opposed to a legal obligation in Ohio) to ensure that an unsafe driver doesn't drive, and the evaluators work closely with the referring physician to explain the risks of driving to the unsafe driver.

Training may be prescribed or doctor visits recommended. A transportation resource guide has been developed to lead people to alternative transportation, if they must restrict or eliminate driving. The program works closely with the family, as the older driver issue is a family issue. The program can also help with alternative housing choices (to make alternative transportation/mobility easier) and other spin-offs of the older driving issue.

This program is not meeting the need of all the older drivers in the jurisdiction, based on cost and time to administer the evaluation. The program developers are working to create a short screening tool to be administered in physician's offices. They have followed the mammography model regarding desired sensitivity and specificity, in that they cannot tolerate sending a poor driver out on the road; therefore they err on the side of conducting full assessments on drivers whose driving ability is not compromised (*pers. comm.*, Bonnie Kantor and Linda Mauger, 1/20/98).

Program administrators have found that stopping driving can have a negative impact on health, and become involved in conversations with older adults and their families which illustrate these issues on a regular basis. Evaluation outcomes for the 400 drivers evaluated to date are as follows: 56 percent of the clients were found to be capable to drive safely at the time of the evaluation, or were capable with vehicle modifications; and 44 percent were determined to be incapable, which included those who are unsafe now, but may be safe after rehabilitation, surgery (cataracts), etc.

Bryn Mawr Rehab Hospital, Malvern, PA: Adapted Driving Program

Bryn Mawr Rehab's Adapted Driving Program provides driving evaluations, training and special equipment recommendations to help older and disabled drivers achieve or maintain independence through safe driving. The program started in 1983. It is staffed by a driving instructor, and an occupational therapist who is also licensed as a driving instructor. Both are Certified Driver Rehabilitation Specialists.

Clients evaluated include people with the following disabilities: cerebral vascular accident (CVA); dementia; brain injury; arthritis; amputation; spinal cord injury; cerebral palsy; learning disabilities; Multiple Sclerosis; hand injuries; small stature; psychiatric conditions; or any other condition that could influence driving. The majority of clients are older drivers that have had a CVA. Drivers of advanced age with no specific diagnosis are also referred to the program. A physician's referral is required to enter the program. As Pennsylvania has a mandatory reporting law, physicians frequently refer drivers to the program to gain information to guide them in filing reports with PennDOT. The driving evaluation consists of a one-hour pre-driver screening (clinical testing) and a one-hour in-vehicle assessment, conducted on the same day.

The clinic screening consists of a medical history; driving history; visual assessment (acuity, fields, tracking, saccades, depth perception); physical assessment (range of motion, strength, coordination, sensation, cervical ROM, trunk balance, ambulation status); reaction time; traffic sign recognition; simultaneous attention; and perception. If the driver is physically disabled, adapted equipment options are explored. The perceptual tests used during the screening can include (depending on time constraints): The Motor-Free Visual Perception Test (MVPT), Hooper Visual Organization Test and Trail-Making A and B.

The simultaneous attention task used during the screening yields a large amount of useful information in a short period of time (2-5 minutes). During this task the client is asked to copy a simple peg pattern while watching a clock. Every 15 seconds a green peg must be placed in a box. This forces the person to simultaneously attend to two simple tasks. During the task the evaluator observes the person and documents the following areas: ability to follow directions; problem solving; speed of performance; simultaneous attention; functional memory; new learning; performance under stress; and color discrimination. The person is scored by time taken to complete the task and the number of green pegs missed.

The primary purpose of the screening is to document key areas of performance that will be useful for the in-car evaluation. The information is also useful to help explain deficit areas should a person fail the on-road evaluation. It is not meant to predict performance, per se. Bryn Mawr's experience has indicated that the best information regarding a patient's ability to drive is determined through a behind-the-wheel evaluation.

The behind-the-wheel evaluation is conducted on nearly everyone that meets the basic State vision and seizure standards. Occasionally, a combination of several significant deficits will preclude the in-car evaluation. To control for risk, the in-car (or van) evaluation starts off on the Bryn Mawr Rehab grounds. The driver is evaluated in the program's vehicle with a dual-control brake. If the driver cannot control the vehicle, he or she is not advanced to the on-road portion. If adapted equipment is required, the evaluation may be limited to the campus, as the driver may not be ready for traffic in the first session. If the driver demonstrates basic vehicle control and has a valid license, he or she is then observed driving in a variety of traffic situations (rural secondary roads, limited access highway, shopping center, downtown traffic in West Chester). If the person is not ready for the full evaluation route, he or she is observed in more simple traffic in a nearby small town. The driver is scored as pass, fail or questionable on 30 areas of performance (i.e. lane position, visual checks, following distance, judgment of space, speed control, attention to traffic devices, memory, etc.). The final score is pass, fail, or questionable based on the observed performance.

Training may be recommended if the deficits observed could be overcome with training. Lessons and re-testing with PennDOT for license coding are required if the person needs adapted devices. Trial lessons are recommended for questionable candidates that appear to have potential to drive. Lessons are not recommended for people with advanced dementia or severe neurological deficits that will not be overcome with training. The driver, family members, and the physician(s) are consulted extensively when making difficult decisions. A re-evaluation can be considered if the person's status may improve over time. If a driver fails the evaluation and is not a candidate for any follow-up driving services, extra time is spent reviewing the results and counseling the person and family to help them adjust to this significant life change. The person is given reprints of articles concerning stopping driving, and alternative transportation options are discussed.

UAB Health System, Birmingham, AL: Driving Assessment Clinic

The UAB Driving Assessment Clinic opened in December 1998 in response to the need for a way to evaluate driving fitness in individuals with medical problems and functional impairments. Most patients seen in the clinic are over age 50, although drivers of any age can be evaluated. The development of the clinic was funded by a grant from the University of Alabama Health Services Foundation. The clinic is integrated into a health system, operating as one of a myriad of health services available to the community and State. The Clinic accepts referrals from physicians, other health care providers, families, as well as self-referrals. The Clinic Director is Cynthia Owsley, PhD, MSPH, and the Clinic Coordinator is Jennifer Wells, CDRS, a certified driving rehabilitation specialist. It is located in the Eye Foundation Hospital at the University of Alabama at Birmingham Medical Center.

There are two parts to the assessment. The in-clinic battery takes about 1.5 hours to administer, and consists of an evaluation of characteristics that are known risk factors for crash involvement and unsafe driving in older adults. Included in the battery are a vision screening, a cognitive assessment, the UFOV test, a review of medical conditions and medications, driving needs, driving habits, social support, and knowledge about the rules of the road and safe driving practices. After the in-clinic screening, there is an evaluation of on-road driving performance in the clinic's specially equipped vehicle. This evaluation lasts for 30 to 45 minutes and addresses the patient's ability to perform a variety of typical driving maneuvers in real traffic situations. This on-road component is offered to those patients who meet minimum requirements from the in-clinic battery. The cost of each component is $150.00, and is an out-of-pocket expense for the clients, as Medicare does not reimburse for driving evaluations in the State of Alabama. The clinic does not refuse clients on the basis of not being able to pay, however.

The results of the assessment are summarized in a written report that is provided to the patient and the referring physician or other health care provider. The report includes an assessment of risk for crash involvement and unsafe driving based on the in-clinic battery and on-road evaluation, and makes a recommendation about the patient's fitness to drive. This recommendation can take a variety of forms (e.g., the patient has adequate skills to continue driving, the patient has significantly deficient skills so should refrain from driving, the patient should avoid driving in certain situations--night, rush hour traffic, inclement weather). If a recommendation is made for driving cessation, the clinic provides counseling on alternative transportation services and strategies.

The clinic's assessment battery is a work in progress. As research points out new risk factors for crash involvement and screening tools for identifying those risks, these tests and evaluations will be incorporated into the clinic's battery. Similarly, as interventions to improve driving are demonstrated to be effective (e.g., health education, cognitive training, on-road training), a training module will be added to the clinic. Finally, the clinic's effectiveness in enhancing safety and preserving mobility, as well as its financial feasibility within the health system, will be evaluated after a sufficient number of patients have been seen.

Sinai Rehabilitation Center, Baltimore, MD: Driver Evaluation and Training Program

Sinai Hospital of Baltimore, Maryland offers a driving rehabilitation program that consists of a clinical driving evaluation, behind the wheel evaluation, and driver training. The driver evaluation and training specialist (Kim Harwood White) is a Certified Driving Rehabilitation Specialist. The goals of the Driver Evaluation and Training Program are:

- To assess the client's functional ability to produce controlled physical motions necessary for the safe and efficient operation of a motor vehicle.
- To screen the client's visual, visual-perceptual, and cognitive skills as related to driving.
- To provide evaluation of the client's ability to integrate physical, visual, perceptual, and cognitive abilities in multiple traffic situations.
- To provide graded behind-the-wheel training and instruction for those clients requiring training/re-training to enable them to safely operate a vehicle without endangering their lives or the lives and property of others.
- To provide recommendations for appropriate vehicles and adaptive driving equipment/devices that will best meet the client's personal transportation needs and allow the client to operate a vehicle within the Highway traffic systems.
- To provide the Medical Advisory board of the Department of Motor Vehicles with reports and recommendations regarding a client's ability to safely operate a motor vehicle as demonstrated during participation in the Driver Training Program.
- To refer clients for further diagnostic measures and/or rehabilitation to improve the client's ability or provide further evaluation of a client's ability to safely operate a personal motor vehicle.

In Maryland, any person who has been treated by a physician or hospital for any of the following physical or mental disorders must report the disorder when applying for or renewing a driver's license for evaluation by the Medical Advisory Board (MAB):

- Alcoholism or Alcohol Abuse
- Cerebral Palsy
- Diabetes
- Drug/Narcotic Abuse or Addiction
- Epilepsy/Loss of Consciousness
- Heart Condition
- Loss of Limb (or loss of use)
- Multiple Sclerosis
- Muscular Dystrophy
- Organic Brain Syndrome
- Schizophrenic Disorders
- Severe Anxiety Disorders
- Stroke
- Major Affective Disorders
- Any other illness in which there was a lapse of consciousness, blackout, or seizure

This is a self-reporting law; and does not mandate responsibility by the treating health-care professionals.

A referral to and participation in the driving evaluation and training program assures the patient, his or her family, the Medical Advisory Board, and referral source that a patient's condition has been evaluated for its effect on his or her ability to safely operate a motor vehicle. Many patients with the above-referenced disorders may also need adaptive equipment to resume driving, such as left foot accelerators, spinner knobs, hand controls, extra mirrors, etc. Patients must be trained in the use of adaptive equipment, and the need for adaptive equipment to drive requires a notation on the driver's license. A physician referral is required for participation in the driver training program, if medical insurance will be billed; however, friends, family, and self-referral occur, and are often self-pay. If a client is referred to the driver training program but refuses to participate, the name of the client is submitted to the referring physician, who is encouraged to notify the Motor Vehicle Administration (MVA) if he or she has reasonable doubt as to the client's ability to operate a motor vehicle. This can be done without violating patient confidentiality by providing the MVA with only the client's name, date of birth, and address.

Patients who participate in the driving program must agree to allow the results to be reported to the MAB. The report may add necessary support for a patient to be allowed to resume driving; however, it may suggest that a patient cease driving (i.e., the effects of the condition compromise the ability to safely operate a motor vehicle).

The clinical driving evaluation costs $80.00 per hour. The time for evaluation varies depending upon a person's speed and level of disability, and rarely exceeds 1.5 hours. The following assessments are performed:

- Upper extremity range of motion, strength, coordination, and sensation;
- Lower extremity range of motion, strength, coordination, and sensation;
- Ambulatory status;
- Sitting balance and endurance;
- Keystone View vision tests: acuity, peripheral vision, sign recognition, depth perception, phoria, night vision, color recognition;
- Motor-Free Visual Perception Test;
- Block Design: construction, apraxia, spatial relations, depth perception;
- Trail-Making Tests (A and B): attention, sequencing, alternating attention;
- Auditory attention tests;
- Driver situation problem solving scenarios;
- Reaction time.

The behind-the-wheel evaluation costs $80.00 per hour. Evaluation time varies slightly, but minimal time for completion of the standardized driving exercises and completion of the designated testing route is 1.5 hours. Assessment areas include:

<u>Performance Skills</u>

- Vehicle entry
- Starting procedures
- Parking lot driving and procedures

<u>General driving skills on residential roads, country roads, and city roads</u>

- Acceleration
- Braking
- Lane position
- Anticipating other vehicles and situations
- Managing hazards
- Signaling intent
- Lane changes
- Following distance
- Yielding right-of-way

Controlled Intersections
Uncontrolled intersections
Turns

Expressway driving

Parking
- Lot parking
- Parallel Parking
- Driveway parking

Observation skills
- Compensation for areas of limited vision
- Anticipating
- Observes cues from other drivers
- Observes posted cues (speed limit signs, regulatory signs, street and highway markings)
- Follows lane markings
- Checks blind spots
- Looks when backing up
- Observes dash board indicators

Endurance

Driver training is provided at a cost of $50.00 per hour. The duration of the training program varies according to a person's weaknesses and targeted training areas; duration of training estimates are discussed after the BTW evaluation has been conducted, as well as at the end of each session. Training is ceased when the driver can complete the behind-the-wheel evaluation driving exercises and the designated testing route safely and with no significant errors. The client may then be scheduled to use the Sinai adapted vehicle to complete the State of Maryland's Motor Vehicle Administration's driving test. Adapted equipment can then be ordered and installed on the client's own vehicle. This may insure that the cost of adapting a vehicle is justified, and supported by the State of Maryland.

Beth Israel Deaconess Medical Center, Boston, MA: DriveWise

This driving evaluation program was designed by the departments of behavioral neurology and occupational therapy for drivers of any age who have neurological, psychological, and/or physical impairments. In the two years that the program has been in operation, approximately 70 drivers have been evaluated. Drivers are referred into the program by family members, primary care physicians, or specialists. There are five parts to the evaluation of driving ability. First is an assessment by a clinical social worker to determine what role driving plays in the individual's life, what it would mean to restrict or cease driving, and what types of alternative transportation are available. Second is an assessment by a neuropsychologist to determine concentration, organizational skills, reasoning, judgment, and speed of information processing. This portion lasts approximately two hours and includes standardized tests as follows: WAIS block design subtest; Raven's Colored Matrices; Mattis Dementia Rating Scale; Digit Span Test; FAS Categories Test; Stroop Test; Go No-Go test; Trail-Making A and B; Written Sequences (months, serial numbers, counting backwards from 20 to 1, alphabet); several subtests from the Wechsler Memory Scale III Test; Rey Osterreith Figure Test; Boston Naming Test; Facial Recognition subtest of the Benton Visual Test; Letter Cancellation; Clock Drawing; and Peg Board test. Third, is a one-hour assessment of mobility, vision, and brake reaction time by an occupational therapist. Fourth, is a 45-minute on-road driving evaluation by a driving instructor and the occupational therapist, which is conducted in a specially equipped vehicle. The on-road test is conducted by a driving school, using a modification of Linda Hunt's Washington University Road Test (WURT). Maneuvers are designed to measure abilities that are difficult for those with brain damage/cognitive impairment (e.g., left-hand turns).

The evaluation team then meets to review their findings, and a written set of recommendations is sent to the participant and referring physician. The fifth component is a follow-up session with the participant and family members, where the social worker presents the team's findings. The social worker can provide educational materials about driving, arrange transportation alternatives, and refer participants to training programs to improve driving skills. If driving cessation is recommended, practical and emotional support is provided for the individual and family members by the clinical social worker, and alternative methods of transportation are identified. If the participant does not follow the recommendation to stop driving, the team may report their findings to the Registry of Motor Vehicles.

An evaluation costs approximately $700-800; each discipline is billed to Medicare or other insurance providers separately. Medicare has been paying for all but the on-road evaluation. The driving school that conducts this portion charges $40, which participants pay for out-of-pocket. The neurologist stated that when billing insurance she writes, "the patient was referred within the context of mental decline of functional capabilities relative to the issue of driving and safety awareness." Medicare and many other insurance providers have paid for the social work evaluation, the neuropsychological evaluation, and the occupational therapy evaluation, using this terminology.

References:

- Hunt (1993)
- Hunt and Weston (*in press*)
- Bryn Mawr Rehabilitation Hospital: Info. provided by Tom Kalina
- Ohio State University Medical Center Older Driver Evaluation Program Evaluation (*pers. comm.*, Bonnie Kantor and Linda Mauger, 1/20/98)
- Sinai Rehabilitation Driver Evaluation and Training Program descriptions
- DriveWise Evaluation, Beth Israel Deaconess Medical Center (a teaching affiliate of Harvard Medical School): Program descriptions; *pers. comm.*, Margaret O'Connor (Neuropsychologist); Jane Matlaw (Public Relations); and Suzanne Curley (Occupational Therapist), 11/19/98.
- Driving Assessment Clinic, UAB Health System: Info. provided by Cynthia Owsley. For more information about the clinic, interested persons can contact (205) 325-8646 or driving@eyes.uab.edu.

IC2(c)i. Standardized Exam over a Common Route

Summary:

Based on the consensus of researchers who have performed work for several State/Provincial DOTs (Romanowicz and Hagge, 1995; McKnight and Stewart, 1990; Jones 1978; McPherson and McKnight, 1981; Engel and Townsend, 1984; Janke and Hersch, 1997) an on-road driving test should measure the constructs of visual search, speed control, and directional control. It should feature a fixed number of possible errors, objective scoring criteria, and the scoring of elements of specific ("structured') maneuvers at specific locations. Examples of structured maneuver errors are "inadequate traffic check," "poor lane position," and "turns too wide or too short." (See attached score sheet). It should also include a destination-finding task (e.g., requiring a driver to safely return to the field office after being directed to drive a short distance past the office; or a "take me to instruction") if implemented in an area familiar to the driver. McPherson and McKnight (1981) state that the use of a set of planned observations of specified performances at particular locations improves uniformity of drive test administration by:

- Allowing the total number of observations and the observations of each type of performance to be standardized regardless of where the test is given.
- Assuring that the examiners' attention is directed toward the same performances at the same time.
- Allowing examiners to practice application of scoring criteria at specific locations until they achieve uniformity of scoring.

They note that the inability to include errors where observations are not planned is frustrating to examiners; however, if the locations of observations are well planned, examiners will be looking where errors are most likely to occur, and the increase in the proportion of total errors that will be observed can outweigh the disregard of errors that occur at other locations. The response of drivers to uncontrollable traffic and weather conditions can say a lot about their competency. To ignore them passes up information concerning an applicant's competency in a manner that can be frustrating to examiners. In addition to the scoring of specific behaviors at specific locations, *critical driving errors* may be listed in a separate section of the score sheet, and marked if committed. These are serious errors that include: examiner intervention; driver strikes object; drives up/over curb/sidewalk; drives in oncoming traffic lane; disobeys sign/signal; dangerous maneuver; inappropriate reaction to school bus; inappropriate reaction to emergency vehicle; inappropriate speed; inappropriate auxiliary equipment use; turn from improper lane.

There are several recommendations regarding delivery of instructions. Instructions should be brief, nontechnical, and use general terms. Instructions should use easily recognized landmarks rather than street names, as street-name use favors drivers who are familiar with the area, penalizes nonreaders, and poses an additional visual task. Instructions should relate only to the route; examiners should not tell applicants which lane to use or give instructions relating to speed, except during the rapid stop check (if it is part of the exam). Wisconsin uses the following language to help clarify instruction, put the person at ease, and avoid misunderstanding or arguments, "I will tell you at least a block ahead of time where to turn. However, I won't tell you which lanes to get into for making a turn or if you should change lanes. I will expect you to decide what is the safe way to turn or change lanes." Further instruction given by Wisconsin DOT driving evaluators is as follows, "I want you to drive as if other traffic is present. That is, drive as if other vehicles are in the next lane, approaching from side streets, and coming toward you." Do not use phrases or words that are instructional (light, signal, stop sign).

Always state *where* to do a maneuver before stating what the maneuver will be. Maneuvers should require planning (e.g., a lane change prior to a turn) and some maneuvers should require working memory skills (e.g., after two blocks turn left). A "take me to" instruction (destination-finding task) is useful in identifying cognitively impaired drivers.

Dobbs (1997) makes the following conclusions about the optimal type of on-road course for road testing of older drivers:

- A lengthy course is unnecessary, if it has been properly designed.
- It should include a large number of left and right turns under varying intersection control conditions.
- It should include left, right, and through maneuvers at uncontrolled intersections.
- It should include a visually complex environment, preferably with moderate to heavy traffic flow and with multiple lanes of traffic in each direction.
- A freeway or highway portion appears to be unnecessary.

Finally, McKnight and McKnight (1998) caution that the road test does not appear to be well-suited to detection of age-related functional declines, *unless* observations of on-road performance are made by professionals who are trained and experienced in the identification of age-related disabilities. In their study of 407 drivers age 62 and older (two-thirds of whom were referred for reexamination due to incidents of unsafe driving), the correlations between road test deficiencies and subject group (incident-involved vs. incident-free) were small (in the 0.1 to 0.2 range). When the effects of road test site and examiner differences were partialled out, the correlations of individual ability-related road test measures with unsafe driving incidents increased to the 0.2 to 0.3 range, with a correlation of 0.41 for navigation errors and 0.46 for the overall test.

Taking into account the considerations described thus far, the Modified Driver Performance Evaluation (Janke and Hersch, 1997) appears to be an appropriate road-test template for a standardized test of older driver ability. Test times range from 30 to 45 minutes. The MDPE differs from the DPE[4], in that it omits the DPE's freeway driving segment and includes a destination-finding task that requires a subject to safely return to the field office after being directed to drive a short distance past the office. A scoresheet is presented on the following page. The MDPE includes:

- 4 left turns and 4 right turns (mixed difficulty levels; 2 of the left and 2 of the right turns should have multiple lanes requiring correct lane choice on approach and finish; 1 left and 1 right should be at signal controlled intersections; 2 additional turns preferably at stop controlled intersections but may be uncontrolled with limit lines, crosswalks, turn lanes).

- 8 through intersections (2 controlled by a light [red, yellow, and green]; 2 controlled by a stop sign; 2 through/straight ahead intersections not involving stops; 2 additional intersections preferably controlled by traffic lights).

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[4] The Driver Performance Evaluation (DPE) is based on Ray Engel's driver performance measurement model. A 4-stage project was undertaken to develop an improved competency-based drive test for possible state-wide implementation in California (Romanowicz and Hagge, 1995). It was piloted in 30 CALDMV field offices. The results provide strong evidence that the DPE is a valid test. Inexperienced drivers and drivers with mental or physical conditions that affect their driving tended to perform worse than did experienced drivers with no known driving-related debility. Novice original, limited term renewals, and 3-crash reexamination driver groups had significantly higher/worse mean scores than did out-of-state originals, congratulations renewal (good drivers not required to take knowledge test), and written test renewal groups.

DMV
A Public Service Agency

MODIFIED DRIVING PERFORMANCE EVALUATION SHEET

DATE	APPLICANT'S FULL NAME *(FIRST, MIDDLE, LAST)*	DRIVER LICENSE NUMBER	NUMBER OF ERRORS

FIELD OFFICE	SIGNATURE OF EXAMINER	ID NUMBER	EXAMINER'S NAME *(PRINT)*

PRE-DRIVE CHECKLIST

1. Driver window ☐
2. Windshield ☐
3. Rear view mirrors ☐
4. Turn signals F / B ☐
5. Brake lights ☐
6. Tires ☐
7. Foot brake ☐
8. Horn ☐
9. Emergency/parking brake ☐
10. Arm signals ☐
11. Windshield wipers ☐
12. Defroster ☐
13. Emergency flasher ☐
14. Headlights ☐
15. Passenger door ☐
16. Glove box ☐
17. Seat belts ☐

CRITICAL DRIVING ERRORS

Intervention by examiner	0
Strikes object	0
Up and over curb or sidewalk	0
Drives in oncoming traffic lane	0
Disobeys traffic sign or signal	0
Dangerous maneuver	0
Reaction to school bus	0
Reaction to emergency vehicle	0
Speed	0
Auxiliary equipment use	0
Turning from improper lane	0

BACKING

Traffic check	0
Speed	0
Braking	0
Vehicle position	0

PARKING LOT DRIVING

	1	2
Traffic check	0	0
Speed	0	0

STRAIGHT BUSINESS AND RESIDENTIAL

	B	R
Traffic checks	0	0
Speed	0	0
Spacing	0	0
Lane position	0	0

TURNS

	LEFT 1	2	3	4	RIGHT 1	2	3	4
Approach	1	2	3	4	1	2	3	4
Traffic check	0	0	0	0	0	0	0	0
Signal	0	0	0	0	0	0	0	0
Speed	0	0	0	0	0	0	0	0
Lane	0	0	0	0	0	0	0	0
Unnecessary stop	0	0	0	0	0	0	0	0
Stop	1	2	3	4	1	2	3	4
Traffic check	0	0	0	0	0	0	0	0
Speed	0	0	0	0	0	0	0	0
Full stop	0	0	0	0	0	0	0	0
Gap or Limit line	0	0	0	0	0	0	0	0
Wheels straight	0	0	0	0				
Turn/Complete	1	2	3	4	1	2	3	4
Traffic check	0	0	0	0	0	0	0	0
Steering control	0	0	0	0	0	0	0	0
Too wide/short	0	0	0	0	0	0	0	0
Correct lane	0	0	0	0	0	0	0	0
Speed	0	0	0	0	0	0	0	0
Signal	0	0	0	0	0	0	0	0

INTERSECTIONS

	1	2	3	4	5	6	7	8
Through								
Traffic check	0	0	0	0	0	0	0	0
Speed	0	0	0	0	0	0	0	0
Unnecessary stop	0	0	0	0	0	0	0	0
Stop	1	2	3	4	5	6	7	8
Traffic check	0	0	0	0	0	0	0	0
Speed	0	0	0	0	0	0	0	0
Full stop	0	0	0	0	0	0	0	0
Gap or Limit line	0	0	0	0	0	0	0	0
Start								
Traffic check	0	0	0	0	0	0	0	0
Yield	0	0	0	0	0	0	0	0
Speed	0	0	0	0	0	0	0	0

LANE CHANGES

	L	R
Traffic check	0	0
Signal	0	0
Speed	0	0
Spacing	0	0
Steering control	0	0

MERGE

Traffic check	0
Signal	0
Speed	0
Spacing	0
Lane position	0
Steering control	0

CURVE

Entering speed	0
Through speed	0
Lane position	0

STREET PARK

	E	X
Traffic check	0	0
Signal	0	0
Speed	0	0
Parking	0	0
Parallel	0	

DESTINATION TRIP

	To	Fr
Traffic checks	0	0
Speed	0	0
Spacing	0	0
Lane position	0	0
Turns	0	0
Intersections	0	0
Lane changes	0	0
Concentration	0	0

COMMENTS

- Curve negotiation (preferably a left curve; lanes should be marked, must require driver to adjust speed).
- 3 lane changes (1 left, 1 right, 1 located anywhere on the route, preferably at higher speeds).
- Minimum of 3 blocks of driving in a business area with moderate traffic density.
- Minimum of 3 blocks of driving in a residential areas preferably with narrow streets.
- Performing parking lot maneuvers, backing, and a street park.

The destination driving task may be incorporated to test for possible cognitive impairment. In their research, Janke and Hersch (1997) found that cognitively impaired referrals had significantly more "confusion errors" than cognitively nonimpaired referrals. This particular MDPE measure was the only driving performance measure where there was a difference in driving performance between cognitively impaired and cognitively nonimpaired drivers.(Subjects were told prior to the "detour" that they would be expected to find their way back).

Consideration should be given to testing an individual who fails the on-road evaluation administered at the DMV in their home area; route familiarity and familiarity with the traffic control devices and traffic patterns in a person's home area may improve driving performance and allow for licensing restrictions to be imposed (e.g., 15 mile radius from home address; no driving on U.S. Route ____), as opposed to license revocation. Staplin et al. (*in press*) found that drivers' error rates vary as a function of the type of traffic control (signal, stop sign, yield, or no control), the familiarity of the course, and the type of movement (straight through, left turn, right turn). Route familiarity had little to no effect on error rates exhibited at signalized intersections. However, for right turns in yield and uncontrolled intersections, error rates were noticeably higher on the unfamiliar course. This may have resulted from drivers "knowing what to look for" as a result of experience in familiar areas.

Turning toward a consideration of road tests for persons with physical and cognitive disabilities, Wisconsin DOT employs a tailored road test for persons with medical conditions or functional impairments. In Wisconsin, a "driving evaluation" is a limited skills test conducted to determine if a person adequately compensates for his or her medical condition or functional impairments. A "skills test," in contrast, is a driving examination consisting of a standard number of driving skills or traffic situations, designed to examine the ability of a person who has not been previously licensed in any jurisdiction to safely operate a representative motor vehicle.

Wisconsin's Administrative Code §Trans 104.08 provides that driving evaluations may be conducted on either a pre-established route or in an area and at a time that can best demonstrate the person's ability to compensate for a medical condition or functional impairment. It also provides that any of the driving skills specified for the "skills test" may be tested, but a complete skills test shall be administered only if the applicant "demonstrates an inability to exercise ordinary and reasonable control in the operation of the vehicle, and the inability is not related to the medical condition or functional impairment." WisDOT DMV Guidelines for administering the driving evaluation further provide that "only those maneuvers that evaluate the disability" are to be included in this test. It must include "maneuvers/situations necessary to determine if a person adequately compensates for the condition or impairment." Examples of functional impairment for which an evaluation may be given include: limited mobility of upper body and neck, which prevents/restricts ability to check for traffic to the sides and rear of the vehicle; substandard vision; severe arthritis that affects range of motion; and mental/emotional condition or brain trauma.

All Wisconsin passenger vehicle *skills tests* (driving examination) must evaluate the following driving skills: (1) four right and four left turns; (2) two stopped and two through intersections; (3) business/residential driving; (4) lane changes; (5) Y turn; (6) hill park; (7) parking lot; (8) parking; and (9) backing. A skills tests may also include a test of the operator's ability to stop the vehicle quickly.

A *limited skills test* (driving evaluation) must include maneuvers/situations necessary to determine if the person adequately compensates for a condition or impairment. The basic maneuvers that are required for all special examinations are as follows: minimum of two left turns; minimum of two right turns; minimum of two intersections (stopped, through, controlled or uncontrolled); urban and rural area (may be optional on driving evaluations); lane change (may be optional on driving evaluations); driveway turn around (may be optional on driving evaluations); curb stop on hill, hazard recognition; and quick stop. Optional maneuvers are at the examiner's discretion, based on the reason for the driving evaluation and the person's physical condition or functional ability. The maneuvers listed are minimum maneuver requirements. When conducting re-exams or limited area special exams, there may be more than two left and two right turns or intersections. The examiner must pay particular attention to the customer's range of motion; reaction time; endurance; coordination; speed in operating/moving controls; strength to operate controls; ability to cope with traffic; and alertness and ability to turn head/body.

The Wisconsin Class D Skills Test scoring sheet (MV3544) is presented on the next page, followed by the Reexamination Score Sheet (MV3137).

A *limited area examination* may be given in Wisconsin to a driver who is unable to cope with complex traffic situations. It may also be appropriate for a customer who has a medical or functional impairment that severely limits driving ability. The objective of this non-directed test is to determine whether the driver can safely operate a motor vehicle in a familiar area. The test is constructed around the driver's home area and on routes that take the driver where he/she needs to go (e.g., doctor, grocery store). A customer does not need to fail the standard exam before qualifying for a limited area exam; however, if a driver chooses to be tested in the limited area, he/she will not be able to drive outside of the designated limit.

Wisconsin provides the following tips to examiners for testing drivers with functional impairment or medical conditions.

Limited mobility of upper body and neck: Have driver turn around in driveway, perform lane changes, and pull over/enter traffic from the curb. These maneuvers require head and body movement, and will help answer the question of whether a driver has enough strength and range of motion to safely operate the vehicle.

Substandard vision: Use a highway with various speed limits and traffic signs. Have the driver read/tell you what action(s) he or she takes in response to the signs. Do this at different speeds to determine the maximum speed at which the driver can safely operate and still make necessary decisions using information on the signs. Also evaluate the driver's positioning in traffic lanes, especially when configuration changes, and the ability to read, understand, and obey other traffic warning signs and follow lane markings.

Severe arthritis or other conditions that affect range of motion: Test the driver in moderate/heavy traffic where there are many stops and starts. If heavy traffic is unavailable, ask driver to pull over

CLASS D SKILLS TEST

Wisconsin Department of Transportation

MV2644 3/97 s.343.16 Wis. Stats.

Driver Name - First, Middle, Last	Birth Date	Driver Identification Number / Social Security Number

Turns

Left 1	2	3	4	Turns	Right 1	2	3	4
				Approach				
O	O	O	O	Traffic Check/Defensive	O	O	O	O
O	O	O	O	Signal	O	O	O	O
O	O	O	O	Speed (Coast)	O	O	O	O
O	O	O	O	Lane (Wide/Short)	O	O	O	O
O	O	O	O	Unnecessary Stop/Hesitates	O	O	O	O
				Stop				
O	O	O	O	Full Stop/Gap/Stop Line/ Crosswalk/Right on Red	O	O	O	O
O	O	O	O	Wheels				
				Turn/Complete				
O	O	O	O	Traffic Check/Defensive	O	O	O	O
O	O	O	O	Speed (Coast)	O	O	O	O
O	O	O	O	Lane (Wide/Short)	O	O	O	O
O	O	O	O	Steering/Hands (Gear)	O	O	O	O

(1 Turn into Wrong Lane) (Room for Another Vehicle) (Does not Enter) (Enters on Yellow) (Curb) [5]

Intersections

(Through/Uncontrolled/Railroad)

	Stop 1	Stop 2	Through 1	Through 2
Stop				
Traffic Check	O	O		
Speed/Lane (Coast)	O	O		
Gap/Stop Line/Crosswalk	O	O		
Start				
Traffic Check/Defensive	O	O	O	O
Speed/Lane (Coast)	O	O	O	O
Unnecessary Stop/Hesitates	O	O	O	O

(Look or Slow) (Enters on Yellow) (Does Not Enter) [5]

Business/Residential

- Traffic Check/Defensive O
- Speed/Unnecessary Stop O
- Lane O
- Close to Vehicle/Object O

(Control Speed) (Does Not Recognize Hazardous Situation) [5]

Lane Change

	L	R
Traffic Check	O	O
Signal	O	O
Speed/Control	O	O
Spacing	O	O

(Blind Spot) (Lane Change Intersection) (Control) [5]

Y Turn

Approach

- Traffic Check O
- Signal O

Performance

- Traffic Check (Side/Rear) O
- Signal O
- Speed (Gear) O
- Control O

Resume

- Traffic Check O
- Speed/Lane O

(Curb) (Blind Spot) (Control) (Look Back) [5]

Hill Park

Approach

- Traffic Check O
- Signal O
- Speed/Lane/Control O

Performance

- Control (Wheels/Brake) O

Resume

- Traffic Check O
- Signal O
- Speed/Lane/Control O

(Curb) (Blind Spot) [5]

Parking Lot

(Enter/Exit)

- Traffic Check O
- Signal O
- Speed/Lane/Crosswalk O
- Right of Way O
- Controls/Equipment O

(Does Not Recognize Hazardous Situation) [5]

Equipment Denial

- No Brakes - Tires
- Horn - Mirrors [75]
- Speedometer
- Expired Plates (more than 30 days)
- No Seat Belt [72]
- Turn Signals
- Lights
- Other:

Parking

(Parallel/Angle/Straight)

Approach

- Traffic Check O
- Signal O

Performance

- Traffic Check O
- Control/Spacing O

Resume

- Traffic Check O
- Signal O
- Speed/Lane O

(Bumper Contact) (Control) (Blind Spot) (Look Back) [5]

Backing

Approach

- Traffic Check O
- Signal O

Performance

- Traffic Check O
- Control/Path O
- Speed O

Resume

- Traffic Check O
- Signal O
- Speed/Lane O

(Speed) (Look Back) (Curb) (Blind Spot) (Center Line) [5]

Immediate Disqualifications

Law Violation

- Speed O
- Disobeys Sign/Signal O
- Drives in Oncoming Traffic Lane O
- Turns into/From Improper Lane O

Dangerous Act

- Up/Over Curb O
- Examiner Warning/Control O
- Uncontrolled Intersection O
- Evasive Action/Right of Way O

Accident

Demonstrates Inordinate Lack of Skill Ability, or Knowledge O

Other O

Comments

Total Score

☐ Pass
☐ Fail

Exam Location	Date	Examiner ID	Examiner Signature

RE-EXAMINATION REPORT

MV2137 [illegible] s.343.16 Wis. Stats.

Wisconsin Department of Transportation

Name (First)	(Middle)	(Last)	Operator License Number	Expiration Date

Address (Street or RFD)	Birth Date	Telephone Number

City	County	Applicant Signature
		X

EXAMINATION DATA

Reason for Exam

☐ Field Generated Re-Exam

☐ Demand/Eval

	Qualified	Unsatisfactory
Knowledge	☐	☐
Highway Signs	☐	☐

	Normal	Deficient
Hearing	☐	☐
Vision - Color	☐	☐

	Yes	No
Corrective Lenses Required	☐	☐

Stereopsis %

V/A	W/O RX	With Present RX	With New RX	Temporal Field of Vision in Degrees
Right Eye				
Left Eye				

Recommended Restrictions

☐ No. 1 Corrective Lenses

☐ No. 2 Hearing Aid - Outside Mirror

☐ No. 3 Automatic Transmission

☐ No. 4 Automatic Turn Signals

☐ No. 5 Daylight Driving Only

☐ No. 9 Complete Hand Controls

☐ No. 10 Left Outside Mirror

☐ No. 11 Right Outside Mirror

☐ No. 12 Adequate seat Adjustment

☐ No. 99 Additional Restrictions Card Required

Score = F-Fair, P-Poor, U-Unsatisfactory

Maneuvers not scored are satisfactory.

		F	P	U
1.	Starting (on the level)	☐	☐	☐
2.	Hill stop and start	☐	☐	☐
3.	Quick stop	☐	☐	☐
4.	Speed and braking	☐	☐	☐
5.	Backing	☐	☐	☐
6.	Parallel parking	☐	☐	☐
7.	Turn-about (Y-turn)	☐	☐	☐
8.	Approach to intersection	☐	☐	☐
9.	Signaling intention	☐	☐	☐
10.	Right turn	☐	☐	☐
11.	Left turn	☐	☐	☐
12.	Traffic signals	☐	☐	☐
13.	Stop sign	☐	☐	☐
14.	Following	☐	☐	☐
15.	Passing and being passed	☐	☐	☐
16.	Position on road	☐	☐	☐
17.	Right of way to vehicles	☐	☐	☐
18.	Right of way to pedestrians	☐	☐	☐
19.	Attention and distraction	☐	☐	☐
20.	Driver position	☐	☐	☐

☐ Qualified ☐ Unsatisfactory

Examiner's Observation of Applicant's Physical Condition and/or Disability

Remarks - Additional Restrictions No. 99

Driving Exam/Eval No.	Examination Date	Re-Exam Appointment Date

X
(Examiner Signature) (Badge Number)

Reason for Cancellation

I acknowledge that my license is cancelled as of this date for the reason stated.

X

to the side of the street and do several pulling from and to the curb maneuvers. In addition, a driver who has difficulty moving his or her legs should be asked to perform the quick stop maneuver.

Mental and emotional condition or brain trauma: The following questions should direct tests chosen: Is the driver able to follow directions? Does the driver appear confused? Does the driver require several seconds of thinking and follow through time before reacting? Does the driver see and react in sufficient time to on/off street situations? Does the driver take several seconds of thinking time to respond to questions or instructions?

Wisconsin was identified by several other Driver License Administrators as having recently been acquitted of violating the ADA or Section 504 of the Rehabilitation Act by requiring an out-of-state applicant with a disability (but whose license was not appropriately restricted) to take a driving evaluation before being issued a driver's license in the state of Wisconsin. The NHTSA Office of Civil Rights stated that WisDOT regulations authorizing a driving evaluation for disabled drivers' license applicants constitutes a safety qualification of Wisconsin's drivers' licensing program. It is less extensive than the "skills test," which is given to applicants who have never held a license in any jurisdiction. In contrast, the DMV guidelines specify that the "driving evaluation" is to be tailored specifically to the physical limitations presented by the individual applicant's impairment. Wisconsin regulations permit waiver of the driving evaluation for disabled persons who already have restrictions on their out-of-state licenses. The restrictions appearing on these licenses give Wisconsin DMV the information it needs about the individual's ability to drive safely with a functional impairment; and therefore it is reasonable for Wisconsin to accept those restrictions as evidence equivalent to a driving evaluation.

The fact that Wisconsin permits some disabled applicants—those for whom it has information about their ability to drive safely—to obtain a license without taking a driving evaluation indicates that the driving evaluation requirement challenged by the Complainant in the discrimination case is not discriminatory within the meaning of the ADA and the Rehabilitation Act.

Hunt, Murphy, Carr, Duchek, Buckles, and Morris (1997a, and 1997b) conducted a study to assess the reliability and stability of a standardized road test for healthy aging people and those with dementia of the Alzheimer type (DAT). The Washington University Road Test (WURT) is a 9.6-km (6 miles) course with urban 2-, 4-, and 6-lane streets providing various road and traffic conditions to enable detection of driving behaviors associated with crashes in the elderly: failing to yield right-of way, responding inappropriately to traffic signs and signals, and difficulty negotiating intersections.
The initial test site (a large empty asphalt parking lot) was used for familiarization of the subject with the test vehicle (standard-model car with automatic transmission, and dual brake pedals). Seven basic motor vehicle operational tasks were assessed on a pass/fail basis: insert key into ignition; start engine; shift from park to drive; drive forward 45 meters (148 feet), make a left turn; stop. Subjects proceeded from closed course to open segment, unless major safety concerns were detected during familiarization. A commercial driving instructor plus the Principal Investigator accompanied each subject during the drive. A global "safe/behavior unlikely to result in crash," "marginal/small-to-moderate risk of crash," or "unsafe/substantial risk of crash" subjective rating of driving performance was made by the instructor and Principal Investigator (PI). A quantitative score was also calculated independently by the instructor and PI. The best possible score was 108, the worst possible score was 0. A 3-point scale (0=moderate to severe impairment; 1=mild impairment; 2=no impairment) was used at predetermined locations on the following maneuvers: left turns, stops, lane maintenance, speed, traffic awareness, merging, concentration, lane changes, traffic signs, comprehension of directions, attention to task,

awareness of how driving is affecting others, judgment, need for intervention by instructor for safety reasons.

The subjects were recruited from the Alzheimer's Disease Research Center (ADRC) at Washington University School of Medicine and included:

- 58 healthy elderly control subjects, mean age = 76.8 years; Clinical Dementia Rating =0
- 65 subjects with Dementia of the Alzheimer's type (DAT), mean age = 73.7 years; divided into 2 groups:
  36 subjects with Clinical Dementia Rating = 0.5 (very mild DAT)
  29 subjects with CDR = 1.0 (mild DAT).

There was a significant relationship between global rating and CDR, such that most CDR-0 subjects were rated as "safe" [78% (45/58) compared to 67% (24/36) of CDR-0.5 subjects and 41% (12/29) of CDR-1 subjects. Only 3 percent of CDR-0 subjects were judged "unsafe," but 19 percent of CDR-0.5 and 41 percent of CDR-1 subjects were judged "unsafe." The remaining subjects in each CDR group were rated "marginal." As dementia severity increased, the quantitative scores decreased. Mean road test scores for the CDR-0, CDR-0.5, and CDR-1 groups were 94.3, 92.0, and 85.6, respectively. Correlational analyses showed a significant association between drive performance scores and CDR level.

The stability of driving behavior over time was examined with a 1-month test-retest paradigm for 63 subjects. The stability of the global rating by the same driving instructor on the same course was 0.53, and for the quantitative score, reliability was 0.76. Few safe drivers at baseline became unsafe at 1 month, and few unsafe drivers at baseline became safe at 1 month. The disproportionate instability came from the "marginal' drivers. It was suggested that visual environmental cuing (e.g., following a lead vehicle) may affect driving performance; cognitively impaired drivers may seek the actions of other drivers to follow the flow of traffic.

For specific driving behaviors, 24 (81%) of the unsafe drivers required assistance [vs 11 (14%) of the safe drivers]. Turn signal use/non use did not discriminate between safe and unsafe drivers. The strongest correlation with the global rating was with qualitative judgments on WURT driving performance. These judgments evolved from observing the overall cognitive performance of the subject's driving.

The WURT scoresheet is presented in the following four pages.

Dobbs (1997) used subjects in the DrivAble cognitive screen development research to develop road test procedures and scoring. The majority of the drivers who failed the road test received low scores on the cognitive screen; the majority of the drivers who passed the road test received high scores on the cognitive screen. The subjects included 279 drivers across three groups:

- 176 patients who were referred to a clinic with suspected decline in mental abilities (majority were diagnosed with Alzheimer's) with a mean age of 72 years;
- 70 mature healthy drivers, who volunteered for the research, with a mean age of 69 years;
- 33 young healthy controls, who also volunteered, ranging in age from 30 to 40, with a mean age of 36 years.

A two-part road test was administered by two experienced driving instructors from the Canadian Automobile Association. Testing was conducted in a mid-sized American car equipped with dual brakes. The first part was a closed course on paved streets with curbs, but was undeveloped allowing traffic to be restricted and signs to be placed as desired. The open road test consisted of 37 maneuvers, required 40 minutes to administer, and was conducted on commercial and residential

WASHINGTON UNIVERSITY ROAD TEST

IN-CAR, OPEN ROAD DRIVE EVALUATION

OPEN ROAD TEST

A. Lane Change on Oakland

1. Signals (0= does not signal; 1=late signal; 2= timely signal)	0	1	2
2. Checks blind spot (0= does not check at all; 1=mirrors only; 2= by turning head)	0	1	2
3. Speed control (0= more than 5mph; 1=5mph above or below speed limit; 2= accurate)	0	1	2
4. Smoothness of lane change (0= unable to perform independent of verbal cues or assistance) 1=too slow or fast, slight indecision;	0	1	2

B. Four Way Stop Sign (Tamm)

1. Plans for stop sign by slowing vehicle	0	1	2
2. Completes stop (0=slows down but fails to stop; 1=slight roll through)	0	1	2
3. Does not hesitate without reason before proceeding (0 =no; 1=yes)	0	1	
4. Checks traffic before proceeding (0=does not look by turning head; 1=looks in 1 direction)	0	1	2
5. Yields right of way (0=no; 1=yes)	0	1	

C. Right Turn at Skinker

1. Traffic light observance (0=no; 1=yes)	0	1	
2. Problem solves for immediate left turn (0=no; 1=yes)	0	1	
3. Car in appropriate lane for left turn (0=no; 1=yes)	0	1	

D. Left turn at Clayton

1. Traffic light observance (left only on arrow) (0=goes on green but traffic is not clear; 1=goes on green but traffic is clear)	0	1	2
2. Appropriate speed for turn (0=no; 1=yes)	0	1	
3. Stays in lane (0=no; 1=yes)	0	1	

WASHINGTON UNIVERSITY ROAD TEST

IN-CAR, OPEN ROAD DRIVE EVALUATION

E. Left turn on Bellevue

1. **Traffic light observance (left turn yield on green or on arrow)** 0 1
(0=no; 1=yes)

2. **Does not hesitate without reason** 0 1
(0=no; 1=yes)

3. **Yields right of way** 0 1 3
(0=no; 1=yes; 3=not observed)

4. **Safety awareness for pedestrians** 0 1 3
(0=no; 1=yes; 3=not observed)

F. Left turn at Wise (four-way stop)

1. Plans to stop by slowing down 0 1
(0=no; 1=yes)

2. Signals 0 1
(0=no; 1=yes)

3. Sign observance for complete stop 0 1
(0=no; 1=yes)

4. Checks traffic before turning 0 1
(0=no; 1=yes)

5. Yields right of way 0 1 3
(0=no; 1=yes; 3=not observed)

6. Does not hesitate without reason 0 1
(0=no; 1=yes)

G. Starting from curb in traffic

1. Signals 0 1 2
(0= does not signal; 1= as pulling out; 2= before pulling out)

2. Checks traffic 0 1 2
(0= does not check traffic; 1= as pulling out; 2= before pulling out)

3. Mirror use 0 1 2
(0= only uses rearview mirror; 1=only uses left mirror; 2= looks over shoulder)

H. At Wise and Barthold (One Way, Do Not Enter),
Ask: "Could you go straight here?" "Why?" 0 1 2

I. Left Turn on McCausland

1. Does not hesitate without reason 0 1
(0=no; 1=yes)

2. Sign observance 0 1
(0=no; 1=yes)

3. Appropriate speed of turn 0 1
(0=no; 1=yes)

WASHINGTON UNIVERSITY ROAD TEST

IN-CAR, OPEN ROAD DRIVE EVALUATION

(J. K. and L. refer to drive from McCausland to Kingshighway).

J. Lane Keeping
(0=crosses lane line unintentionally; 1=drives straight;) 0 1

K. Appropriate Speed (between 5 miles per hour or more below speed limit or 5 miles per hour above speed limit)
(0=no; 1=yes) 0 1

L. Awareness of Traffic Environment

1. Checks mirrors 0 1
(0=no; 1=yes)

2. Looks ahead at traffic 0 1
(0=no; 1=yes)

3. Reacts to flow of traffic 0 1
(0=no; 1=yes)

4. Awareness of how driving is affecting others 0 1 3
(0=no; 1=yes; 3=not observed)

5. Attends to task of driving 0 1
(0=no; 1=yes)

M. Left on Kingshighway

1. Traffic light observance (left on arrow) 0 1
(0=no; 1=yes)

2. Does not hesitate without reason 0 1
(0=no; 1=yes)

3. Turns in appropriate lane 0 1
(0=no; 1=yes)

N. Problem Solving (traffic merging from right)

1. Awareness of traffic environment 0 1
(0=no; 1=yes)

2. Speed control 0 1
(0=no; 1=yes)

3. Appropriate reaction to merging car 0 1 3
(0=no; 1=yes; 3=not observed)

O. Prepare for Right turn onto Forest Park blvd.

1. Signals 0 1
(0=no; 1=yes)

2. Problem solves merging traffic 0 1 3
(0=no; 1=yes; 3=not observed)

3. Checks blind spot 0 1 2
(0= fails to check; 1=mirror; 2= turns head to check)

WASHINGTON UNIVERSITY ROAD TEST

IN-CAR, OPEN ROAD DRIVE EVALUATION

P.	**Lapses of Concentration** (0=no; 1=yes)	0	1
Q.	**Follows Directions** (0=no; 1=yes)	0	1
R.	**Overall Judgement** (0=no; 1=yes)	0	1

TOTAL SCORE: ____________________

S. Requirement for Driving Assistance (i.e. instructor uses dual brake or steering wheel)
Yes ______ No______

T. Non-Standard Situation – Describe (i.e. hazard detection):______________________________

____

____

____

U. Investigator's Global Judgement of Driving Safety: (determine prior to calculation of total score above)
Occupational Therapist (2) Safe____ (1) Marginal____ (0) Unsafe____

V. Driving Instructor: (2) Safe____ (1) Marginal____ (0) Unsafe____

"Safe"	Demonstrated behavior very unlikely to result in accidents or traffic conflict.
"Marginal"	Demonstrated behavior presents a small to moderate increase in risk of accidents or traffic conflict.
"Unsafe"	Demonstrated behavior presents substantial risk of accidents or traffic conflict.

streets, and an urban freeway. Maneuvers were selected to maximize those implicated in older-driver crashes. Some instructions for downstream maneuvers were given; other maneuvers required planning (e.g., a lane change prior to a turn); and some maneuvers required working memory skills (e.g., turn left after two blocks). There was also a "take me to" instruction. Definition and scoring of errors was as follows:

- Hazardous or potentially catastrophic driving errors: errors committed by drivers who are no longer competent to drive (e.g., wrong-way on a freeway, stop at green light), and would result in a crash if examiner did not intervene or traffic did not adjust.
- Discriminating driving errors: potentially dangerous errors that signal declining driving skill (e.g., poor positioning on turns and straight aways, observational and scanning errors, and overcautiousness).
- Non-Discriminating driving errors: errors made equally often by good and bad drivers, reflecting bad habits as opposed to declining ability (e.g., rolled stops and speed errors). Drivers are not penalized for non-discriminating errors. Discriminating errors are documented and scored in terms of their severity (5, 10, or 51 points). Hazardous errors were renamed as Criterion errors and the commission results in an automatic fail. A combined criterion of one or more criterion errors and/or discriminating point total exceeding criterion, results in a failure on the road test.

Using the joint criterion, all of the young normal drivers passed the road test, approximately 95 percent of the mature control group drivers passed the road test, and only 25 percent of the cognitively impaired (patient) group passed the road test.

A driving assessment procedure in the United Kingdom is described next. The procedures used at Mobility Advice and Vehicle Information Service (MAVIS) are to help answer the question of whether a license holder can safely return to driving following a crash or injury, or if a physical, mental, or medical condition is acquired that is likely to affect fitness to drive. MAVIS is located on the site of the Transport Research Laboratory, Department of the Environment, Transport and the Regions, Crowthorne, Berkshire, England. The assessment consists of four complementary modules: two in the office (i.e., an interview and a physical/sensory assessment); and two sessions in a car, which require driving on a private road course and driving in real traffic. The in-car exercises are used to evaluate a client's physical and cognitive driving skills. The full assessment (in-office plus in-car) takes approximately 4 to 4.5 hours with a 0.5- to 1-hour lunch break. Following the assessment, the findings are discussed with the client and advice is provided regarding appropriate courses of action. The in-car assessment is described below.

Private Road Course. The testing is divided into 10 exercises and takes about 1 hour to complete. A warm-up drive is completed around the outer roads before the exercises are begun. The exercises are scored on a scale of 1 to 4; a score of 4 indicating "definitely safe," a score of 3 indicating "probably safe," a score of 2 indicating "probably unsafe," and a score of 1 indicating "definitely unsafe." Second attempts are given for some of the exercises. The maneuvers and skills assessed include:

Exercise	Maneuver	Skills Assessed
1	Routine drive around course, maintaining proper lane position, stopping at stop lines, and yielding at give way lines.	Operation of car controls; perception of environment; spatial ability
2	Routine drive making 3 passes through traffic lights, stopping for red lights and proceeding on green.	Choice reaction

Exercise	Maneuver	Skills Assessed
3	Similar to previous exercise, however client must also look for directional information sign and follow the direction indicated.	Assessing choice reaction; work load; and orientation
4	Drive which includes following instructions along a certain path, entering a dead-end area and turning around, and driving out of the dead-end, and back on the course.	Audio/visual memory, operation of car controls, spatial ability, and orientation
5	A reverse onto a side road.	Spatial ability and operation of car controls
6	Conducting a parking maneuver.	Spatial ability and orientation
7	Conducting a driving maneuver which requires the car running on one side of the center line, then upon adviser instruction positioning car on to other side of center line.	Spatial ability
8	Task requires driving down a hill and weaving in and out of cones.	Motor coordination and spatial ability
9	Driver given instructions and a map, and asked to follow course along map.	Information processing and cognitive mapping
10	Upon successful completion of Exercise 9, client is instructed to drive around same route without instruction.	Memory

In-Car Assessment in Real Traffic Conditions. This assessment is a continuation of the evaluation of skills from the private road course (i.e., use of car controls, spatial skills, and perception of the environment) plus an assessment of decision making, steering while driving at 60 mph, attention, interaction with other road users, and the effect of motor/cognitive workload in multitasking exercises. Although the route is standardized and each client drives the same route (which is about 10 miles in length and takes about 25 minutes to complete), the same traffic and operating conditions do not prevail for each client. Therefore the advisor scores particular actions and not every event. A brief description of each exercise and what it assesses, follows:

Exercise	Maneuver	Skills Assessed
1	Observed driving behavior through 5 roundabouts. Elements for scoring: unnecessary stops at roundabout, necessary stops at roundabout, speed of approach, position with regard to other traffic	Decision making
2	Counting to 30 while negotiating roundabout. Elements for scoring: effect of counting on driving performance, effect of driving performance on counting, choice of which is given priority (driving or counting)	Divided attention
3	Observed driving behavior at 4 mini roundabouts.	Decision making
4	Interactions with other road users. Elements for scoring: does client observe and take appropriate action for pedestrians using crossings? Does client observe speed restrictions, both signs and physical barriers? Does client take note of happenings in busy center?	Interactions with other road users

Exercise	Maneuver	Skills Assessed
5	Driving at 60 mph keeping a safe course and avoiding centerlines and edgelines.	Spatial ability at speed
6	Detection of traffic signs	Attention
7	Behavior when making two specific lane changes. Elements for scoring: client observation and awareness of conditions prior to lane change, signaling, appropriate speed for safe lane change.	Interaction with and awareness of other road users
8	Taking a route which encounters 4 roundabouts by following signs to a destination. Elements for scoring: correct direction, safe and accurate positioning, client awareness of other traffic, behavior at roundabouts.	Information processing in high workloads

A written report is provided to the client, but client confidentiality is practiced. The aim of MAVIS is to offer information on driving ability, not to decide on driving license status.

References:

- Dobbs (1997)
- Engel (1991)
- Engel and Townsend (1984)
- Janke (1994)
- Janke and Hersch (1997)
- Jones (1978)
- MAVIS (1998)
- McKnight and Adams (1970)
- McKnight and Stewart (1990)
- McPherson and McKnight (1981)
- Ranney and Pulling (1990)
- Romanowicz and Hagge (1995)
- Staplin, Gish, Decina, Lococo, and McKnight (1998)
- Tarawneh, McCoy, Bishu, and Ballard (1993)
- Vanosdall and Rudisill (1979)
- Wisconsin DMV Driver Skills Test (Section 335,5/1/97) and Special Examination (Section 345, Draft 12/1/97)

IC2(c)ii.Customized ("Home Area") Exam, Tailored to Individuals' Driving Patterns

Summary:

A study was conducted in cooperation with the CA DMV, using a sample of drivers over the age of 60 who had been referred to the Department for reexamination (Staplin et al, 1998; Janke and Hersch, 1997). A within-subjects research design was applied, calling for two test drives by each subject: one drive on a standard route presumed to be of relatively lower familiarity, common to all study participants; and a second drive over a route of relatively higher familiarity that was unique to each individual, in the immediate area of the person's residence. Field measures of driving competency were obtained, using a Modified Driver Performance Evaluation protocol (Janke and Hersch, 1997) with demonstrated interrater reliability, scored by examiners who were specially-trained in its use and in the testing of older, frail individuals. The road test route was free-form, rather than pre-planned (of necessity); structured maneuvers could not be assigned to specific points on the route. However, the maneuvers and scoresheet were as described in section IC2ci of this *Notebook*, except a merge maneuver was not required. The home area drive included 1 to 3 destination trips, each beginning at the driver's home. The driver chose a destination (doctor's office, bank, grocery store) then drove to the destination and back home again. Eighty subjects in the Staplin et al. study took the standard exam (28 passed and 52 failed) and 61 subjects took the home area exam (25 passed and 36 failed). Seventeen of the drivers who failed the standard exam, did so because of hazardous performance; their drive tests were terminated and they were not allowed to take the home area exam. Eight of the subjects who completed the standard exam but "failed" it were able to perform the home area drive test satisfactorily.

In this study, error rates varied as a function of the type of traffic control (signal, stop sign, yield, or no control), the familiarity of the course, and the type of movement (straight through, left turn, right turn). Route familiarity had little to no effect on error rates exhibited at signalized intersections. However, for right turns in yield and uncontrolled intersections, error rates were noticeably higher on the unfamiliar course. This may have resulted from drivers "knowing what to look for" as a result of experience in familiar areas. The more common maneuver problems included "failure to come to a complete stop at a stop sign," which was noted on 53 percent of the test drives over unfamiliar routes and 57 percent of the test drives over familiar routes. "Stopping for no reason" was noted on 39 percent and "turning too wide or too short" on 46 percent of test drives over unfamiliar routes; both were noted on 26 percent of test drives on familiar routes. Other potentially serious safety problems noted on at least 20 percent of test drives (on unfamiliar routes) by the examiners included "stopped over limit lines (stop bars)," "consistently drives too slowly," and "unsafe left turn gap acceptance." These errors were less common on the familiar routes; presumably this reflected differences in drivers' expectancies for the demands encountered along each route type. Errors that were *more* frequent on the familiar routes, being noted on at least 20 percent of test drives, included "infringes on others' right-of-way when changing lanes" and "near miss (pedestrian or car) other than during gap acceptance."

In their profiles of State practices, Petrucelli and Malinowski (1992) indicated that the following States specifically issue license restrictions for a geographical area or radius from home: Alabama, California, Colorado, Delaware, Illinois, Iowa, Michigan, Missouri, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, and Wisconsin. They reported that in Illinois, a restricted local license may be issued to applicants who have difficulty operating a vehicle in more populated areas. The applicant must live in a non-urban area or a town with a population of less than 3,500. Applicants must successfully complete a vision, written, and driving evaluation. The

driving evaluation is administered over a route that the applicant would normally drive to go to the grocery store, doctor, etc. in his or her local area. In most cases, the applicant is not permitted to drive on or cross over any federal or state highways. A driver who passes this type of road test is restricted to the tested route.

In the State of Wisconsin, a *limited area examination* may be given to a driver who is unable to cope with complex traffic situations. It may also be appropriate for a customer who has a medical or functional impairment that severely limits driving ability. The objective of this non-directed test is to determine whether the driver can safely operate a motor vehicle in a familiar area. The test is constructed around the driver's home area and on routes that take the driver where he/she needs to go (e.g., doctor, grocery store). A customer does not need to fail the standard exam before qualifying for a limited area exam; however, if a driver chooses to be tested in the limited area, he/she will not be able to drive outside of the designated limit (i.e., a limited area test will always result in a restricted license). The required minimum maneuvers are the same as those required for all special examinations (see earlier description in *Notebook* section IC2ci).

Janke and Hersch (1997) point out that a home-area drive test is one of the necessary bases of a graded licensing system in its attempt to devise workable tradeoffs between increments of safety and increments of mobility for individual drivers.

References:

- Janke and Eberhard (1998)
- Janke and Hersch (1997)
- Petrucelli and Malinowski (1992)
- Staplin, Gish, Decina, Lococo, and McKnight (1998)
- Wisconsin DMV Special Examination (Section 345, Draft 12/1/97)

I.C. DEVELOP TOOLS NEEDED TO IMPLEMENT MODEL PROGRAMS

I.C.3. Rehabilitation Procedures

(a) Elderly population *without* chronic conditions (includes post-trauma recovery)

(b) Elderly population *with* chronic conditions -- intervention required

AARP: 55-Alive/Mature Driving Course

The American Association of Retired Persons (AARP) 55-Alive/Mature Driving course is an eight-hour driver improvement/classroom refresher designed to provide drivers age 50 and older with information about the effects of aging on driving, compensation techniques, rules of the road, and defensive driving techniques. The curriculum consists of nine chapters and is conducted over a two-day period, with each session lasting four hours. It is taught, promoted, and administered by volunteers (approximately 7,000 nationwide) utilizing the peer concept, who are recruited and trained by AARP, and serve as Area, State, Associate or Assistant State Coordinators, Chief Trainers, or Instructors. The volunteers receive a 3-phase training process. In the first phase, an instructor training session provides the overall training to conduct educational discussion groups and review educational learning skills. In the second phase, the Instructor's first course is conducted as a practice teaching session (it is monitored by the trainer). The last phase is an on-going supervision process supplemented by in-service training workshops held regularly. Participants are charged a minimal fee ($8.00) to help offset overall program costs (Instructor recruitment and training, Instructor out-of-pocket expenses, ongoing supervisory training nationwide, and program materials and distribution). AARP subsidizes the remaining expenses. Each Instructor volunteers his/her own time.

Legislation has been enacted in 33 States and the District of Columbia that requires all automobile insurance companies conducting business in those States to provide a multi-year premium discount to graduates of State-approved classroom driver improvement courses. 55-Alive is approved in every state. Several automobile insurance companies in selected States voluntarily provide premium reductions to graduates of 55-Alive.

Several evaluations have been conducted on program effectiveness. McKnight, Simone, and Weidman (1982) found that drivers who took the course had a significantly higher knowledge score than a control group (not taking the course) and that it was retained during the entire evaluation period (14 months). Drivers taking the course also showed a trend in violation reduction. Evaluations by CA DMV, NY DMV, and NY Department of Insurance demonstrated fatal injury crash and violation reductions among program participants (AARP "55 Alive" Fact Sheet).

AAA: Safe Driving for Mature Operators Course

This driver improvement course is conducted in a classroom, generally in two four-hour sessions, for drivers age 55+. According to American Automobile Association (AAA) Driver Safety Services in Heathrow, FL, presenting the material across two sessions is preferable to scheduling a one-day session that lasts 6 to 8 hours. The half-day format allows drivers to travel during non-rush periods (e.g., late morning to early afternoon), and is also better for information retention. Some areas schedule a full-day session on Saturdays, to avoid requiring their drivers to drive in busy traffic.

The cost to the participant ranges nationwide from $5.00 to $40.00. For example, it is offered by AAA clubs in Kansas for $5.00; Northern California clubs charge $10.00, and in the Lehigh Valley (PA), the cost is $20.00 per AAA member and $30.00 for non-members. There are no tests.

Insurance discounts vary across the nation, and therefore, individuals must obtain information about insurance discounts in their State by contacting their local AAA office. Selected examples follow.

AAA's Safe Driving For Mature Operators course has been approved by the Pennsylvania Department of Transportation for a minimum 5 percent premium reduction for each motor vehicle on a policy under which all named insureds are age 55 or older and have successfully completed a driver improvement course. To retain the discount, insureds must take the course every three years. Connecticut statutes require a minimum discount of 5 percent for drivers over the age of 62, for a minimum of 24 months. Many companies have exceeded these minimums. In California, drivers over age 55 who complete the course are entitled to a 5 percent reduction on bodily injury and a 5 percent reduction on property damage. This premium reduction averages approximately $13 to $18 annually.

The course covers aging effects on driving, and reviews safe driving practices (looking far ahead; signaling; leaving a safety margin; a review of signs, signals and pavement markings; use of safety belts; and effects of medicines and alcohol on driving).

Instructors are required to complete a 40-hour certification course every three years. During two of the days, instructors learn the course content. On an additional day, they receive hands-on training on the road, to practice some of the emergency skills they will teach in the course. During two more days, they are back in the classroom, giving a 1-segment presentation from the course to the other students, and critiquing other students' presentations.

In certain AAA motorclubs there are additional optional components of the Mature Driver Program. In addition to the classroom segments (scheduled in 2, 4-hour sessions in the afternoons, and also in 4, 2-hour evening sessions), AAA of Hartford, CT offers a physical testing and vision screening component as well as a driver evaluation component. The first component includes vision screening with the Optec 1000 Vision Tester (acuity, road sign recognition, depth perception, color vision, and peripheral vision), and the AAA Night Sight Meter (measures vision in darkness under headlight glare and no glare conditions), as well as brake reaction time testing, using the AAA Brake Reaction Timer. The cost for this component alone is $27.00 for AAA members. AAA Hartford also offers an on-road driving evaluation, either in combination with the classroom lectures, or separately. The cost for classroom instruction alone is $15.00, and for an in-car evaluation alone, the cost is $60.00. AAA Hartford offers a package deal (classroom plus on-road driving evaluation) for $45.00. The 90 minute in-car evaluation is conducted by an AAA instructor in a dual brake-controlled training vehicle. For approximately 60 minutes, the individual drives over a pre-determined route while the instructor observes the driver's ability to follow simple directions, control the vehicle's movement, and make sound judgments and safe operating decisions. The remaining time is used to complete a written evaluation, discuss the results, and plan a strategy for appropriate corrective measures. Approximately 50 older drivers participate in both segments each year. This program has been in existence for over 20 years. Many older drivers are referred to AAA for on-road evaluation by their families, physicians, and even the DMV. AAA provides the driver with a "report card," but the results are confidential. A driver may share the evaluation results with the physician or family, but AAA will not report results to anyone but the person who was evaluated.

Mature Driver Retraining Workshop (Traffic Improvement Association [TIA], St. Joseph's Mercy Hospital, and AAA Michigan)

The *Mature Driver Retraining Workshops* are voluntary, and are designed to help drivers age 55 and older evaluate their driving skills (a self-assessment). Each *Workshop* consists of two, four-hour sessions, held on consecutive days, and an optional half-hour on-road evaluation with a certified instructor. The *Workshop* is advertised through Senior Centers and Area Agencies on Aging. The instructors are AAA-certified, and are retired law enforcement officers. The first four hours consists of a classroom review using AAA "Safe Driving for Mature Operators" course materials. The second classroom session incorporates psychophysical testing to allow an individual to evaluate his or her own abilities (the results are confidential). The psychophysical tests include simple reaction time; visual capabilities (acuity and depth perception) and visual attention (Visual Attention Analyzer/UFOV). The driving course is laid out by the University of Michigan Traffic Engineering Department. The instructor provides feedback on possible problem areas in an individual's driving behavior and will offer suggestions for improvement.

The cost is $41.00 per driver, but generally, only $20.00 is charged to an individual. The balance is funded by AAA Michigan, St. Joseph's Mercy Hospital, and TIA. They are looking forward to a larger grant to help fund the course this year, as it is important to keep the price low. One community received funding from their police department, allowing students to participate at no cost. Another community offered the workshop at $5.00 per participant, as a result of funding provided by a local insurance agency.

Fourteen workshop were conducted in Oakland, Wayne, Macomb, and Washtenaw Counties between May 1998 and October 1998 (Stuart Packard and Associates, 1998). One hundred eighty-five older persons participated in the workshops. One hundred four participants completed follow up evaluations of the Program; 66 percent were female, and 33 percent were male. Sixty-six percent of the respondents rated their driving ability as good or excellent. Seventy-seven percent stated that they drive 5 or more days per week on average. Eighty-five percent indicated that they had not been stopped by police in the past three years, and 86 percent indicated they had not been involved in a crash in the past three years. Sixty percent indicated that they do not voluntarily restrict their driving. Of the 64 respondents who evaluated the on-road portion of the class, 84 percent stated that they were given information that will change some of their driving practices. This included use of turn signals, coming to a complete stop at stop signs, correct yielding procedures, maintaining reasonable speed, and maintaining 3 seconds of space between vehicles. Ninety-six percent of the respondents stated that they would recommend the workshop to others.

<u>National Safety Council Defensive Driving Course: Coaching the Mature Driver</u>

This course is designed for senior drivers, (age 55 and older) to review the effects of aging on driving and how to compensate for the physical and mental changes, to promote defensive driving. This is a State of Florida-approved course for insurance discounts (5 to 10 percent). The goal is to help older drivers maintain their safe and defensive driving abilities. The course covers adjusting to certain driving habits and limitations; backing, parking and multiple lane driving; how seniors are perceived by other motorists; urban, rural and highway driving; road sign recognition; and physical effects of aging. The class is taught in two 3-hour classroom segments in an interactive format including lecture, slides, films and a workbook. Tuition is approximately $10.00 (Note: It is free from the Indiana Bureau of Motor Vehicles). Instructors require certification through the National Safety Council; they must complete an Instructor Development Course and be associated with a registered training agency.

<u>Driving School Association of the Americas: E-VAL for Mature Drivers</u>

The Driving School Association of the Americas is a national association of driving school owners, that includes approximately 2,500 driving schools in the U.S. They are in the process of developing a curriculum for drivers age 50 and older. The curriculum will consist of three components: (1) a 90-minute on-road driving evaluation; (2) a 2-hour classroom segment; and (3) a follow-up 60-minute on-road driving evaluation.

The first on-road evaluation will begin at the driver's home. The instructor/evaluator will employ a 32-point checklist to evaluate driving performance (e.g., visual search behavior; stopping, left-turn, and right-turn techniques). Drivers will be instructed where to drive during this portion. After the checklist has been completed, drivers will then be evaluated during a "Freedom Drive." During this portion of the evaluation, drivers choose their own routes; this portion demonstrates how well a person can negotiate a (probably) familiar area, without the assistance/instruction of a passenger.

The classroom segment is taught in a group setting. The content includes a discussion of new laws, new traffic control devices, and new highway design elements. In addition, a critique of driving performance during the evaluations is provided, and corrections to poor performance are provided.

During the last segment, drivers undergo a second on-road performance evaluation. An evaluation report will be provided to the driver that contains an in-depth description of driving skill, outlines corrective behaviors, and may recommend additional behind-the-wheel lessons. The evaluation report will remain confidential (e.g., drivers will not be reported to the DMV for unsafe performance).

Once the E-VAL for Mature Drivers curriculum is established, the Driving Schools Association will provide a Train-the-Trainer course at each of their professional regional and annual conferences. The program may be ready to implement by Spring 1999 (*pers. comm.*, Jack Sousa, 10/6/98). The instructors will initially be credentialed by the Driving School Association of the Americas to evaluate "well" elderly clients; however, Mr. Sousa indicated that ADED will be asked for input in certification requirements for evaluating drivers with disabilities.

The program will be marketed through high school adult education programs and community colleges. The plan is to make the program as community-based as possible, to make it easily accessible to older drivers. The cost of this program has not been determined; however, it is probable that it will vary from State to State.

Bogdonoff Enterprises, Inc (The BEI Group): The Driver Skill Enhancement Program (D-SEP)

BEI has developed the Driver Skill Enhancement Program, aimed at improving the driving skills of persons age 55 and older. The proposed program includes screening, testing, and counseling, combined with classroom instruction, and simulator-based and on-road training and practice. D-SEP will be a 5-day program, that starts with screening to determine a driver's present capability; this is used as the basis for tailoring a plan for training and practice. The screening procedure will require approximately 1.5 hours to complete, and includes simple tests of vision, cognition, perception, and physical ability, in addition to the completion of a health, medication-use, and driving history questionnaire. Lectures will be used to increase drivers' knowledge of issues ranging from vision skills to complex driving situations. Classroom sessions will focus on strategic driving issues, including recognizing and managing dangerous driving situations; developing effective visual scanning techniques; and awareness of following and stopping distances for reducing driving risks. Additional class time will be devoted to the program philosophy, specific older driver issues, and suggested physical exercises for maintenance of mobility and strength. Simulators will be used to provide training and practice in key elements of driving. The simulator training will not use vehicle simulators, but will use small simulators that evaluate visual and attentional performance, and reaction time. In-vehicle training will integrate all skills in actual driving situations in the client's own car; however, this will not occur on public roads. Activities will include training in panic braking techniques; skidpad exercises; rapid and controlled lane changes; backing; and parking. These exercises are designed to improve participants' vehicle control skills and response to emergency situations (Bogdonoff, 1997).

The kinds of people who will be recruited to be trainers include teaching assistants, social workers, and occupational therapists. A 1-week training program will be delivered to the trainers.

Participants will be encouraged to return at intervals for testing to determine skill retention and further needs for practice. According to Bogdonoff (1998), BEI is discussing plans with a consortium of State agencies and insurance providers to set up a demonstration of the D-SEP in central New Jersey. The demonstration would serve to provide training for older drivers in New Jersey, as well as promote the establishment of similar training programs elsewhere. The estimated cost per driver ranges from $500 to $1,500, and will depend on whether it becomes a non-profit, government, or private program. Dr. Bogdonoff hopes to find an insurance company in New Jersey that would provide an insurance premium discount of 25 percent, to drivers who complete the program (*pers. comm.*, Dr. Seymour Bogdonoff, October 9, 1998).

References:

- AAA "Safe Driving for Mature Operators"
- AARP "55 Alive" Fact Sheet
- Bogdonoff (1997, 1998)
- McKnight, Simone, and Weidman (1982)
- Michigan "Mature Driver Workshop" (*pers. comm.*, Frank Cardimen, President, Traffic Improvement Association 1/22/98);
- Stuart Packard and Associates (1998)
- National Safety Council/Defensive Driving Course: "Coaching the Mature Driver"
- *pers. comm.*, Rosa Fix, Supervisor, AAA Program in Hartford, CT
- *pers. comm.*, Jack Sousa, Driving School Association of the Americas, Waterbury, CT
- *pers. comm.*, Seymour Bogdonoff, Chairman, BEI, Princeton, NJ

1C3(a)ii. Rehabilitation Procedures - Elderly Population Without Chronic Conditions: Perceptual Skills Training

Visual Attention Analyzer/Useful Field of View

UFOV training is available on a turnkey computer system through Visual Resources, Inc., including a 17-inch interactive touch screen monitor, a Pentium computer system, a printer, and a User's Manual. The Visual Attention Analyzer (see *Notebook* Section IC2(a)iv: Supplemental tests specialized for attentional and informational processing skills) is currently being evaluated as a rehabilitation tool to increase the size of a driver's useful field of view. In a study by Roenker, Cissell, and Ball (submitted) 71 subjects with UFOV restrictions of 35 percent or more were divided into one of two training groups: UFOV Training or Doron Driving Simulator Training. The UFOV training (n=49 subjects, mean age = 72.1 years) consisted of four, 1-hour blocks on UFOV, customized to the needs of the individual (processing speed, divided attention training, and/or selective attention training). The size of UFOV was assessed, and training continued until a mastery level of 75 percent correct performance was achieved (average training time = 4.5 hours). The Doron Driving Simulator Training (n=22 subjects, mean age = 72.4 years) consisted of two educational sessions of 2 hours each. It included 3 hours of instruction in driver safety and a 1-hour, on-the-road demonstration of these driving skills (e.g., safe following distance, use of turn signals). A Control group (n=25, mean age = 69.4 years) consisted of individuals with less than 30 percent UFOV reduction. Participants were assessed on several visual, attentional, and driving tasks; then training proceeded, and subjects were re-assessed on the same measures. These included UFOV; simple RT to simulated brake lights (Doron L-225 Driving Simulator); complex RT to Doron simulator stimuli; and a 15-mile open road driving evaluation (1-mile warm up, plus 2 loops of a 7-mile urban/suburban route).

The Driving evaluation proceeded as follows. Two independent evaluators in the back seat rated each driver on a checklist of 455 driving skills. Behaviors were rated on a 3-point scale: 0=very unsafe or inappropriate; 1=somewhat unsafe; 2=safe or appropriate. Also, a global rating of driving skill was indicated, ranging from 1 (drive aborted/very unsafe) to 6 (very competent driver). Eleven composite behaviors were formed from the 455 individual items: (1) acceleration; (2) gap selection; (3) position in traffic; (4) signals; (5) speed; (6) stop position; (7) deceleration; (8) tracking; (9) turning; (10) right of way; and (11) changing lanes. A visual search composite had to be dropped from analyses due to difficulty in assessing behavior. A dangerous maneuver composite was created from 17 high-traffic roadways, consisting of 6 left unprotected turns, 9 entrances to high-traffic roads from a stop sign, and 2 opportunities for inappropriate stopping in traffic to turn right.

Results were as follows. UFOV scores significantly improved across testing sessions for only the UFOV-trained subjects (average = 24.44 point improvement). No significant differences were found across testing sessions for Simple Reaction Time. For Complex RT, only the UFOV-trained group significantly improved their scores (average improvement = 0.287 seconds, or 23 feet). On the on-road driving evaluation, both the Simulator and UFOV-trained group improved their global ratings across test sessions; there was no change in the control groups' global rating. For turning (turning into the correct lane) and signals (signaling 100-150 ft in advance of a turn) composites, only the Simulator-trained group significantly improved from the pre- to post-training test. For the stop position (positioning vehicle at stops in order to see clearly but not obstructing traffic flow) measure, both the Simulator- and UFOV-trained groups performed significantly better than the Control group. The gap selection composite and the tracking composite were significantly correlated to UFOV performance. No group by pre/post interactions were found for the other composites, but general improvement was found for all groups from pre- to post-test. This reflects comfort and familiarity on the second drive through the route.

For the dangerous maneuvers composite, only the UFOV-trained group demonstrated a significant reduction in the number of dangerous maneuvers from pre- to post-test. Simulator training was effective in some areas of specific instruction and demonstration; UFOV training did not transfer to driving skills that reflect the mechanical operation of the vehicle, but improved items that measured critical search and judgment abilities in visually cluttered and cognitively demanding situations.

Other clinical trials utilizing the UFOV for training are still active.

Vision Aerobics

Vision Aerobics, Inc., 12 Doughty Lane, Fair Haven, NJ 07704, phone: 732-219-1916; fax: 732-219-9797. Software distributed by Dual Control Safety Centers, Inc. 9 Delaware Ave., Cherry Hill, NJ 08002.

This product includes software installation/usage instruction booklet; diskette (CD-ROM if multi-user/commercial package) containing Vision Aerobics software; dura-lens, high impact polymer 3-D viewer glasses; registration card to receive updates/upgrades of software and technical support. The software requires an IBM-compatible computer and a VGA color monitor.

Vision Aerobics is a computer software program that contains three sets of eye exercises designed to improve peripheral vision, static and dynamic acuity, scanning field of vision, depth perception, eye-hand coordination, and speed of reaction. The premise is that people have "flabby eye muscles" which can become more efficient and better conditioned through aerobic exercising, just as the heart and legs benefit from regular exercise. Vision Aerobics is based on eye exercise techniques used and recommended by eye doctors and vision specialists for over 40 years. The "Eyes in Motion" component is an arcade-type exercise that helps improve ability to make rapid and accurate eye movements. It exercises all eye muscles and can improve visual acuity, peripheral vision, and reading skills. The "Images" component is a 3-D exercise to condition the muscles that align the eyes for depth perception. It helps to gradually condition eye muscles to focus at varying distances and to perceive depth better. The "Relaxation" component (in full color) helps relieve the stress of work and (in 3-D) relaxes the eyes. Using over 40 game-like exercises scientifically designed to condition the eye, users have reported improvement in both their static and dynamic vision, with 10 minutes' daily exercise. The software automatically records a user's score after each exercise. In the "Images" component, for example, the more difficult the exercise, the more points a user can accumulate. The scores are a reflection of the ability to keep the two images "together" (fused) even though they are actually moving apart. As the difficulty level increases, the images move farther apart at increasingly greater speed.

Preliminary, unpublished research suggests a significant improvement in visual skills among subjects ages 9 to 86 who have used the eye exercises 3 to 5 times per week for four consecutive weeks. (Note: These clinical and field studies have been conducted at: Continental Insurance Company, NJ; Community Medical Center, NJ; NJ Division of Highway Traffic Safety using senior drivers; Laidlaw Transit using school bus drivers; Montgomery County, MD using school children). In 1993, a pilot study of the effects of visual training among senior drivers was jointly conducted by the NJ Division of Highway Traffic Safety, The Lighthouse Senior Health Center of Community Medical Centers, and Vision Aerobics, Inc. Thirty-five subjects ages 65 to 86 participated in a 4-week program that required them to exercise their eyes with Vision Aerobics five times per week for 10 minutes per day. The following results were obtained: visual skills (unspecified in the report) increased by an average of 52 percent; 81 percent of the subjects reported an increased awareness of their driving environment and were more alert when driving; 25 percent reported improvements in day and/or night vision including peripheral vision; and 19 percent reported improvement in reading vision. According to the developer (Richard Cheu) Vision Aerobics can help prevent traffic crashes, particularly among seniors, by improving dynamic vision and reaction times. (Note: No published studies using crashes or violations as a measure of effectiveness for Vision Aerobics treatment groups, nor any objective measure of visual performance before and after training could be identified in the technical literature).

Vision Aerobics is currently available at no cost to older drivers at 14 sites in Ocean, Atlantic, Camden, and Cape May Counties in New Jersey, under a program operated by the International Association of Lions Clubs.

Dynavision

Distributed through Performance Enterprises, 76 Major Button's Drive, Markham, Ontario, Canada, L3P 3G7; phone: (905) 472-9074; fax: (905) 294-6327.

Dynavision was originally developed as a device to improve the visuomotor skills of athletes competing in sports such as hockey, basketball, football, and tennis, and has been adapted to provide the same training benefits to people whose visual and motor function has been compromised by injury or disease. The apparatus can be used to: increase active upper extremity range of motion and coordination; train compensatory scanning strategies for visual inattention and visual field deficit; and improve oculomotor control, eye-hand coordination, and muscular and physical endurance.

The training area measures 47 in by 47 in (120 cm by 120 cm) in length and width, and weighs 287 pounds (130 kg). The apparatus must be wall mounted. The board is vertically adjustable to accommodate users of different heights, as well as users who are seated and those in wheelchairs. The training surface houses 64 small square buttons, each illuminated by a small light bulb. The bulbs are arranged in a pattern of 5 rings (concentric circles). Clients are required to locate an illuminated button and strike it with their hand as quickly as possible. After each hit, another button will randomly light up; this sequence continues for the duration of the exercise. A successful hit is acknowledged by a beeping signal. The average time to strike the buttons and the total number of successful hits during a given exercise (the main performance variable) are recorded by the apparatus.

Tasks or exercises last either 30, 60, or 240 seconds. A computerized display panel and a printer are built into the side of the apparatus and provide immediate performance feedback. A LED display is positioned just above the center of the training surface. It can display up to seven computer-selected, random numbers every five seconds for preselected exposure periods ranging from 0.01 to 1.0 second. The client can be instructed to call out the digits displayed, as well as use them to perform various computations while performing the button-striking tasks. Exercises are either self-paced (Mode A) or apparatus-paced (Mode B). In the self-paced mode, the target button remains illuminated until struck. It then moves to another random location on the board. In the more challenging apparatus-paced tasks, a target button that is not struck within a preset time period, extinguishes automatically, and a new target immediately appears elsewhere on the board. The most challenging tasks combine the striking of buttons within the apparatus-paced tasks with the calling out of digits displayed on the LED panel.

The size and location of the area on the board in which buttons are illuminated can be manipulated in order to train specific abilities. The buttons are arranged in five concentric rings, thus tasks involving use of all five rings represent the largest board size. Tasks can also be selected using only four rings or three rings, which decreases the working area in which the lighted buttons appear. The board can also be divided into four quadrants: upper right, upper left, lower right, and lower left. Tasks can be restricted to any combination of quadrants.

There are approximately 90 units in use in the U.S., in physical therapy departments; and, according to Mary Warren, an occupational therapist experienced with this apparatus, Dynavision is the only standardized reproducible instrument that is large enough for retraining driving-related skills. It can be used to train people to search a visual field where they have a deficit (usually left neglect), but they must have good attentional abilities. Ms. Warren doesn't recommend retraining for people with visual inattention from brain damage. Retraining works best for people with blindness in a visual field but intact attentional mechanisms. It is possible to train drivers to "look where they can't see" and to use license restrictions for drivers who will be compliant. There is a need to look at the demand in the area in which a driver needs to be mobile, when restricting to time of day and radius from home.

There are several published studies on the effectiveness of Dynavision rehabilitation programs for people who had sustained CVAs (cerebral vascular accidents). The first study (Klavora et al., 1995a) examined the effects of Dynavision training on a variety of psychomotor skills in one 71-year old post-stroke male driver whose license was suspended. The subject had limited mobility in his left arm and leg, and some peripheral visual impairment. Dynavision training occurred over a course of 4 weeks, with 4 sessions per week, at approximately 60 minutes per session. A battery of four tests were all administered on each of six days before the treatment period and each of three days after the treatment period to establish a reliable baseline for comparison. The four tests were also administered once each week during training to track change in test performance. Performance improvements began to occur after the start of treatment. Following Dynavision training, the subject had improved on all four measures: he showed a 40 percent increase in the number of hits on a 4-minute Dynavision task; a 6.95 percent decrease (faster) in simple reaction time; a 12.2 percent decrease (faster) in choice reaction time; a 21 percent decrease (faster) in the amount of time to scan a string of letters in a search for two target letters; and a 67 percent increase in the amount of time he could successfully perform a visuomotor coordination task. Even though the subject did not pass an on-road driving test, his posttraining on-the-road driving performance was evaluated as significantly improved from the baseline performance test and a recommendation was made that he receive 4 to 6 hours of additional behind-the-wheel training before attempting another on-road driving test.

In the second study (Klavora et al., 1995b), the usefulness of the Dynavision apparatus for driving-related rehabilitation and the benefits of Dynavision training on the motor, perceptual, and cognitive abilities of 10 older (age 46-73) post-CVA individuals were evaluated. Most of the subjects in the study experienced multiple deficits, including hemiplegia, hemiparesis, reduced peripheral visual field, loss of energy, emotional liability, and reduced attentional capacity. All subjects had failed behind-the-wheel assessments. Training involved three 40-minute Dynavision Training sessions per week for 6 weeks. Comparisons between performance levels before and after the program on several Dynavision, response, and reaction time variables showed significant improvements. Dynavision training resulted in significantly improved behind-the-wheel driving performance when compared with expected outcomes. On the second BTW assessment, 6 of the 10 subjects earned a "safe to resume driving and/or receive on-road driving lessons," and 4 subjects were assessed as "unsafe to drive at this time." The expected frequency for safe assessments on a second attempt was 24 percent during the period of study; the safe rate for study subjects was 60 percent. Furthermore, there was a correlation between Dynavision performance and between "safe" and "unsafe" drivers. The safe drivers scored a significantly greater number of hits than unsafe drivers on the Dynavision endurance and speed tasks.

In a study by Klavora et al. (1997), 56 post-stroke patients whose driving licenses were under suspension completed a Dynavision Performance Assessment Battery of four tests, plus the Cognitive Behavioral Driver's Inventory, in conjunction with an on-road driving test. An analysis showed that each test yielded reasonable prediction of the on-road driving fitness of elderly post-stroke drivers; however, when the scores on the two tests were combined, they explained a greater proportion of the variance in on-road testing than either task alone. All patients who passed the CBDI and the endurance task on the Dynavision test battery were successful in the on-road tests.

References:

- *pers. comm.*, Kristi Berg, President, Visual Resources, Inc.
- Roenker, Cissell, and Ball (submitted)
- 3 on-going studies funded by NIH through Roybal Center (Principal Investigators: Christie Rom, Tom Kalina, and Linda Hunt)
- Vision Aerobics Website; Letter to L. Decina from R. Cheu, 1996
- *pers. comm.*, Peter Klavora, Univ. of Toronto; Mary Warren, Eye Foundation of Kansas City, MO; and Phil Jones, Performance Enterprises, Ontario, Canada
- Klavora, Warren, and Leung (undated). *Dynavision for Rehabilitation of Visual and Motor Deficits: A User's Guide*
- Klavora et al. (1995a, 1995b, 1997)
- Klavora and Warren (1998)

1C3(a)iii. Rehabilitation Procedures - Elderly Population Without Chronic Conditions: Vehicle Modification

Equipment that comes standard on many vehicles or may be added without the requirement for training by an occupational therapist is described in this section of the Notebook. Special adaptive equipment is described in Section IC3(b)iii.

Many vehicle design characteristics are of special importance to disabled and elderly drivers. Automatic transmission may be a necessity for many drivers with disabilities, and in most cases, it is highly desirable. In addition, power steering and braking reduce the exertion required to drive. Power steering is a must for any driver using one hand to steer, and for drivers with poor endurance, general muscle weakness, and poor muscle control. Other features include power windows, power seats with adjustable seat height, lumbar support, adjustable steering wheel, cruise control, air conditioning (a must for those who have lost capability to regulate body temperature), trunk release, power door locks, rear window defroster, and remote adjustable right and left outside mirrors.

After-market equipment available for use by intact elderly drivers with age-related functional impairments include seat cushions, back rests, pedal extenders, wide angle (convex) stick-on mirrors for side-view mirrors, and a rear-view mirror available from AAA (Panamirror) that expands vision to the left and right rear to reduce the blind spot. The Panamirror consists of three mirrored segments. The central mirror, which comprises a large-radius convex sphere, covers a rearward field approximately the width of the rear window. This treatment minimizes the distance distortion normally associated with convex mirrors. Mirror segments to the left and right sides are designed for the detection of vehicles to the sides, with continually reducing radii to provide maximum visibility of objects in the blind spot. The mirror is attached over the existing rear-view mirror.

Regarding the availability of pedal extenders through AAA, Bill When (AAA Safety Services) advised that pedal extenders were available in the past from AAA for $25.00-30.00; however, many organizations will not supply this equipment without a prescription from a physician or OT, and the price has escalated to near $150.00. Additionally, there was not much demand for the Panamirror, so AAA has discontinued its sale, and provides a list of vendors where Panamirror-type mirrors can be purchased.

The following table lists common disabilities, their effects on driving, and suggested adaptive aids.

Common Disabilities, Their Effects on Driving, and Suggested Adaptive Aids.

Disability	Effects on Driving	Suggested Driving Aids
Lack of Range of Motion - Neck	• Limited ability to see the full field of traffic	• Convex or 48° rear- and side-view mirrors
General Muscle Weakness	• Difficulty turning steering wheel and applying pressure to brake and clutch • Difficulty applying and releasing brake	• Power steering, power brakes, and automatic transmission • Adaptation of parking brake (for the stronger limb)
Poor Endurance, Fatigue	• Inability to drive for long periods of time without rest	• Power steering, power brakes, cruise control
Small Body Size	• Insufficient height to see out of windows • Inability to reach brake, accelerator, dimmer switch, and parking brake	• Specially constructed seat to raise driver (some vehicles have seat height adjustments) • Extensions on brake, accelerator, dimmer switch, and parking brake or hand operated controls.
Short Legs	• Inability to reach brake and accelerator • Inability to operate dimmer switch and parking brake	• Extension of the brake and accelerator pedals of up to 2 in (5 cm) • Back cushion • Seat cushion • Hand-operated dimmer switch and parking brake
Short Arms	• Inability to reach dashboard controls and ignition • Possible inability to reach gear shift and turn signal • Difficulty using conventional steering wheel • Difficulty performing many hand-over-hand steering maneuvers	• Back cushion; extensions for dashboard controls and ignition key • Extensions on gear shift lever and turn signal lever • Steering column extension on adjustable steering wheel • Small steering wheel (requiring fewer revolutions to turn the wheel).

References:

- AAA Driver Test and Training Equipment Brochure
- *pers. comm.*, Bill When, AAA Driver Safety Services, Heathrow, FL, 7/98
- Transport Canada (1986)
- Vehicle Selection Guidelines, Milton S. Hershey Medical Center Brochure

1C3(a)iv. Rehabilitation Procedures - Elderly Population Without Chronic Conditions: Fitness and Nutrition

Fitness

Joint flexibility is an essential component of driving skill. If upper extremity range of movement is impaired in the older driver, mobility and coordination may be seriously weakened. Older drivers with some upper extremity dysfunction may not be able to steer effectively with both hands gripping the steering wheel rim. Upper extremity movements required for hand control and steering control operation include shoulder abduction, flexion, extension, internal rotation, external rotation, circumduction, and forearm flexion, extension, supination, and pronation (Gurgold and Harden, 1978).

Also with advancing age there is decreased head and neck mobility that adversely affects the older person's ability to complete driving tasks. A restricted range of motion can reduce an older driver's ability to operate an automobile, especially for effectively scanning directly and indirectly (mirrors) to the rear and sides of his/her vehicle to observe blind spots, as well as hindering timely recognition of conflicts during turning and merging maneuvers at intersections (Ostrow, Shaffron, and McPherson, 1992).

Decreased flexibility with age is probably the result of combined histological and morphological changes in the components of the joint, including cartilage, ligaments, and tendons (Adrian, 1981; Serfass, 1980). The greater calcification of cartilage and surrounding tissue, the shortening of muscles, increased tension and anxiety, and the prevalence of arthritic and other orthopedic conditions all contribute to reduced flexibility (Piscopo, 1981). Changes in joints and tendons may adversely affect the flexibility and stability of joints. Studies that have made assessments of flexibility in older persons generally support the conclusion of a decline in flexibility in the middle and later years. Motion perception in the lower extremities, metatarsophalangeal joints (those between the toe and ankle bones), decline with age as well (Kokmen, Bossemeyer, and Williams, 1978). It has also been reported that over 50 percent of people over the age of 65 have osteoarthritis in at least one joint.

One encouraging note is that many of the movement execution problems associated with losses in flexibility pervasive among older road users may stem simply from an overall decline in physical fitness among this group, and is thus amenable to remediation. One research study involving 63 older drivers found that drivers ages 60 to 75 demonstrated less shoulder flexibility and torso/neck rotation than a comparison group including 43 younger drivers (McPherson, Ostrow, and Shaffron, 1988). However, an exercise program conducted by Ostrow et al. (1992) was shown to be an effective intervention for older drivers for enhancing driving skills that accentuate demands on the range of motion, such as observing to the rear and parallel parking. The exercises consisted of chin flexion/extension, neck rotations, head side bending, chin tucks, rotating the shoulders backward, and trunk rotations. After participating in the program, older drivers showed improvements using a field-based assessment of automotive driving skill. Subjects in the experimental group who received the range-of-motion training looked more frequently to the sides and rear of their vehicle than drivers in a control group who did not participate in the exercise program.

Meister (1998) reports that exercise can significantly benefit even people above the age of 80. In a study of nursing-home residents whose average age was 87, ten weeks of progressive resistance exercise led to significant increases in muscular strength, walking speed, and stair-climbing ability.

As described in section IA2(a) of this *Notebook*, older drivers who have diminished physical performance ability are more likely to be involved in automobile crashes, than older drivers who are physically fit. Information about the benefits of exercise for older adults is ubiquitous. Brochures with activity tips for older adults may be found in grocery stores; articles are written in the magazine sections of Sunday newspapers (e.g., *Parade Magazine*); the internet has hundreds of advertisements for fitness videos and programs for older adults; and video rental centers, retailers and discount stores offer exercise videotapes geared to seniors. Examples are provided at the end of this section. As noted throughout various sections of this *Notebook*, health and social service providers are aware of the benefits of exercise for older persons, and have developed exercise programs that are presented in senior centers, local health and fitness centers, and hospital wellness centers. Other sources that may reference the benefits of fitness and include simple exercises are identified in *Notebook* Section IB3.

According to Dr. Nicholas DiNubile, an orthopedic consultant to the Philadelphia 76'ers basketball team and the Pennsylvania Ballet, fitness strengthens bones, improves balance, and makes falls less likely to occur; if people are in better shape and have better muscle tone, they are less likely to sustain a severe fracture if they do fall (O'Shea, *Parade Magazine*, September 6, 1998). O'Shea states that falls are the leading cause of death and injury in the U.S. for persons over age 65. Across America, nearly 1,000 people fracture their hips in falls every day. Falling has been associated with increased crash risk; some of the same factors that are associated with falling are associated with automobile crashes.

Seniors need to do exercises that will increase muscle strength, aerobic endurance, and flexibility. Weight-bearing exercises that put stress on bones helps to prevent calcium loss; this will help to strengthen bones and help them to absorb vital minerals. Weight training with light dumbbells, weight machines, or calisthenics (push ups, dips, chins) are all good for the upper body. It is not necessary to go to a gym for this kind of exercise; several resources note that weight training can be accomplished at home using 2.5 pound weights (soup cans, water bottles). A position stand on "Exercise and Physical Activity for Older Adults" by the American College of Sports (summarized by Bowerman, 1998) states that "when the intensity of exercise is low, only modest increases in strength are achieved by older subjects." They state that a number of studies have demonstrated that, given an adequate training stimulus, older men and women show similar or greater strength gains compared with young individuals as a result of resistance training. Two- to threefold increases in muscle strength can be accomplished in a 3- to 4-month timeframe in older adults. They further state that the effects of a heavy-resistance strength-training program on bone density in older adults can offset the typical age-associated declines in bone health by maintaining or increasing bone mineral density and total body mineral content. However, in addition to its effect on bone, strength training also increases muscle mass and strength, dynamic balance, and overall levels of physical activity. All of these outcomes may result in a reduction in the risk of osteoporotic fractures.

Next is aerobic endurance. Aerobic activities are those which increase the heart rate and make a person breathe more quickly, such as bicycling, swimming, and brisk walking while swinging one's arms. Bowerman (1998) says that endurance training appears to lower blood pressure to the same degree in young and older hypertensive adults. He states that the contraindications to exercise testing and exercise training for older men and women are the same as for young adults. The major absolute contraindications precluding exercise testing are:

- Recent ECG changes or myocardial infarction
- Unstable angina
- Uncontrolled arrhythmias
- Third degree heart block
- Acute congestive heart failure

The major relative contraindications for exercise testing include:

- Elevated blood pressure
- Cardiomyopathies
- Valvular heart disease
- Complex ventricular ectopy
- Uncontrolled metabolic diseases

Regular aerobic exercise can increase oxygen uptake, which brings greater endurance for the heart, lungs, and skeletal muscles, and improved ability to burn fat. One workout program geared to seniors is Geri-Fit (see ad at the end of this section). It was developed by a geriatrician and has been medically reviewed and approved by doctors, physical therapists, exercise physiologists, and other health care professionals. It is a 45-minute strength training exercise program for older adults. The exercises are performed seated in a chair, and classes are guided by a trained and certified instructor. Participants bring their own set of 2-pound dumbbells to class. Their website lists several agencies that have purchased their exercise program, which include two senior centers in Ohio. There are dozens of aerobic exercise videotapes on the market, many of which are geared to seniors. Jodi Stolove, a fitness instructor, has three videotapes ranging from 20 to 45 minutes on chair dancing (O'Shea, *Parade Magazine*, May 17, 1998). She states that they provide a balanced workout that includes a warm-up, toning, aerobic conditioning, stomach crunches, and gentle stretching, all from a chair. The seated workouts are ideal for individuals with a bad knee, arthritis, or poor balance. One videotape exercise program found on the internet is called "More Gain, Less Pain: A Low-Stress Exercise Program for Seniors" (www.fitnesslink.com/moregain.htm). It features Charles Manning, a Certified Personal Trainer, Certified Aerobic Instructor and Corporate Fitness Director. The tapes feature a warm-up, aerobic training, muscle strengthening and toning, and a final stretch. The cost is $19.95. Of course, individuals can contact their local health and fitness club, YMCA, hospital wellness center, or senior center to find out what programs are available in weight training and aerobics for seniors. For example, Howard County (Maryland) Office on Aging provides: seated exercise classes; American Arthritis Foundation-approved exercise classes; Tai Chi; low-impact aerobics; and country line dancing in their senior centers. Classes are twice weekly for 8 to 12 weeks, and cost approximately $25.00.

The last area is flexibility. Staying flexible is important for reaching, bending, keeping balance, and lowers the risk of serious injury in the event of a fall. Simple exercises can be done at home, and most of the videotape exercise programs and regular programming of exercise shows on TV include stretching. Yoga classes at the local YMCA or senior center are another option. Other home activities such as raking leaves and sweeping provide a benefit. Simple exercises are shown at the end of this section, from a pamphlet distributed by the Central Plains (Kansas) Area Agency on Aging.

The National Institute on Aging is currently funding a study to determine whether a multicomponent physical conditioning program can enhance driving performance and improve physical ability among active drivers age 70 and older who have physical impairments, but who are free of severe visual and cognitive impairments (TRB Committee A3B13: *Safe Mobility of Older Persons*, Newsletter, November 1998).

Nutrition

The material in this section is largely reproduced from an article by Kathleen A. Meister (1998) posted on the American Council on Science and Health's Internet Website (www.asch.org) and by Paula Kurtzweil (1996) originally appearing in the March 1996 *FDA Consumer* reprinted on the American Dietetic Association Website (www.eatright.org/olderamericans). Sections are also cited from The American Dietetic Association Position Paper on Nutrition, Aging, and the Continuum of Care.

Kurtzweil states that nutrition remains important throughout life; many chronic diseases that develop late in life, such as osteoporosis, can be influenced by earlier poor habits. Insufficient exercise and calcium intake, especially during adolescence and early adulthood, can significantly increase the risk of osteoporosis, a disease that causes bones to become brittle and crack or break. She goes on to say that good nutrition in the later years still can help lessen the effects of diseases prevalent among older Americans or improve the quality of life in people who have such diseases. They include osteoporosis, obesity, high blood pressure, heart disease, certain cancers, gastrointestinal problems, and chronic undernutrition. Studies show that a good diet in later years helps both in reducing the risk of these diseases and in managing the diseases' signs and symptoms. This contributes to a higher quality of life, enabling older people to maintain their independence by continuing to perform basic daily activities, such as bathing, dressing and eating (and driving). Poor nutrition, on the other hand, can prolong recovery from illnesses, increase the costs and incidence of institutionalization, and lead to a poorer quality of life.

Meister (1998) reports that in a 1997 national survey conducted by the American Dietetic Association, 55 percent of respondents age 55 and older reported that they make a conscientious effort to eat healthfully; only 28 percent of respondents aged 25 to 34 reported the same. People age 60 and older do about as well as younger people in terms of fulfilling recognized guidelines concerning intake of fat, saturated fat, and cholesterol. In addition, the proportion of seniors whose intakes of various nutrients are at Recommended Dietary Allowance (RDA) levels is only slightly lower than the proportion of younger adults with such intakes. Nevertheless, some senior citizens do develop significant nutritional problems.

Many things contribute to the risk of malnutrition in older adults. These include:

- Chronic diseases that may lead to physical limitations, making shopping for, preparing, and consuming food difficult without assistance.

- Dental problems that may incline some seniors to avoid eating foods that must be chewed well.

- Depression is relatively common among older people, and it can lead to severe weight loss.

- Changes in the senses of smell and taste, which can result from aging itself or from drug therapy, can cause decreases in food consumption or disinterest in, even aversion to, formerly preferred foods.

- The gastrointestinal side effects of some medications, which can interfere with the desire to eat. Some medicines also affect the absorption or metabolism of nutrients: laxatives that contain mineral oil can decrease the absorption of certain vitamins, for example.

- People often become less active as they age, and consequently, their appetites may decrease. Increasing physical activity, by following an exercise regimen, may stimulate seniors' appetites. It may also help older adults to maintain physical abilities necessary for routine actions, to slow the development of osteoporosis, and to improve their cardiovascular fitness and immune-system functioning.

- Isolation, which is a major risk factor for poor nutrition among seniors, and especially among those seniors who have recently lost a spouse. Someone who is suddenly alone after many years of living with another person may lose interest in eating or, if the housemate was the sole food preparer, may not be accustomed to or even marginally skilled at designing healthful meals and preparing food.

- Lack of money may lead older people to scrimp on important food purchases—for example, perishable items like fresh fruits, vegetables and meat—because of higher costs and fear of waste. They may avoid cooking or baking foods like meats, stews and casseroles because recipes for these foods usually yield large quantities. Financial problems also may cause older people to delay medical and dental treatments that could correct problems that interfere with good nutrition.

An evaluation of the Elderly Nutrition Program of the Older Americans Act indicates that 67 percent to 88 percent of participants are at moderate to high nutritional risk (Ponza, Ohls, and Millen, 1996). These community-based programs are finding serious nutrition-related problems among older adults, especially among the frail homebound. Many older adults have two to three diagnosed chronic health conditions; 26 percent of participants in congregate meal programs and 43 percent of those who receive home-delivered meals had a hospital or nursing facility stay in the previous year. One survey found that almost two-thirds of respondents had a weight outside the healthful range and that 18 percent to 32 percent had involuntarily gained or lost 10 pounds within the 6 months before the survey (Ponza et al., 1996). As pointed out in Section IC2(b)v of this *Notebook*, *Consumer Report's* (1998) analysis of data on 35,000 patients found that dietary counseling is given only to 1 in 5 patients during their physical examination appointment with their physician.

The nutritional needs and priorities of the frail elderly differ considerably from those of their active peers (Meister, 1998). Healthy older adults may benefit from following recognized dietary recommendations applicable to most younger adults in the U.S., such as limiting fat intake; but the frail elderly may need to disregard some of those recommendations. For example, to prevent weight loss they may need to ingest fat at levels above those generally recommended.

Meister (1998) states that in older adults, poor health and poor nutrition often interact in a vicious circle: inadequate food intake promotes illness, and illness diminishes food intake. She cites several research studies that have shown that improving nutrition can contribute to improvements in both health and functioning in older adults. These are presented below.

> In one of the studies conducted by F. Michael Gloth III, M.D. and his colleagues at Johns Hopkins University, correction of vitamin D deficiency in frail elders led to improvements on a standard test of their ability to function independently. The improvements may have been due to the relief of symptoms such as muscle weakness and bone pain that often occur in people deficient in vitamin D. In a study conducted in the Netherlands, administration of B-complex and vitamin-C supplements to poorly nourished, elderly nursing home residents led to desirable increases in body weight. Although vitamins are not weight-gain agents, in this case an improvement in vitamin nutrition may have beneficially affected the elders' appetite and disposition, and this may have led to increases in food intake. The improvement in vitamin nutrition may also have increased the seniors' ability to use the nutrients they consumed.
>
> At least two studies have shown that the administration of liquid supplements of protein and other nutrients can improve clinical outcomes in elderly patients whose hips have fractured. In these two studies the patients who received the supplements spent fewer days in a hospital, and had fewer fatal complications from their fractures, than those patients who did not.

In a study conducted in Ireland, correction of marginal thiamin deficiencies in senior citizens led to increases in appetite and subjective well-being and to a decrease in fatigue.

In two double-blind studies, modest vitamin and mineral supplementation improved immune-system functioning in older adults. In one of these studies the subjects who received the supplements had fewer "sick days" from infection than those who instead received a placebo (23 versus 48 days). Meister cautions that taking an overdose of vitamin D can cause serious problems, including bone loss—the very condition that most users of vitamin D supplements want to prevent. Physicians in Los Angeles reported in 1997 on four people who had unintentionally worsened their osteoporosis by taking too much supplemental vitamin D. Supplement users should avoid taking more than one product that contains vitamin D. If an individual takes both a multivitamin that contains vitamin D and a calcium supplement that contains it, one's vitamin D intake might be excessive.

Regarding dietary supplements, Meister states that two kinds of dietary supplements, vitamin-mineral pills and supplementary beverages (e.g., Ensure), are heavily marketed to senior citizens. Both kinds of supplements can contribute to adequate nourishment in some seniors, but they are far from nutritional panaceas. Supplementary beverages were introduced for consumption not by healthy, active people, but by persons with medical conditions that interfere with eating. Such supplements may be appropriate for patients recovering from serious illnesses, for frail elders who need to put on weight, and for persons with medical or dental problems that make chewing or swallowing difficult. Healthy people do not need such products; they would benefit far more from eating a balanced, nutritionally adequate diet that includes diverse foods. Vitamin-mineral pills can be beneficial in some situations, to decrease the risk of vitamin deficiency in frail elders, for example, but such supplements cannot offset an unhealthy diet and should not be used instead of strategies to relieve problems, depression, poor dentition, and medication side effects, for example, that interfere with food consumption. Healthy, active older adults who consume ample food from all the major food groups (grains, vegetables, fruits, dairy products, and meat/meat alternatives) may not need vitamin or mineral supplements at all. Older adults with low calorie intakes, however, may benefit from taking a multivitamin with minerals, because maintaining an adequate intake of such nutrients becomes increasingly difficult as the caloric value of one's diet decreases. Also, it is advisable for older adults who do not drink milk, the main source of calcium and vitamin D in the U.S. diet, to take supplements that provide the Daily Value of those nutrients, especially if the non-milk-drinking seniors are seldom exposed to sunlight.

The current Recommended Dietary Allowances (RDAs) do not provide separate recommendations for persons older than 51 years and, thus, do not take into account that older adults have special nutrition needs (Food and Nutrition Board, 1989). In 1996, the American Dietetic Association developed a "Nutrition and Health For Older Americans Campaign" and posted fact sheets about eating healthy geared to older adults on their internet website (www.eatright.org/older americans/foodneeds.html). This site includes a food guide pyramid for older Americans that illustrates some of the nutritional needs and differences. They indicate that persons who want help in interpreting the pyramid should ask their doctor to recommend a registered dietitian, or call The American Dietetic Association's Consumer Nutrition Hot Line (1-800-366-1655) for a referral. Some of these are discussed below.

- Calorie Needs. While vitamin and mineral requirements don't decline, the need for calories decreases by 25 percent as we age.

- Convenience. Healthy, balanced intake of nutrients will increase if foods, both convenient to obtain and prepare, are emphasized in meal planning.

- Thirst and Fluid Requirements. As they age, many people experience a decreased sensitivity to thirst. In addition, many older adults may have difficulty in moving around the house to get something to drink, or may restrict their fluid intake due to an incontinence problem.

Kurtzweil (1996) reports that many older people may find help under the Older Americans Act, which provides nutrition and other services that target older people who are in greatest social and economic need, with particular attention on low-income minorities. According to the U.S. Administration on Aging, which administers the Older Americans Act, the nutrition programs were set up to address the dietary inadequacy and social isolation among older people. Home-delivered meals and congregate nutrition services are the primary nutrition programs. The congregate meal program allows seniors to gather at a local site, often the local senior citizen center, school or other public building or a restaurant, for a meal and other activities, such as games and lectures on nutrition and other topics of interest to older people. Available since 1972, these programs, funded by the federal, state and local governments, ensure that senior citizens get at least one nutritious meal five to seven days a week. Under current standards, that meal must comply with the Dietary Guidelines for Americans and provide at least one-third of the Recommended Dietary Allowances for an older person. Often, people receive foods that correspond with their special dietary needs, such as no-added-salt foods for those who need to restrict their sodium intake or ground meat for those who have trouble chewing.

Other nutrition services provided under the Older Americans Act are nutrition education, screening and counseling. Kurtzweil cites Jean Lloyd, a registered dietitian and nutrition officer with the Administration on Aging, who states that while these nutrition programs target poor people, they are available to other older people regardless of income. Although no one is charged for the meals, older people can voluntarily and confidentially donate money, she said. The meals provide not only good nutrition, but they also give older people a chance to socialize—a key factor in preventing the adverse nutritional effects of social isolation. For those who qualify, food stamps are another aid for improving nutrition. Under this program, a one-person household can receive up to $115 a month in food stamps to buy most grocery items. For the homebound, grocery-shopping assistance is available in many areas. Usually provided by nongovernment organizations, this service shops for and delivers groceries to people at their request. The recipient pays for the groceries and sometimes a service fee.

However, in their position paper on "Nutrition, Aging, and the Continuum of Care" the American Dietetic Association cites Poza et al. (1996) and Burt (1993), who indicate that Federal programs to combat hunger and food insecurity reach only one-third of needy older adults (Burt, 1993). The Older Americans Act's congregate and home-delivered meal programs and the US Department of Agriculture's Food Stamp Program reach those with the highest rates of food insecurity, but fail to reach many who do not meet the income guidelines for food stamps or who will not accept aid because of its connotation as welfare. Many may be unaware of, are unable to get to, or are uncomfortable attending a congregate meal program, or no programs exist in their area. Additionally, they may fail to qualify or be placed on long waiting lists for home-delivered meals (Poza et al, 1996; Burt, 1993). To date, older adults have not been a primary focus of hunger advocacy groups, food banks, food pantries, and soup kitchens. (American Dietetic Association).

Kurtzweil suggests that family members and friends can help ensure that older people take advantage of food programs by putting them in touch with the appropriate agencies or organizations and helping them fill out the necessary forms. In some communities, private organizations sell home-delivered meals.

Other steps include: looking in occasionally to ensure that the older person is eating adequately; preparing foods for and making them available to the older person; and joining the older person for meals. In some cases, they may help see that the older person is moved to an environment, such as their home, an assisted-living facility, or a nursing home, that can help ensure that the older person gets proper nutrition. Whatever an older person's living situation, proper medical and dental treatment is important for treating medical problems, such as gastrointestinal distress and chewing difficulties, that interfere with good nutrition. If a medication seems to ruin an older person's taste and appetite, a switch to another drug may help.

A review of basic diet principles may help improve nutrition. Explaining to older people the importance of good nutrition in the later years may motivate them to make a greater effort to select nutritious foods. Health and wellness programs sponsored by Hospitals, YMCA's, and senior centers often provide information about nutrition in seminars or classes. The "Eat Well" brochure contained at the end of this section was found at a local grocery store.

The American Dietetic Association states that "Nutritional well-being is integral to successful aging. Successful aging, in turn, results from a broadly defined continuum of care that promotes quality of life, independence, and health. Medical and other supportive services, including food and nutrition services, that are appropriate to levels of dependency, diseases, conditions, and functional ability are key components of the continuum of care. The burgeoning elder population, changing concepts of aging itself, and dramatic changes in the delivery of health care accentuate the importance of food and nutrition as sustenance as well as in disease prevention and therapy." They further state that "Good nutritional status in older adults benefits both the individual and society: health is improved, dependence is decreased, time required to recuperate from illness is reduced, and utilization of health care resources is contained."

In development of the Model Driver Screening and Evaluation Program, it appears that a dietetics professional is an important referral source in the case management of persons who cease driving. Administrators of the Ohio Older Driver Program have found that stopping driving has an incredibly negative impact on health. For example, a person's vitamin B level is likely to fall off when they "stop driving to restaurants for lunch (for a fish sandwich) and stay home and eat cookies." (*pers. comm.*, Bonnie Kantor, 1/20/98).

References

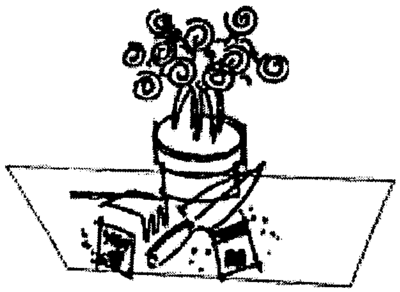
- Chair Dancing, Department P., 2658 Del Mar Heights Road, Del Mar, California 92014; 1-800-551-4386; www.chairdancing.com.
- "Helping You Drive Safely Longer" (Pamphlet: Central Plains Area Agency on Aging)
- Michael O'Shea (in *Parade Magazine*, 5/17/98 and 9/6/98)
- Gurgold and Harden (1978).
- Daniel Bowerman, D.C. (in *Health and Fitness Magazine*, November, 1998)
- Brochures distributed at local grocery stores, "Stay Active: Activity Tips for Older Adults" and "Eat Well: Food Tips for Older Adults." (developed as part of "*To Your Health! Food and Activity Tips For Older Adults*," an information and education campaign to promote healthful food choices and physical activity for healthy adults age 55+. "*To Your Health*" is a cooperative effort by the National Council on the Aging, the National Institute on Aging, the President's Council on Physical Fitness and Sports, and the Food Marketing Institute.
- Jean-Noel Bassior (in *Parade Magazine*, November 22, 1998)

- Geri-Fit Co. Ltd. P.O. Box 444, Hudson, OH 44236; phone: 330-655-9306; 1-888-GERIFIT; fax: 330-655-9347; www.gerifit.com
- "More Gain, Less Pain: A Low-Stress Exercise Program for Seniors;" (www.fitnesslink.com/moregain.htm)
- Ostrow, Shaffron, and McPherson (1992).
- Adrian (1981).
- Serfass (1980).
- Piscopo (1981).
- Kokmen, Bossemeyer, and Williams (1978).
- McPherson, Ostrow, and Shaffron (1988).
- Ponza, Ohls, and Millen (1996).
- Burt (1993).
- ADA Position adopted by the House of Delegates on October 26, 1986, and reaffirmed on October 24, 1991 and September 15, 1995. This position will be in effect until December 31, 1999.

Little Things Count

You may already be fairly active in your daily routine. For example, doing yard-work and housework count towards being active for 30 minutes daily. Here are some other ways you can make short spurts of activity count:

- Stretch for a few minutes before you get out of bed in the morning and before you go to bed at night.
- Stand while talking on the phone and stretch during television commercials.
- Take a quick walk while waiting for a delayed appointment. Walk around the building, or up and down the stairs.
- Go to a shopping mall or supermarket and walk — a great way to get out and meet new people!
- Turn off the power tools and use manual tools when gardening.
- Put away the TV remote control. Walk around the living room each time you change channels.
- When possible, park your car further away or get off the bus sooner and enjoy walking.
- Take the stairs when possible.
- Walk your dog (or borrow a friend's dog) a little longer each time and more often.
- Walk around in your house — wear out your rugs right at home!



Make Fitness Fun

If you don't love it, you'll leave it. Staying active has to be FUN. Tie activities to your hobbies and social life. If you enjoy strolling at the shopping mall, go at a time when traffic is light and walk a little faster and longer each time. Combine an uphill hike with bird watching.

Remember:

Frequency. Stay active most days of the week.

Intensity. Get your heart pumping and get air into your lungs.

Time. Aim for 30 minutes daily; 10 minutes at a time will do.

And:

Find social activities you enjoy.

Understand your limits. Start slowly and expect to feel tired (and maybe a little sore) at first.

Now is the time to start. ***You can do it!***

Keep Moving

Find out about physical activity programs at your

- Community center (YMCA, YWCA, JCC)
- School or community college
- Park and recreation center
- Senior center or area agency on aging
- Hospital wellness center
- Local religious organization
- Health club

These groups may provide organized programs, educational materials and even trained staff to give you advice.

For More Information

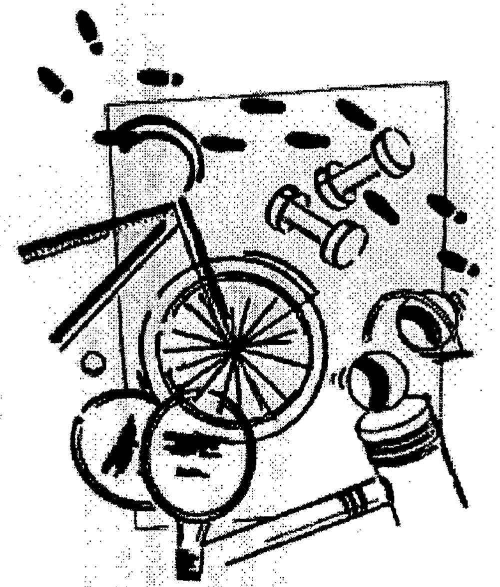
- Earn a Presidential Sports Award from the President's Council on Physical Fitness and Sports in any of 68 categories by requesting a free activity log and brochure. Write to: Presidential Sports Award, P.O. Box 68207, Indianapolis, IN 46268
- Write to the American Association of Retired Persons (AARP) and request a free copy of *Pep Up Your Life*, publication #D549, AARP Fulfillment, 601 E Street, NW, Washington, DC 20049.

This brochure was developed as part of *To Your Health! Food & Activity Tips For Older Adults*, an information and education campaign to promote healthy food choices and physical activity for healthy adults ages 55 and older. *To Your Health!* is a cooperative effort by The National Council on the Aging, the National Institute on Aging, the President's Council on Physical Fitness and Sports, and the Food Marketing Institute.

For more information about *To Your Health!* contact:
Food Marketing Institute
800 Connecticut Ave., NW • Washington, DC 20006-2701

To Your Health!

Stay Active



Activity Tips for Older Adults

Time on Your Side

While there are no guarantees, staying active may help you look, feel, and even act years younger than your actual age. Keeping your body active may even help your mind stay sharper over the years. Even common everyday activities such as walking, gardening and taking the stairs can make a difference.

You reap great benefits from small amounts of activity. The key is to do at least 30 minutes of moderate physical activity each day, most days of the week. Regular activity may help you feel better and stay healthy as you go about your daily tasks and enjoy your leisure.

It is never too late to start. In a recent study, nursing home residents in their 80s and 90s began lifting light weights to strengthen their leg muscles. After three months, they were able to get out of chairs and climb stairs more easily than before. So, if you are already active, keep it up! If you need to become more active, the tips that follow will help you get started.

Move it! Don't Lose it!

When it comes to muscle, the saying is true: "Use it or lose it." Your body is like a machine that stays in tune by being used. Some of the weakness that comes with age may be related to inactivity. Active people often

- have more energy for travel, volunteering or friends.
- feel good about how they look.
- have a more positive outlook.
- have stronger bones, better balance and coordination.

There are three things you need to work on to be physically fit: muscle strength, aerobic endurance and flexibility.

Muscle Strength

Without strong, flexible muscles, anything physical becomes more of an effort, whether it is carrying groceries or getting up from a chair.

Building strength doesn't mean you have to go to a gym. You can begin at home. Haul dirt in your garden to build strength in your legs or push a wheelbarrow to build strength in your upper arms. If you don't have a garden, use common household items like unopened soup cans as hand weights. Lift these simple weights while watching the evening news or talking on the phone with friends.

Aerobic Endurance

When you do aerobic activities, your heart beats faster and you breathe more quickly. Bicycling, swimming and brisk walking while swinging your arms are examples of aerobic activities. Aerobic activities may help you sleep better, feel energized and improve your circulation.

Flexibility

Staying flexible is important so you can reach, bend, keep your balance and lower your risk of serious injury if you fall. Stretching is a great way to overcome muscle stiffness. Learn simple stretches from a fitness professional, from books at your local library, by watching exercise shows on TV, or by taking a flexibility or yoga class at your local community center. Even activities such as raking leaves in a wide sweeping motion can stretch your arms, shoulders and upper back muscles.

Make Your Own Plan!

Keep a weekly diary of activities that you currently do and enjoy.
Write down how you felt after being active and detail your plans to stay active.

Weekly Activity Diary

Day	Aerobic Activities	Stretching Activities	Strength Building Activities	How I Felt Afterwards	What I Can Do to be More Active
Sample	*Country dancing*	*Nothing*	*Carried groceries*	*Full of energy but need to stretch more*	*Stretch while watching TV news*
1					
2					
3					
4					
5					
6					
7					

Get Started

See your doctor before you start a physical activity program! Then:

- Choose activities you enjoy.
- Set realistic goals and keep track of your progress in a notebook.
- Start gradually and work up to more days or longer periods of time.
- Listen to your body. Know when to rest. **Stop if you have muscle pain, swelling, numbness or tingling. See your doctor if the symptoms do not go away or get worse.**
- Enjoy plenty of water, juices, vegetables, and "watery" fruits such as grapes, melons and oranges to replace the fluid you lose during physical activity. Don't be fooled by the temperature. Heat, wind and even cold weather can dehydrate you. You may not feel thirsty, but exhaustion can set in. Aim for six to eight glasses of water daily.
- Make physical activity a social event. Staying active is a great way to see friends or make new ones. See the "Keep Moving" section at the end of this brochure to find others who enjoy staying active.

Food How To's

1. Enjoy a wide variety of foods.

To get all the vitamins, minerals and nutrients you need, enjoy foods from ALL the food groups. If you are a "meat and potatoes" lover, try adding squash, carrots or zucchini to your favorite beef stew.

2. Eat five servings of fruits and vegetables.

It's easy! Add sliced or dried fruit to your cereal, enjoy a glass of juice, try some vegetable soup or have a salad. Whether they are fresh, frozen, canned or dried, fruits and vegetables are important sources of vitamins and fiber.

3. Get six servings of breads, cereals, rice and pasta.

No, they don't make you fat! They provide you with energy. If you eat cereal in the morning (one serving) and a sandwich for lunch (two servings), you'll be half way to your goal!

4. Choose lean for better health.

Trim fat from meat and remove poultry skin before eating to reduce fat. Meat cuts from the round and loin usually have less fat.

5. Drink milk or eat yogurt and cheese at least twice a day.

Bones of all ages need calcium. Look for low-fat dairy products such as 1% or skim milk, low-fat yogurt and reduced-fat cheeses.

6. Tingle your tastebuds.

Use herbs and spices rather than added salt, butter or margarine to boost flavor. Look for seasonings and spice mixtures without added salt.

7. Make mealtimes social events.

Join others for meals. Start your own pot luck lunch or supper club with friends. Join a senior center that offers meals.

8. Eat smaller meals more often.

If you get full quickly or find big meals unappetizing, eat mini-meals throughout the day. Try some of these snacks:

- Cereal, bagels, pita bread, tortillas, bread sticks, rice cakes, crackers, pretzels, air-popped popcorn, ginger snaps, graham crackers or English muffins.
- Dried and fresh fruits, or juices.
- Carrots, celery, pepper strips, jicama, snap peas, zucchini or cucumber rounds.

9. Read Nutrition Facts on the food label.

Pay careful attention to serving sizes. If you eat more or less than the serving size on the label, you will be getting more or less of the nutrients listed.

10. Round out frozen dinners.

While frozen meals are convenient, they can't provide all the vitamins, minerals and fiber you need. Add a green salad, whole grain bread and fresh fruit to a frozen dinner entree. Use the *Nutrition Facts* label to buy frozen meal-type dinners that fit your nutrition needs. You may want to purchase meals that are lower in fat and sodium.

For More Information

- Call the National Institute on Aging's Information Center, 800-222-2225.
- To locate a registered dietitian in your area, ask your physician or call the consumer nutrition hotline of The American Dietetic Association's *National Center for Nutrition and Dietetics* at 800-366-1655, weekdays, 10 a.m. to 5 p.m., EST.
- Call the Food and Drug Administration and request the publication *Using the New Food Label To Choose Healthier Foods*, 301-443-3170.
- Call the USDA's Meat and Poultry Hotline at 800-535-4555 or 202-720-3333, weekdays 10 a.m. to 4 p.m., EST.
- Write to the American Association of Retired Persons (AARP) and request a free copy of *Healthy Eating for a Healthy Life*, stock #D13565, AARP Fulfillment (Ref. #EE0949), 601 E Street, NW, Washington, DC 20049.
- To find a senior nutrition program in your area, call the Eldercare Locator Service at 800-677-1116 weekdays, 9 a.m. to 11 p.m., EST.

This brochure was developed as part of To Your Health! Food & Activity Tips For Older Adults, an information and education campaign to promote healthy food choices and physical activity for healthy adults ages 50 and older. To Your Health is a cooperative effort by The National Council on the Aging, the National Institute on Aging, the President's Council on Physical Fitness and Sports, and the Food Marketing Institute.

For more information about To Your Health, contact:
Food Marketing Institute
800 Connecticut Ave., NW • Washington, DC 20006-2701

To Your Health!

Eat Well

Food Tips for Older Adults

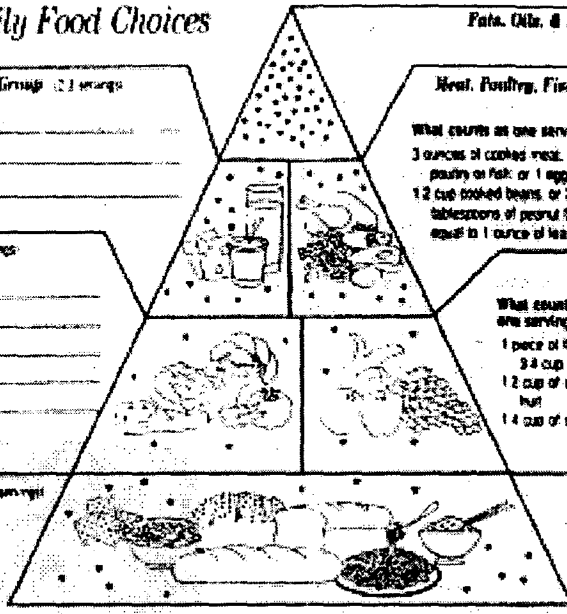
You Are What You Eat!

Enjoying nutritious food is important at any age. Although you are not "growing" at the same rate you did when you were younger, food still becomes part of you. You need the same vitamins and minerals you did when you were younger. Healthful food choices keep your body vital and strong and might even help prevent some diseases.

Tune-up Time

Think of your body as a high-performance machine. Staying active cranks up its calorie-burning engine. How do you take care of your personal engine? Is it sitting idle? Do you put a poor fuel mixture into your tank? Do you fill your body with regular fuel — calories only? Or, do you give it premium fuel — nutrient-rich foods from the Food Guide Pyramid? Repairing your body-machine can be costly. So, eat well and stay active!

Check Your Daily Food Choices



Fats, Oils, & Sweets (use sparingly)

Milk, Yogurt, & Cheese Group (2-3 servings)

What counts as one serving?
1 cup of milk
1 cup of yogurt
1 1/2 to 2 ounces of cheese

☐ ______
☐ ______
☐ ______

Meat, Poultry, Fish, Dry Beans, Eggs, & Nuts Group (2-3 servings)

What counts as one serving?
3 ounces of cooked meat, poultry or fish, or 1 egg,
1/2 cup cooked beans, or 2 tablespoons of peanut butter are equal to 1 ounce of lean meat

☐ ______
☐ ______
☐ ______

Vegetable Group (3-5 servings)

What counts as one serving?
1/2 cup of chopped raw or cooked vegetables
1 cup of leafy raw vegetables

☐ ______
☐ ______
☐ ______
☐ ______
☐ ______

Fruit Group (2-4 servings)

What counts as one serving?
1 piece of fruit or 3/4 cup of juice
1/2 cup of canned fruit
1/4 cup of dried fruit

☐ ______
☐ ______
☐ ______
☐ ______

Bread, Cereal, Rice, & Pasta (6-11 servings)

What counts as one serving?
1 slice of bread
1/2 cup of cooked cereal, rice or pasta
About 1 cup of dry cereal (serving sizes vary)

☐ ______
☐ ______
☐ ______
☐ ______
☐ ______
☐ ______
☐ ______
☐ ______
☐ ______
☐ ______
☐ ______

What Is A Serving?

You may be surprised how easily you can meet the Food Guide Pyramid's goals when you know the size of a serving. Use familiar household items as a guide to serving sizes.

- One half-cup portion of spaghetti or rice is a serving. One half-cup would fill an ice cream scoop. If you eat more than a half-cup, you may be eating two or more servings in a single portion.
- A cup is about the size of a closed fist.
- A three-ounce serving of meat, fish, or poultry is about the size of a deck of cards or an audio cassette tape.

Building Your Food Pyramid from the Bottom Up

Most people know what they should eat — the challenge is to do it. The goal is to enjoy a variety of foods in the recommended amounts, most days of the week.

Think about your food choices over the past day. Now look at the food groups and serving sizes of the Food Guide Pyramid. For each serving you have eaten, check off a box and write down the food's name next to the group that matches the food. Mixed food items like beef stew would count as 1 meat serving, 1 vegetable serving and a fat serving (if made with meat drippings).

Are you eating at least the minimum number of servings from each food group? Is your pyramid "upside down"? In other words, are you eating more from the top of the pyramid (sweets, oils, butter or margarine) than the base (breads, rice or pasta)? If you need to make changes, follow the "Food How To's."

For more information, or to find out where you can view a 20 minute video on this subject, call:

Central Plains
Area Agency on Aging
(316) 383-7824
Serving Sedgwick, Harvey and Butler Counties in Kansas

This brochure was developed in conjunction with the staff of Rehability, a national rehabilitation corporation specializing in physical therapy with three offices in the tri-county area: Wichita, Derby and Newton.

Central Plains Area Agency on Aging published this brochure with the support of a demonstration grant from the Administration on Aging

March, 1995

Helping You Drive Safely Longer

Central Plains
Area Agency on Aging

510 N. Main
Wichita, Kansas 67203

(316) 383-7824

Self-awareness is the key to safe driving. Are you at risk for a traffic accident? This brochure is about helping seniors assess their driving ability and providing information on how to drive safely longer. Take this short Driving Assessment:

DRIVING ASSESSMENT

HEARING

- With the car windows rolled up, can you hear a siren or horn? ☐ Yes ☐ No
- Do you hear the sound of your turn signals? ☐ Yes ☐ No

VISION

- Are objects clear and bright? ☐ Yes ☐ No
- Do you see clearly at night? ☐ Yes ☐ No
- Can you go outside in the bright sunlight and see clearly right away? ☐ Yes ☐ No
- Can you see clearly over the steering wheel? ☐ Yes ☐ No

HEAD AND NECK

- Can you turn your head an equal distance from one side to the other? ☐ Yes ☐ No
- Can you turn your head and neck far enough to see over your shoulder? ☐ Yes ☐ No

ARMS AND HANDS

- Can you drive as far as you desire without your hands and arms becoming tired? ☐ Yes ☐ No
- Can you drive for 30 minutes without your fingers or arms becoming tingly or numb? ☐ Yes ☐ No
- Can you keep a firm but comfortable grip on the steering wheel with both hands while keeping your elbows bent and relaxed? ☐ Yes ☐ No
- Can you lift your arm high enough to adjust the rear view mirror? ☐ Yes ☐ No
- Can you cross one hand over the other when turning the wheel? ☐ Yes ☐ No

LEGS AND FEET

- Can you depress the brake pedal with your knee bent? ☐ Yes ☐ No
- Can you sit for 15 minutes without your feet or legs becoming tingly or numb? ☐ Yes ☐ No
- Do you always use your right foot to depress the brake pedal? ☐ Yes ☐ No
- Can you bend your foot at least 10 degrees? ☐ Yes ☐ No

If you answered "no" to any of the above questions, inside are some helpful tips and simple exercises which may help you drive safely longer.

Tips to Help You Drive Safely Longer

HEARING

Background noises can significantly distort sound and interfere with your driving. A turn signal left on because you don't hear it can cause an accident.

Helpful Tips:

- Have your hearing checked annually.
- Turn off the radio.
- Check exhaust pipes and have bad ones replaced before they become noisy.
- Keep air conditioner or heater fan on the lowest setting to reduce background noise.
- Purchase a device that amplifies the sound of your turn signals.

VISION

Being able to see road signs and signals, other vehicles, and pedestrians is affected by more than just visual acuity.

Helpful Tips:

- Have your vision checked annually.
- Avoid driving at night.
- Clean the inside and outside of windshield and windows.
- Clean headlights and mirrors.
- Give your eyes a few minutes to adjust to changes in light and dark. Use this time to fasten seat belt and adjust mirrors.
- If you can't see over the steering wheel, sit on a cushion or pillow (make sure you can still reach the gas and brake pedals).

Simple Exercises to Help You Drive Safely Longer

The following sections describe exercises you can do at home which may improve your physical mobility which effects driving ability. Before beginning any exercise program, consult your doctor. Your doctor may recommend that you do these exercises 3 to 5 times per week.

HEAD AND NECK

Stiffness in the neck which keeps you from turning your head limits your field of vision.

For each of these exercises, hold for 5 counts and repeat 10 times.

1. Flexion
Curl chin to chest.

2. Axial Extension
Tuck chin in; don't tip head down.

3. Rotation
Tuck chin in, Turn head to look over right shoulder and then look over left shoulder.

4. Sidebending
Tilt head to right shoulder, then left.

ARMS AND HANDS

If your arms and hands become tired or tingly and numb when driving and you have difficulty gripping the steering wheel and lifting your arms to adjust the rearview mirror, try these exercises or activities.

1. Cup Exercise
Gather 5 to 10 styrofoam or plastic cups and practice turning them upside-down and right-side up. Then practice stacking and unstacking them as quickly as possible. This exercise will help to improve your gross motor coordination and speed.

2. Transferring Objects Exercise
Practice transferring various objects from one side of the table to the other. This will help with coordination and seeing things using your peripheral vision.

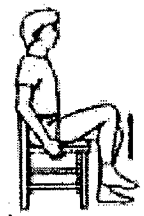
3. Folding Clothes
Folding clothes is a good activity to help increase gross upper extremity movement.

LEGS AND FEET

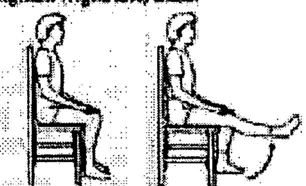
Stiff or numb legs and feet slow reaction time and ability to quickly depress the brake or gas pedal.

For each of these exercises, hold for 5 counts and repeat 10 times.

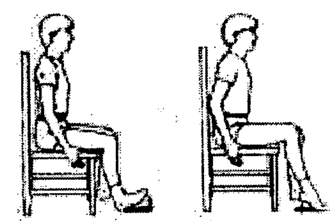
1. Hip Flexion
Sitting, lift (right/left) knee to chest.



2. Knee Extension
Sit with back against chair. Straighten (right/left) knee.



3. Ankle Flexion
Sit with feet on floor. Raise (right/left) foot. Keep heel on floor. Raise heel. Keep toes on floor and hold.



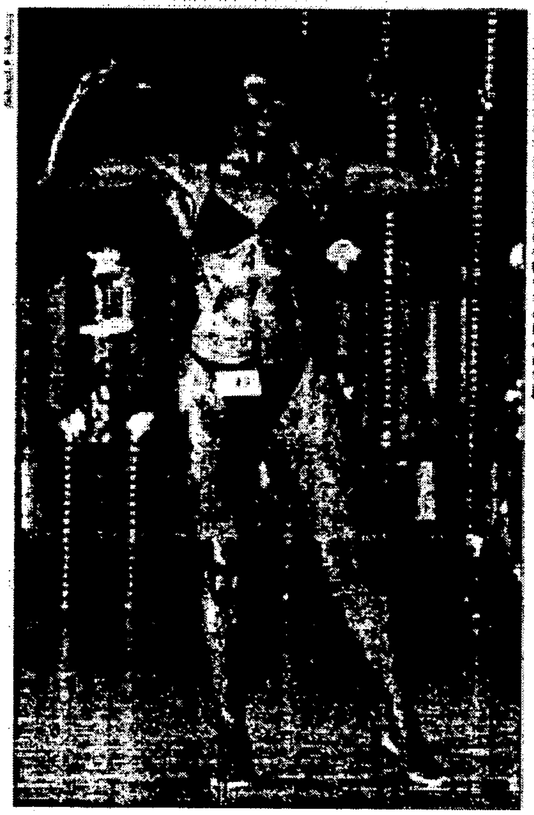
She began lifting weights to get strong enough to carry 50-pound bags. Today, Morjorie Newlin lifts 100 pounds and is an award-winning bodybuilder...Oh, and she's 78.

Sure, You'll Get Older. So What?

"I JUST CAN'T GO and find somebody to ask for help every time I want to lift a finger," said Morjorie Newlin, explaining why she took up bodybuilding.

We were at a gym in Philadelphia where Newlin was training for the National Physique Committee's Philadelphia Bodybuilding Championships. Newlin sat down at the leg-press machine, bracing her feet against a platform connected to 180 pounds of cast iron. She pushed it back and forth 12 times, then paused and did three more sets of 12. Not bad for a 78-year-old grandmother of four who started weightlifting just six years ago.

Newlin, who has won 25 trophies so far, said it was never her intention to bare her sculpted muscles in public. She began lifting weights to become strong enough to handle everyday tasks, like keeping her cat supplied with kitty litter. A few years ago, her supermarket had a sale on 50-pound bags, but Newlin couldn't find anyone to lift them off the shelf. That's no longer a problem. Nor is the upkeep of her two-story home. "I always felt I could do whatever I want to," she said, "and now I know I can." Newlin shovels snow, cuts grass and hauls a 50-pound fan up from the basement every spring. "I couldn't do all this before without being worn out."



Six years ago at 72, Morjorie Newlin won her first bodybuilding contest. "When the judges announced her age, the audience went haywire," recalls her former trainer, Bob Rivers. "I thought they were applauding because the old lady made it onto the stage," jokes Newlin.

Newlin always enjoyed exercising. After finishing her workday as a registered nurse, she'd often stop into a health club for a stint on the treadmill or stationary bike. But after retiring in 1987 to care for her terminally ill husband, Newlin decided to take up weight training. She knew resistance training with free weights and machines builds strength, stamina and endurance, and it prevents osteoporosis.

Although she suffers from a back problem and arthritis, both have improved since she began working out. She never worries about pushing herself too hard. "I used to be a nurse," Newlin reminded me. "I know about anatomy. I know what I should and shouldn't be doing."

The soft-spoken bodybuilder said she would like to see at least one belief about aging changed: "An older person can exercise with weights and build muscle," Newlin asserted. Her current trainer, the Rev. Richard Brown III, agreed. "She's opened my eyes to seniors," he said. Recently, Brown started Newlin on the "dead lift"—hoisting a 45-pound barbell up from the floor. Already she has increased the weight to 65 pounds.

How does she see herself next year, at age 79? "Well, I could add 50 pounds to the dead lift by next year," she replied. "And I should be able to bench-press 100." She hopes to grow steadily stronger or at least maintain her present strength.

"People say, 'When you get to this age, you can't do this and you can't do that,' but that's not the way it is," she added. "I never considered my age when I went to the gym." In fact, Newlin never thought about her age at all until she attracted so much attention. "I see some people so terrified about getting older, but it's going to happen if you're still alive," she said, laughing.

Does she wish she'd started bodybuilding when she was younger? "Of course, but I'm not agonizing over it," she said. "I still think that, as long as I live, there's something else I can do."

"She's showing us that no matter how old you are, as long as you have breath, you have life," said Brown. "And as long as you have life, there's hope." ■

Morjorie Newlin's Exercise Tips

Can someone 80 or even older start a fitness program? Anyone—with a doctor's approval—can increase his or her strength, says the 78-year-old bodybuilding champion Morjorie Newlin.

■ Start with two weights—2½ pounds each—she advises, or two cans of soup or two small bottles of water. "Move your arms up and down until you're comfortable and feel you can do more. Your arms will feel stronger after a time."

■ "Don't try to do too much," Newlin says. She warms up on a treadmill before working out with weights four times a week.

BY JEAN-NOEL BASSIOR

Geri-Fit® Q&A

Francesca Gern, instructor, leads the Geri-Fit® class

What is Geri-Fit®?

Geri-Fit® is a 45-minute strength training exercise program for older adults that helps to rebuild lost strength.

How is Geri-Fit® different from aerobics?

Because there's no dancing, jumping, floor work or choreography to learn, Geri-Fit® appeals to both women and men. The exercises are performed seated in a chair and classes are guided by a trained and Certified instructor.

Is there any special equipment used?

No. Each participant brings their own set of 2-pound (each) dumbbells to class and an exercise mat or towel. Men may start out using a set of 3 to 5-pound dumbbells, depending on their fitness level. Chairs are needed to perform the upper body exercises, however, these are provided at the centers where the Geri-Fit® program is offered.

Do I have to be in good shape to enroll?

Geri-Fit® accommodates all senior ages and fitness levels - whether this is the first time you have ever exercised in your life, or you currently walk or lead an active lifestyle. All the exercises can be modified to suit your fitness level; you'll simply work out at your own pace. Even those confined to a wheel chair can participate.

Is Geri-Fit safe to do?

The Geri-Fit® program was designed by a geriatrician and has been medically reviewed and approved by doctors, physical therapists, exercise physiologists and other health care professionals. However, you should consult with your physician before starting any exercise program.

I have diabetes; I've just had surgery; I have a heart condition; I have high blood pressure; I have osteoporosis; I have osteo-arthritis; I'm on special medication. Can I still take Geri-Fit®?

Medical histories and enrollment qualification should be discussed with your physician before starting the Geri-Fit® program. Your doctor will tell you if he/she thinks the program is appropriate for you. Chances are, he/she will highly recommend the program. If your doctor should have any questions, please have him/her call our office to speak with one of our customer service representatives during normal business hours.

Please feel free to contact the agencies listed below that have purchased the Geri-Fit® exercise program:

Solon Senior Center
Eileen Regan, Director
33790 Bainbridge Rd.
Solon, OH 44139
Tel: 440-349-6363

Deborah J. Moore
1902 Glen Lake Circle N
St. Petersburg, FL 33702
Tel: 813-579-4343

Tri-City Senior Center
Barbara Nyegran, Director
16999 Bagley Rd.
Middleburg Hts., OH 44130
Tel: 440-243-5564

Richard Gooch
Racquet Club of Temple, Inc.
620 Fryers Creek Circle
Temple, TX 76504
Tel: 254-773-2121

Geri-Fite Company, Ltd.
P.O. Box 444
Hudson, OH 44236
Tel: 330-655-8306 / 1-888-GERIFIT
Fax: 330-655-8347
email:gerifit@aol.com

More GAIN
Less PAIN

A Low-Stress Exercise Program for Seniors

Featuring
Charles Manning, CPT
Certified Personal Trainer, Certified Aerobic Instructor and Corporate Fitness Director

You Can Fight Aging!

With More GAIN LESS Pain

"A Low-Stress Exercise Program For Active Older Adults"

- Lower your resting heart rate
- Reduce your risk of cardiovascular disease
- Maintain a desirable weight
- Reduce stress
- Increase your quality of life

Many people still think growing older causes physical decay: slowing down, losing stamina, and growing weaker. But aging doesn't cause inactivity; *inactivity accelerates aging.* When regular physical activity is maintained from youth on, changes associated with aging slow markedly. Even better, changes as a result of inactivity can be reversed by exercise to a striking degree. In fact, older people improve by a greater percentage, compared to young adults, when each group begins regular exercise. The worse shape you are in, the more you have to gain. Fighting the effects of aging takes a four pronged attack: endurance, strength, flexibility, and balance. The rewards that can be won are large.

Regular aerobic exercise can give older people the oxygen uptake of sedentary folks half their age. Any continuous movement will do. Higher oxygen uptake brings greater endurance for heart, lungs, and skeletal muscles and improved ability to burn fat. Increased fitness also reduces risks of being overweight and obesity, hypertension, high cholesterol, hyperglycemia and diabetes, cardiovascular disease and some kinds of cancer.

Inactivity leads to reduced muscle mass and increased fat. Loss of muscle strength erodes quality of life. These changes reduce the ability to perform tasks such as lifting a full trash can, pushing a lawn mower, and opening jars and bottles. Lifting grandchildren is limited. The stronger your muscles become, the longer you'll be able to perform routine household and yard chores without frustration, and the more activities you will be able to enjoy. It's never too late to begin.

Beginning an exercise program at any age can be a challenge. But with *More GAIN LESS Pain* exercise video, the guess work is taken out. Instructions are easy to follow, and safety is foremost. The video features a warm-up, aerobic training, muscle strengthening and toning, and a final stretch.

The music is inspiring and easy to follow. Taped at beautiful Rock Springs Equestrain Community in Greenville, North Carolina.

Charles Manning is a Certified Personal Trainer (CPT), Certified Aerobic Instructor and Corporate Fitness Director. Let Charles and friends guide you through a less stressful workout that will leave you refreshed.

To order *More GAIN LESS Pain*, call toll free (800) 392-4434 or fill out the order form below.

YES, send me the *More GAIN LESS Pain exercise video* so I can start fighting the aging process!

For orders outside the United States, please call 919-851-0123 for pricing information.

Number of videos @ $19.95 each: [ ]

Please add $4.95 shipping/handling: [ ]

TOTAL: [ ]

Charge to my:
☐ VISA
☐ MasterCard

Card Number: [ ] Exp. Date: [ ]

Name as it appears on credit card: [ ]

Send to: [ ]

Address: [ ]

1C3(b)i. Rehabilitation Procedures - Elderly Population With Chronic Conditions Requiring Intervention: Physician and/or Occupational Therapist Review

Loss of the ability to drive is often a major obstacle to being able to live independently and return to employment following a disability. Hunt (1993) reports that many health professionals are unaware that automobiles can be adapted to enable independent transportation for the physically disabled. The objective of occupational therapy treatment is to make changes in performance components (e.g., strength, fine motor ability, problem solving ability) and or contexts (e.g., environmental factors) so that a person can function in a specific activity (AOTA, 1994a). When these changes cannot be made, the occupational therapist teaches the individual compensatory techniques to allow success in performance areas in spite of continued impairment. Occupational therapists may be certified by AOTA in neurorehabilitation, pediatrics, and geriatrics (certification under development). Other certification that OTs may obtain from external associations include: hand therapy, driver rehabilitation specialty, aquatic therapy, and as an assistive technology provider.

Driver rehabilitation services are established to assist individuals with a variety of disabilities to achieve independent, low-risk driving. Driver rehabilitation may be of benefit whenever a disabling condition affects a person's driving ability. Disabilities may be neurological, orthopedic, or developmental in nature, or may occur as a result of age-associated changes. A table is presented at the end of this section that lists the following: specific diagnoses; their effects on driving; what can be done to remediate a person to allow him or her to continue to drive safely; and a generic list of referral resources. This information was largely taken from a report by Sabo and Shipp (1989) and Harvard and Shipp (1998), with input using Fact Sheets produced by ADED. This matrix will be of particular use to health care specialists who may not have undergone any inservice training about the effects of medical conditions on driving ability, and can help point professionals in the right direction when referring a driver for further evaluation/remediation of their ability to drive safely. A similar table is presented in Section IC3(b)iii, for drivers with physical impairments (e.g., missing or non-functional limbs) who may benefit from adaptive equipment.

Whether a disabled/impaired individual can be remediated to drive is governed by the following:

- Can the person handle the mental and physical demands of driving?
- Will he or she be able to transfer to a driver seat or will the individual need to drive from a wheelchair?
- Will the person need special modifications to operate the vehicle?

Acquiring the correct information to answer these questions requires the assistance of professionals. An individual's physician and health care team will have input, but the expertise and assistance of a driver rehabilitation specialist is recommended. Driver rehabilitation specialists can be contacted through a rehabilitation center, the Association for Driver Rehabilitation Specialists/ADED, or the American Occupational Therapy Association (AOTA). Driving rehabilitation specialists come from a variety of disciplines including driver education and occupational, physical, recreational, and kinesio therapies. The primary discipline providing these services is occupational therapy. It is important to note that no discipline is able to provide these specialized services solely on the basis of their degree or credential—all disciplines require additional training. Training programs to provide driver rehabilitation specialists are scarce. ADED is working on a Professional Development series to provide training workshops. The target date for the first workshop is August 2000. AOTA is developing a driver rehabilitation soft-bound book in response to requests from their membership for training materials. ADED is working in partnership with AOTA on this project.

ADED began the certification process for driver rehabilitation specialists in 1992. The exam was developed in 1994-95. To take the exam, the applicant must either hold an undergraduate degree in rehabilitation, education, health, safety, therapy or a related profession; or have eight years of full-time experience working in the field of Driver Rehabilitation. There are too few CDRS's to perform assessments on all who need them. To increase the number of CDRS's, at least two things must happen: (1) an educational core curriculum must be established; and (2) a curriculum must be developed. AOTA is informally assessing current university-level driver rehabilitation instruction within OT coursework. Driver rehabilitation content is not required, although many universities provide a one-hour, non-standardized introductory session. ADED is currently convening an education committee to develop educational standards that will serve as the foundation for training curriculums.

The Association of Driver Educators for the Disabled has a fact sheet called "Recommended Practices for Driver Rehabilitation Services." It states that a driver rehabilitation program must have a qualified driver rehabilitation specialist and the appropriate vehicle(s) and equipment to provide comprehensive services in the following areas:

1. Clinical Evaluation: Applicable testing in the areas of physical functioning, visual/perceptual/cognitive screening. Where applicable, a wheelchair/seating assessment shall be conducted.

2. Driving Evaluation: Shall include an on-the-road performance assessment of the client in an actual driving environment using equipment similar to that which is being prescribed.

3. Vehicle Modification/Prescription: All prescriptions shall be based on the client's demonstrated performance in an actual driving experience with equipment similar to that which is being prescribed. The prescription should include appropriate description and dimensions of the client's vehicle and wheelchair.

4. Driver Education: Shall include sufficient practice and training to enable the client to operate a motor vehicle with the prescribed equipment at a level that meets the client's needs for a driver's license.

5. Final Fitting: The client shall receive a final fitting and operational assessment in his/her modified vehicle.

Many major rehabilitation centers conduct complete driver evaluation programs which are certified by their State's department of motor vehicles. This includes a pre-driver evaluation, behind-the-wheel lessons, and assistance in licensing. Pre-driver evaluation includes testing eyesight, motor control, judgment, and reaction time. Hunt (1993) states that poor judgment may be the only limiting factor that revokes a driver's license. Judgment and attentional deficits require serious consideration because these cannot be remediated with compensatory techniques or equipment.

For example, at Bryn Mawr Rehabilitation Hospital's Adapted Driver Education Program, which has a State license and speciality certification, approximately 250 individuals are evaluated and trained each year. Tom Kalina, the program coordinator, stated that "success depends on the situation; if someone fails, it can still be a successful evaluation because it helps the person see that he or she is not able to drive anymore."

Another example is the Cleveland Clinic Foundation Driver Rehabilitation service. The primary goal of the service is to enable their clients to attain low-risk independent mobility in the community using the least amount of adaptive technology possible. Services are provided by a Registered Occupational Therapist, who is a also a Certified Driver Rehabilitation Specialist - a health care professional specifically trained in the evaluation and treatment of visual, physical, sensory, and cognitive/perceptual dysfunction within the driving task. The program features a specially-modified evaluation sedan which can be fitted with several types of hand controls, adapted steering devices, a left-side accelerator pedal, devices to activate secondary controls, and other adaptive driving aids.

One of the services offered at the Clinic includes Occupational Therapy Driving Education. Most clients entering the program undergo a three hour OT Driving Evaluation. It consists of a two hour clinical assessment which screens visual, cognitive/perceptual, and physical capabilities as they relate to the driving task, followed by a one hour behind-the-wheel assessment in their evaluation sedan using necessary adaptations. If concerns are identified during the Driving Evaluation, or if the person needs to learn safe use of adaptive driving aids, a systematic program of therapy designed to decrease a client's driving risk may be recommended. This form of occupational therapy treatment is called "driver rehabilitation" and is individualized to the client's particular needs. Obtaining proper license restrictions for adapted equipment is also included under this service.

Vehicle Modification Consultation service is provided by Cleveland Clinic Foundation primarily to those who have successfully completed driver rehabilitation using adapted equipment, or to individuals who require modifications to a vehicle in order to be transported safely as passengers. The detailed report generated by this service describes what equipment and vehicle modifications an individual requires. The report may be submitted to equipment vendors/van modifiers for competitive bid.

Driving programs stress that a consultation with the individual's physician is necessary to make sure that he or she is physically and psychologically prepared for the driving experience. If an individual is evaluated too soon after an injury, there is the danger of recommending too much equipment and, consequently, spending money on adaptive equipment he or she will not need in the future. After a traumatic experience, such as a spinal cord injury, there is a great deal to re-learn. A person should be cautioned not to put too much pressure on himself or herself too soon.

Most driver evaluation programs utilize vehicles with hand controls and steering devices to instruct their clients. Some cars have a Chair Topper mounted on the roof which mechanically loads and stores the wheelchair for the driver or passenger. Most programs also operate a fully modified van for people who drive from their wheelchairs. This van may have a raised top as well as a lowered floor. It may also have a Lift-A-Way or Swing-a-Way wheelchair lift with power doors on the side cargo door and a remote control entry device. Some driving programs are even including the lowered-floor minivan conversion such as the Braun Entervan.

After entering the vehicle, the evaluator can determine if the client will drive from a wheelchair or from a power seat. The power seat base moves electrically into position next to the client so that the transfer may be comfortable and safe. Generally, if a person can transfer, he or she should drive from the van seat which is bolted to the floor. If the client cannot transfer, an electric wheelchair tiedown can be added along with special stabilizing belts to secure the client and the wheelchair behind the steering wheel.

There are many different types of driving controls and assistive driving devices. These include hand controls for throttle and brake, extended steering columns to position the wheel at the proper height, lower effort steering and braking, and modified vehicle switches. In a driver training vehicle, it may take a few sessions to fit this equipment. Once the client is evaluated by the instructor, he or she can begin to shop for a vehicle. Hunt (1993) reports that adaptive devices have been referred to as "gadgets" that can be recommended by physicians. She states that this suggestion is erroneous because physicians are generally not familiar with the variety of adaptive devices or the functional performance skills necessary to use these devices. In addition, selection of appropriate devices requires trial usage, followed by the modification or selection of a different device. Because people are generally unable to spontaneously adjust to driving with these devices, they require training; OTs can provide training and practice in a nonthreatening, nonjudgmental environment.

Credentials for Occupational Therapists:

Occupational therapy services include, but are not limited to:

- Assessing and providing treatment in consultation with the individual, family, or other appropriate persons;
- Designing interventions directed toward developing, improving, sustaining, or restoring daily living skills, including self-care skills and activities that involve interactions with others and the environment, work readiness or performance, play skills or leisure capacities, or enhancing educational performance skills;
- Developing, improving, sustaining, or restoring sensorimotor, oral-motor, perceptual, or neuromuscular functioning, or emotional, motivational, cognitive, or psychosocial components of performance;
- Educating the individual, family, or other appropriate persons in carrying out appropriate interventions.

These services may encompass assessing the need and design, development, adaption, application, or training in the use of assistive technology devices; designing, fabricating, or applying rehabilitative technology; training in the use of orthotic or prosthetic devices; applying physical agent modalities as an adjunct to or in preparation for purposeful activity; applying ergonomic principles; adapting environments and processes to enhance functional performance; or promoting health and wellness (AOTA, 1994b).

Accreditation of educational programs for the occupational therapist and the occupational therapy assistant is granted by the Accreditation Council for Occupational Therapy Education (ACOTE) of the American Occupational Therapy Association (AOTA). The ACOTE is recognized as the accrediting agency for occupational therapy education by the United States Department of Education (USDE) and the Council on Higher Education Accreditation (CHEA).

An occupational therapist is a "professional-level" practitioner who has, at a minimum, a Bachelor's Degree in occupational therapy (or a Master's degree in OT, after receiving a BA in another field), has completed 6 months of field work, and has passed the national certification examination. An Occupational Therapy Assistant (COTA) is also a practitioner, for whom standards are provided by AOTA. The COTA is a "technical-level" practitioner who has completed an Associate's Degree Program in occupational therapy (2 years post-secondary education), has completed 3 months of field work, and has passed the national certification examination. All COTAs require more than a minimal level of supervision by an OT when providing services (AOTA, 1993). The major function of a COTA is to provide quality occupational therapy services to assigned individuals *under the supervision of an OT*, such as assisting with data collection and evaluation; developing treatment goals; implementing and coordinating intervention plans; providing direct service; adapting intervention equipment; administering standardized tests; etc.

Occupational therapists who treat for strokes, spinal cord injuries, amyotrophic lateral sclerosis, Alzheimer's Disease, brain injury, Multiple Sclerosis, or Parkinson's Disease may become Board Certified in Neurorehabilitation (BCN). Neurorehabilitation encompasses the treatment of sensory, motor, cognitive, and behavioral processes which impact on functional performance in persons with central nervous system disorders. Requirements for board certification include: (1) 5 years of experience in neurorehabilitation since initial certification/licensure including direct treatment, supervision, teaching, etc; and at least 2 years of direct treatment in neurorehabilitation practice; (2) demonstrated professional development; and (3) a qualifying score on the written exam.

Excerpts From: STANDARDS FOR AN ACCREDITED EDUCATIONAL PROGRAM FOR THE OCCUPATIONAL THERAPIST (American Occupational Therapy Association, 1998) are provided in the pages that follow, to promote an awareness of the depth and breadth of the training to become an OT, the skill level of OT for providing assessment and rehabilitation, and how OTs fit into the health care delivery system.

STANDARDS FOR AN ACCREDITED EDUCATIONAL PROGRAM FOR THE OCCUPATIONAL THERAPIST

Basic Tenets of Occupational Therapy

- Acknowledge and understand the importance of the history and philosophical base of the profession of occupational therapy.
- Understand the meaning and dynamics of occupation and purposeful activity including the interaction of performance areas, performance components and performance contexts.
- Be able to articulate to the consumer, potential employers, and general public the unique nature of occupation as viewed by the profession of occupational therapy and communicate the value of occupation for the client.
- Acknowledge and understand the importance of the balance of performance areas to the achievement of mental and physical health.
- Understand and appreciate the role of occupation in the promotion of health and the prevention of disease and disability for the individual, family, and society.
- Understand the effects of health, disability, disease processes, and traumatic injury to the individual within the context of family and society.
- Exhibit the ability to analyze tasks relative to performance areas, performance components, and performance contexts.
- Appreciate the individual's perception of quality of life, well being, and occupation to promote health and prevention of injury and disease.
- Understand the need for compensatory strategies when desired life tasks cannot be performed.

Screening and Evaluation

- Use standardized and non-standardized screening tools to determine the need for occupational therapy intervention. These include, but are not limited to, specified screening assessments, skilled observation, checklists, histories, interviews with the client/family/significant others, and consultations with other professionals.

- Select appropriate assessment tools based on client need, contextual factors, and psychometric properties of tests.
- Use appropriate procedures and protocols, including standardized formats, when administering assessments.
- Understand and appreciate the participation of the certified occupational therapy assistant as a data gatherer and contributor to the screening and evaluation process.
- Exhibit the ability to interpret criterion referenced and norm referenced standardized tests scores based on an understanding of sampling, normative data, standard and criterion scores, reliability, and validity.
- Consider factors that might bias assessment results, such as culture, disability status, and situational variables related to the individual and context.
- Interpret the evaluation data in relation to uniform terminology of the profession and relevant theoretical frameworks.
- Demonstrate the ability to use safety precautions with the client during the evaluation and screening process. These include, but are not limited to, standards for infection control that include universal precautions.
- Understand the need when indicated for referral to specialists both internal and external to the profession for additional evaluation.
- Document occupational therapy services to ensure accountability of service provision and meet standards for reimbursement of services. Documentation shall effectively communicate the need and rationale for occupational therapy services. Documentation must be appropriate to the system in which the service is delivered.
- Adhere to the Standards for Educational and Psychological Testing by the American Psychological Association.

Intervention Plan: Formulation and Implementation

- Identify appropriate models of practice, theoretical approaches, and frames of reference based on the interpretation of evaluation findings.
- Develop occupational intervention plans and strategies, based on the stated needs of the client and data gathered during the evaluation process, including goals and methods to achieve them.
- Provide evidence-based effective therapeutic intervention related to performance areas, performance components, and performance contexts directly and in collaboration with the client and others.
- Employ relevant occupations and purposeful activities that support the intervention goals and are meaningful to the client.
- Use individual and group interaction as a means of achieving therapeutic goals.
- Develop and promote use of appropriate home and community programming to support performance in the client's natural environment.
- Foster education of client/family/significant others, including prevention, health maintenance, and safety, which facilitate skills in performance areas.
- Exhibit the ability to use the teaching-learning process with client/family/significant others, colleagues, other health providers, and the public. This includes assisting learners to identify their needs and objectives, and using educational methods that will support those needs and objectives.
- Demonstrate the ability to collaborate through written, oral, and nonverbal communication with client/family/significant others, colleagues, other health providers, and the public.

Level I fieldwork shall be integral to the program's curriculum design and include experiences designed to enrich didactic coursework through directed observation and participation in selected aspects of the occupational therapy process. The focus of these experiences is not intended to be independent performance. Supervised Level I fieldwork with qualified personnel, includes, but is not limited to, initially certified nationally occupational therapy practitioners, psychologists, physicians assistant, teachers, social workers, nurses, and physical therapists. The goal of Level I Fieldwork is to introduce students to the fieldwork experience, develop a basic comfort level with and understanding of the needs of clients.

Level II fieldwork shall be integral to the program's curriculum design and shall include an in-depth experience in delivering occupational therapy services to clients, focusing on the application of purposeful and meaningful occupation. It is recommended that the student be exposed to a variety of clients across the life span and to a variety of settings. The fieldwork experience shall be designed to promote clinical reasoning and reflective practice, to transmit the values and beliefs that enable ethical practice, and to develop professionalism and competence as career responsibilities. The goal of Level II fieldwork is to develop competent, entry-level, generalist occupational therapists. The student can complete Level II fieldwork in a minimum of one setting and maximum of four different settings. It Requires a minimum of the equivalent of 24 weeks full time of Level II fieldwork. This may be completed on a full-time or part-time basis, but not less than half-time relative to the fieldwork site. A maximum of 12 weeks of Level II fieldwork can be completed under the supervision of an occupational therapist in a setting without an occupational therapist on site, in keeping with state credentialing requirements.

References:

- American Occupational Therapy Association, Inc. (AOTA), 4720 Montgomery Lane, P.O. Box 31220, Bethesda, MD 20824-1220. Phone: (301) 652-2682, Fax: (301) 652-7711. www.aota.org.
- American Occupational Therapy Association (1993, 1994a, 1994b, 1998)
- Association of Driver Educators for the Disabled (ADED), P.O. Box 49, Edgerton, WI 53534. Phone: (608) 884-8833; Fax: (608) 884-4851
- B R A U N Guidelines for Choosing the Right Mobility Equipment, Automotive Innovations, Inc Website (www.ai1.com) Automotive Innovations, Inc. 4 First Street, Bridgewater, MA 02324, (508) 697-8324.
- Bryn Mawr Adapted Driver Education Program. "Steering Toward Independence," Daily Local News, Chester County, PA Newspaper; November 6, 1995
- Cleveland Clinic Foundation, Driver Rehabilitation Services, 9500 Euclid Avenue, Cleveland, OH, 44195 (216) 444-2200 (Website:www.ccf.org)
- Hunt (1993)
- Association of Driver Educators for the Disabled. (undated). *Driving and Alzheimer's/Dementia.*
- Association of Driver Educators for the Disabled. (undated). *Driving After a Stroke.*
- Association of Driver Educators for the Disabled. (undated). *Driving After a Spinal Cord Injury.*
- Benner, L., Bytof, J., and Gallop, S. (undated). *Functional Vision and Driving.*
- Sabo, S. and Shipp, M. (1989). *Disabilities and Their Implications for Driving.* Louisiana Tech University, Center for Rehabilitation Science and Biomedical Engineering.

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**
Alzheimer's Disease/Dementia	Compromises in: • attention • processing speed • visuospatial functioning • decision making • judgment • planning • memory • behavior • awareness of problem areas Warning signs: • driving too slowly • failure to observe signs or signals • difficulty interpreting traffic situations and predicting changes • failure to yield • easily frustrated or confused • frequently gets lost • needs instructions from passengers • poor road position or driving the wrong way down streets	• Comprehensive evaluation by driver rehabilitation specialist (clinical plus driving) to determine extent of impairments, and level of hazard posed by driver • Counseling (during early stages) re: compensatory strategies (where and when to drive; taking a passenger, etc.), planning for retirement from driving • Due to progressive nature of the disease, periodic re-evaluation of driving safety should be conducted in response to changes with the individual's level of functioning.	• Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • Rehab Facility with Driving Program (clinical eval + BTW+training)

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**
Parkinson's Disease A disorder of the central nervous system that is slowly progressive	• difficulty and slowness in initiating movement • resting tremors in forearms and elbow, w/ pill-rolling movements of the fingers • rigidity in muscles of the neck, trunk, and forearm • difficulty with fine and gross motor skills While there is no loss in sensory function, there may be dementia and memory loss. The person may not know where he or she is in relation to the space around them.	• Usually no adaptive equipment is needed; the focus of training should be to teach compensatory techniques for decreased physical functioning • An evaluation of the person's active range of motion should be done to ensure the necessary range to reach controls • Reaction time and fine and gross motor coordination should be evaluated • A cognitive assessment should be conducted to assess the thought processes involved in driving • Reevaluation should be conducted in response to significant changes in the person's level of functioning	•Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • Rehab Facility with Driving Program (clinical eval + BTW+training) • General Rehab Facility (PT, OT, Psychologist, Speech-Language)

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**

Stroke
(Syndrome that involves damage to brain tissue caused by a disruption of the blood supply to the brain. The affected areas will in part determine whether the effects of stroke are severe, moderate, or minimal, and whether they are temporary or permanent)
	May affect vision perception, physical functionality, and reaction time, including:
	• All or partial loss of muscle strength on 1 side of the body, & involuntary muscle movements may interfere with the ability to use the involved limbs for operating primary & secondary controls. Sitting balance may also be a problem.
	• Possible partial loss of vision and/or perceptual changes including visual field defects, inability to recognize & understand signs, signals, & markings.
	• Impaired cognitive skills: decision making & judgment.
	• Reaction time may be impaired for responding to events on the roadway that require an immediate response (evasive maneuvers or immediate stops)
	Warning signs:
	• inappropriate driving speeds
	• needs help from passengers
	• failure to observe signs or signals
	• slow or poor decisions (poor judge of distances, too close to other cars)
	• easily frustrated or confused
	• pattern of getting lost, even in familiar areas
	• accidents or near misses
	• drifting across lane markings & into
		• Comprehensive evaluation by driver rehabilitation specialist (clinical plus driving) to determine extent of impairments
		• Adaptive equipment for physical problems:
		  • spinner knob
		  • left foot accelerator
		  • right-side mounted turn signal lever
		  • parking brake extension
		  • chest harness for balance
		  • hand operated dimmer switch
		• Physical therapy and occupational therapy (strength building exercises)
		• Compensatory scanning techniques may need to be taught if there is a visual field deficit
		• If the person experiences difficulty in navigation skills, training may need to be focused on this area
		• Speech therapy for language skills; both verbal and written info.
		• Need to monitor side effects of medications and effects on driving (side effects of coumadin and heparin--anti-coagulant medications--include possible bleeding from the body orifices).
			• Neurologist/Neuropsychologist/ Psychologist/Psychiatrist
			• Physiatrist
			• General Rehab Facility (PT, OT, Psychologist, Speech-Language)
			• Rehab Facility with Driving Program (clinical eval + BTW+training)
			
			Note: Harvard and Shipp (1998) state that a person with left-sided neglect should not drive.

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**

Spinal Cord Injury	• Loss of strength and/or range of motion. Depending on location of injury, may affect breathing, use of arms, shoulders, hands, and legs. (see specific functional deficit in matrix of physical deficits).
	
	• May also include compromised visual perception and reaction time.
		• Comprehensive evaluation by driver rehabilitation specialist (clinical plus driving) to determine extent of impairments
		• The level and extent of spinal cord involvement will determine the need for vehicle modifications and adaptive driving equipment. Adaptive equipment for physical problems:
		  • reduced effort steering systems
		  • servo brake and accelerator control
		  • joystick driving systems
		  • mirror system for person who can't turn head
		  • adaptive equipment/vehicle modifications for wheelchair access
		• Dynavision
		• Need to monitor side effects of medications and effects on driving (Anti-spasmodic medication may be prescribed for a person with a high level spinal cord injury. Drowsiness, weakness, and fatigue are possible side effects of Valium, Dantrium, and Lioresal).
			• Neurologist/Neuropsychologist/ Psychologist/Psychiatrist
			• Physiatrist
			• General Rehab Facility (PT, OT, Psychologist, Speech-Language)
			• Rehab Facility with Driving Program (clinical eval + BTW+training)

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**
Traumatic Brain Injury	• Impairments in muscle function and joint mobility. Ranges from extensive loss of strength, range of motion, coordination, reaction abilities, and/or balance to little to no physical limitations. • Loss of sensation in various parts of the body. • Impaired problem-solving ability, judgment, memory, and attention span. • Impairments in ability to recognize road signs, signals, markings. • Impaired perceptual motor skills (spatial relationships and reaction time). • Visual field deficits, resulting in person not being able to see whole roadway.	• The extent of physical limitations will determine the type of vehicle that is needed and how the vehicle should be modified and equipped. It is impossible to generalize adaptive equipment needs of people with traumatic brain injuries due to the uniqueness of the symptoms in each person's case. • The ability to exercise sound judgment and carry out needed decision-making and problem-solving skills may be impaired to the point that reaching the goal of becoming a safe driver is unattainable. • Dynavision • Need to monitor side effects of medications and effects on driving (weakness and fatigue are possible side effects of anti-convulsant medications, such as Dilantin, Clonopin, Tegretol, or Phenobarbital).	• Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • Physiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training)

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**
Cerebral Palsy	Depending upon location of brain damage: • Sensory and perceptual problems • Intellectual impairment • Seizure disorders and emotional problems • Involuntary muscle movements, imbalance in muscle tone and strength The presence of spasticity may make it difficult to execute the fine motor movements needed to operate the primary and secondary driving controls. Involuntary movements may lead to inadvertent activation of the driving controls.	• The extent of visual-perceptual impairment, cognitive impairment, and quality of muscle tone and movements will determine the potential of a person with cerebral palsy to drive. • The ability to independently get into, get properly seated in, and get out of a standard-size sedan may be impaired. A van equipped with the necessary adaptive driving equipment and modified to accept a wheelchair in the driver's station, may be the vehicle of choice.	• Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • Physiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • May require van modification + training)

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**
Friedreich's Ataxia (Spinal cord and cerebellar degeneration)	• Diminished muscle control • Diminished ability to coordinate arms and hands due to severe tremors • Visual and perceptual limitations • Mental deterioration • Slowed reaction time • Difficulty getting into and out of a standard-sized sedan	• The ability to coordinate the various arm and leg movements required to operate primary and secondary controls may be so impaired that attaining the goal of safe driving is impossible even with adaptive driving equipment. • Due to the progressive nature of the disease, periodic re-evaluation of driving ability and equipment should be conducted in response to changes with the individual's level of function.	• Ophthalmologist/Optometrist • Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • Physiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW + training) • May require van modification + training)
Multiple Sclerosis (Chronic disabling disease of the central nervous system)	• Symptoms begin as a vague feeling of tingling or numbness in one area of the body that lasts less than 24 hours. As disease progresses, symptoms become more severe and may include weakness; inability to coordinate voluntary muscular movements; losses in sensation; blurred or double vision; loss of balance; and impairments in conceptual thinking, memory, attention span, and judgment. • Effects on driving range from few (if any) to cognitive, perceptual or sensory problems that are so severe that it is impossible for the person to drive safely.	• The disease is unpredictable and not all people with MS experience the same symptoms; this makes it difficult to generalize adaptive equipment or training needs. • Periodic re-evaluation of driving ability and equipment needs is required to track changes in level of function. A complete vision exam is essential, due to changing visual deficits. Driving could be ruled out, solely on the basis of vision.	• Ophthalmologist/Optometrist • Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • Physiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW + training) • May require van modification + training)

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**
Muscular Dystrophy (a group of chronic, progressive diseases that result in degeneration of skeletal or voluntary musculature).	The age of onset and rate of progression vary according to the type of dystrophy involved. Effects include: • Weakening of the respiratory muscle leading to endurance problems. • Muscle weakness in the arms, legs, and trunk leading to the need for a wheelchair for mobility. • Weakening of face and eye muscles impairing the ability to swallow food or talk. • Weakening of heart muscle leading to fatigue and impairments in the ability to independently carry out abilities of daily living. • Losses in strength and flexibility may limit the persons ability to reach, grasp, and operate driving controls; turn a standard steering wheel through its full circular motion; and accurately view and interpret the roadway and surroundings. • Impairments in the ability to get into and out of a standard size sedan.	• May range from a standard sedan with minimal adaptive driving equipment to an extensively modified van with adaptive driving equipment and modified to accept a wheelchair in the driver's station. • Periodic re-evaluation of driving ability and equipment needs should be conducted, due to the progressive nature of the disease	• Ophthalmologist/Optometrist • Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • Physiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • May require van modification + training)

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**
Poliomyelitis (a viral infectious disease of the nervous system that causes degenerative changes resulting in muscular paralysis or weakness, primarily in the legs and trunk.)	• Weakening or paralysis of muscles associated with trunk, pelvis, shoulder, arm, and leg functions may impair the ability to operate standard primary and secondary controls. • Weakening or paralysis of muscles associated with breathing • Major deficits in the lower extremities may impair ambulation and transfer, and necessitate the use of orthotics, ambulation aids, or wheelchairs. This may impair ability to get into and out of a standard sedan independently. • Deformities such as curvature of the spine or partial dislocation of the spine may occur.	• In cases where the legs alone are affected, a vehicle equipped with hand operated brake and accelerator controls, a spinner knob, an extension on the parking brake, and a dimmer switch relocated for hand activation, may be all that is required to maintain safe driving performance. • If the arms and legs are weakened, more extensive adaptive driving equipment and/or vehicle modifications will be needed. • Periodic re-evaluation for equipment needs may be necessary over the course of time, if the person becomes significantly weaker.	• Physiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • May require van modification + training)

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**
Rheumatic Disease (includes 100 different conditions that cause aching and pain in the joints and connective tissues throughout the body; results in heat, swelling, redness, stiffness, and pain. Three prevalent forms are rheumatoid arthritis, ankylosing spondylitis, and degenerative joint disease.)	• Loss of joint mobility resulting in diminished ability to reach, grasp, manipulate, and release standard and primary and secondary driving controls. • Diminished strength and endurance making long distance driving difficult.	• The need for adaptive equipment will depend on the parts of the body affected by the disease. • Driving equipment and adaptive aids may include extended gear lever, extended parking brake, tilt steering, power seats, power windows, power steering, and power brakes. • Additional mirrors may be needed for drivers with limited ability to turn their heads. • More extensive adaptive equipment /vehicle modifications may be necessary for the person whose ability to use legs and/or arms is severely affected by the disease. • Need to monitor side effects of medications and effects on driving (People with arthritis may be taking anti-inflammatory or pain relieving medications such as Decadron, Aspirin, Anaprox, Butazolidin, Clinoril, or Motrin. Potential side effects vary depending on the prescribed medication).	• Physiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • May require van modification + training)

Diagnoses			
Diagnosis	**Effects on Driving**	**Remediation**	**Resources**
Spina Bifida (a birth defect resulting from the failure of the vertebral canal to close normally around the posterior end of the spinal cord.)	• Weakness or paralysis of the leg and feet muscles may result in the inability to reach and operate brake & accelerator pedals, floor-mounted parking brake, or floor-mounted dimmer switch. • Abnormal (or absent) sensation in the lower back & legs, making it difficult to independently get into or out of a car. • Impairment in visual-perceptual functioning resulting in impairment in the ability to accurately perceive the roadway & its surroundings. Perceptual problem that may occur in persons with unarrested or poorly arrested hydrocephalus include: visual discrimination (color, size, shape, position, same & different); visual closure (part-whole); figure-ground; form constancy; depth perception; visual orientation in space. • Auditory impairments (localization, discrimination, and identification) • Impairment in proprioceptive abilities (body scheme, right-left discrimination, spatial relationships) & kinesthetic abilities (position in space). • If hydrocephalus is not arrested early, mental redardation & other cognitive disorders usually occur. (poor attending behavior, short attention span, memory deficits).	• A visual examination should be performed, due to possible deficits in eye movement • A visual perceptual assessment should be performed • The need for vehicle modifications or adaptive equipment will depend on the parts of the body affected, and the loss in strength/joint mobility. • Examples of adaptive equipment that may be helpful include: hand controls for brake and accelerator, spinner knob, hand-operated dimmer switch, and transfer board. • An extensively modified van is necessary for the person who needs to drive from a wheelchair.	• Ophthalmologist/Optometrist • Physiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • May require van modification + training)

Visual Impairments			
Visual/Perceptual Impairment (Deficit)	**Effects on Driving**	**Remediation**	**Resources**
Depth Perception (Ability to judge distances. Dependent on stereopsis which is binocular appreciation of three dimensional space. Most so-called depth perception tests assess stereopsis.)	• Timing of turns • Stopping distance • Timing of pulling out into traffic • Lane position • Difficulty in merging or in blending with traffic • Distance judgment • Stops too soon or goes over line at intersections • Difficulty in parking lots	• Cuing: "Stop so you can see the wheel of the car in front of you and some of the pavement." " If a car fills your rearview mirror, it is too close." • Vision Aerobics	• Ophthalmologist/Optometrist • Rehab Facility with Driving Program (clinical eval + BTW+training)
Acuity	• Delay in responding to environment (due to difficulty in anticipating and detecting hazards) • Can't read street/highway signs and other info. • Increased difficulties in low light conditions	• New lens prescription • Specialized driver training	• Ophthalmologist/Optometrist • Rehab Facility with Driving Program (clinical eval + BTW+training) • MVA regarding low vision driving program
Blurred or Double Vision (May be a result of the following eye diseases: Diabetic Retinopathy, Cataracts, Macular Degeneration)	• Delay in ability to recognize threats • Slow to recognize signs • Difficulty staying in lane • Eyes may be more sensitive to light and glare making night driving difficult.	Diabetic Retinopathy: ophthalmologic laser surgery or vitrectomy Macular Degeneration: Low vision optical aids Cataracts: eye surgery	• Ophthalmologist/Optometrist • Rehab Facility with Driving Program (clinical eval + BTW+training) • MVA regarding low vision driving program

Visual Impairments			
Visual/Perceptual Impairment (Deficit)	**Effects on Driving**	**Remediation**	**Resources**
Visual Attention/Fixation (The act of keeping one or both eyes pointed directly at an object of regard for as long as needed or requested.)	• Distractibility • Difficulty maintaining lane position • Staying at traffic signals too long	• Dynavision • Visual Attention Analyzer • Evaluation required NOTE: Individuals with visual inattention are generally poor candidates to resume driving, and training with Dynavision should be considered carefully before being undertaken (*Dynavision Users Guide*)	• Family Physician • Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training)
Visual Field Cut (May be seen with spatial body neglect and is associated with frontal lobe damage and left or right occuloparietal and parietal damage. Client fails to "see" all relevant information or is missing a particular zone in his/her peripheral field.)	• Missing streets or stimuli on neglected side • Difficulty maintaining lane position • Following the edge of the road • May not see vehicles during quick glances for lane changes • Denial see also peripheral vision	Persons with visual field defects with intact visual attentional capabilities will attempt to compensate for the loss by engaging visual attention; they will direct eye movements toward the side of vision loss in an attempt to gather visual information from that side. • Dynavision training • Extra head turns and mirrors • Evaluation required NOTE: Persons with visual field cuts combined with visual inattention should not resume driving (client will likely be a hazard), as remediation is not possible with denial.	• Family Physician • Ophthalmologist/Optometrist • Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • MVA referral for low vision program

Visual Impairments			
Visual/Perceptual Impairment (Deficit)	**Effects on Driving**	**Remediation**	**Resources**
Color Discrimination	Diminished ability to perceive differences in color, usually for red and green.	• Education: client must learn sequence for traffic signals and sign shapes.	• Ophthalmologist/Optometrist • State Licensed Driving Instructors/Schools
Accommodation and Focusing (The ability to automatically and without strain, bring near objects into clear focus. Relaxation of accommodation allows distant objects to become clear.) Also: Convergence and Divergence (The ability to smoothly and automatically bring the eyes together to look at things closely, or move them apart)	Driving requires a flexible accommodation system, to allow the driver to shift from far (intended path of travel) to near (speedometer, rear-view mirrors). Deficit may result in difficulty: • reading street signs • interpreting speed from speedometer • using information seen in mirrors • positioning vehicle in turns and curves Client is likely to drive slow in order to have the time to figure out what is happening	• Vision Aerobics	• Ophthalmologist/Optometrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language)

Visual Impairments			
Visual/Perceptual Impairment (Deficit)	**Effects on Driving**	**Remediation**	**Resources**
Ocular Motility/Range of Motion/Pursuit Movements (The ability to coordinate and move the eyes smoothly through all planes)	• Diminished ability to attend to all stimuli in the environment; will likely miss the most important information • Difficulty maintaining lane position • May be slow in pulling out into traffic • May miss stimuli in the environment (signs, pedestrians, bicyclists) • Usually poor at dealing with intersections or cross traffic. • May stare at road scene • May move eyes randomly and be distracted by any movement Practitioner may observe clumsiness or lack of balance	• Level of impairment will impact client's ability to be trained/remediated. • Evaluation and training required.	• Ophthalmologist/Optometrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training)
Peripheral Vision	• Misses stimuli in the environment • Timing of turns may be off • May not see cross) traffic	• Wide-angle rear-view mirrors • Training to make more head movements Note: if the jurisdiction has a specific requirement for peripheral vision, a license may not be granted to individuals who do not meet the minimum requirement.	• Ophthalmologist/Optometrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • MVA low vision program

Visual Impairments			
Visual/Perceptual Impairment (Deficit)	**Effects on Driving**	**Remediation**	**Resources**
Impaired Figure-Ground Discrimination	• Unable to distinguish foreground from background • Difficulty finding STOP sign among other stimuli in environment • Difficulty as traffic increases and/or road scene increases in complexity • Difficulty finding controls or dashboard information quickly	• Recommendation to drive only in familiar areas, during non-rush hours • Evaluation and training required	• Ophthalmologist/Optometrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • State Licensed Driving Instructors/Schools
Parts-To-Whole Deficits	• Can "see" individual items in road scene but may not realize what's happening in the whole environment • Unable to look ahead in anticipation of potential threats (e.g., may see stopped cars, police cars, and ambulances, but not recognize that there has been an accident).	• Level of impairment will effect prognosis for remediation. • Evaluation and training required.	• Ophthalmologist/Optometrist • Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • State Licensed Driving Instructors/Schools
Position in Space Deficits	• Unsure of position as related to another object • Problems particularly when close to other objects, such as in parking lots • Will often go past limit line or stop too early • Trouble orienting vehicle when in curves or coming out of turns	NOTE: problem does not usually improve significantly with cues or practice	• Ophthalmologist/Optometrist • Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • State Licensed Driving Instructors/Schools

Visual Impairments			
Visual/Perceptual Impairment (Deficit)	**Effects on Driving**	**Remediation**	**Resources**
Impaired Right/Left Discrimination	• Confused right and left • Ends up on wrong side of road • Puts turn signal on for opposite direction of intended turn	• Evaluation and training required. • Driving may be appropriate only in familiar and routine driving areas.	• Ophthalmologist/Optometrist • Neurologist/Neuropsychologist/ Psychologist/Psychiatrist • General Rehab Facility (PT, OT, Psychologist, Speech-Language) • Rehab Facility with Driving Program (clinical eval + BTW+training) • State Licensed Driving Instructors/Schools

1C3(b)ii. Rehabilitation Procedures - Elderly Population With Chronic Conditions Requiring Intervention: Physical Rehabilitation

A physical therapist (PT) can assist individuals in understanding normal age-related changes, and can develop exercise programs to assist an individual in regaining lost abilities or developing new ones. Some age-related bodily changes may be misunderstood and unnecessarily limit daily activities. Normal aging need not result in pain and a decrease in physical mobility. More than 90,000 physical therapists practice in the U.S. (APTA Fact Sheet, 1997), and treat nearly one million people every day. Although many physical therapists practice in hospitals, more than 70 percent practice in private physical therapy offices, community health centers, industrial health centers, sports facilities, rehabilitation centers, nursing homes, home health agencies, schools or pediatric centers, work in research institutions, or teach in colleges and universities.

Physical Therapy Services

A physical therapist, working with the older adult, understands the anatomical and physiological changes that occur with normal aging. The PT will evaluate and develop a specially designed therapeutic exercise program. Physical therapy intervention may prevent life long disability and restore the highest level of functioning. Through the use of tests, evaluations, exercises, treatments with modalities, screening programs, as well as educational information, physical therapists:

- increase, restore or maintain range of motion, physical strength, flexibility, coordination, balance and endurance;
- recommend adaptations to make the home accessible and safe;
- teach positioning, transfers, and walking skills promote maximum function and independence within an individual's capability;
- increase overall fitness through exercise programs;
- prevent further decline in functional abilities through education, energy conservation techniques, joint protection, and use of assistive devices to promote independence;
- improve sensation, joint proprioception;
- reduce pain.

Common Conditions

A vast number of conditions are treated effectively with physical therapy intervention. Examples of specific diseases and conditions that may affect older people and be improved with physical therapy include:

- Arthritis
- Osteoporosis
- Cerebral Vascular Accident (Stroke)
- Cancer
- Parkinson's Disease
- Urinary and Fecal Incontinence
- Amputations
- Cardiac and Pulmonary Diseases
- Dementias
- Alzheimer's Disease

- Coordination and Balance Disorders
- Functional Limitations related to mobility
- Sports/Orthopedic Injuries
- Joint Replacements
- Hip Fractures

Reimbursement

Physical therapy evaluation and treatment is covered fully or in some percentage by:
- Medicare
- Medicaid
- Private Insurance Companies
- Options under the Federal Employee Health
- Benefit Programs
- Workers' Compensation Programs
- Private Pay
- HMO (Health Maintenance Organizations)
- PPO (Preferred Provider Organizations)

Credentials

Physical Therapists (P.T.):
- Have completed coursework in the medical, biological, physical and psychological sciences;
- Graduate from an accredited education program;
- Complete bachelors, masters or doctoral degrees with special clinical experiences in physical therapy;
- May opt to gain further expertise and seek a clinical speciality in geriatrics;
- Meet licensure requirements required in all states for PT's.

Physical Therapist Assistants (P.T.A.):
- Must have an associates degree from an accredited PT assistant program;
- Work under the direct supervision of a Physical Therapist;
- Meet licensure requirements in states where it's required.

Geriatric Certified Specialists (GCS) are physical therapists who have demonstrated expertise in working with geriatric patients by attaining additional licensure. As of 6/97 (latest Webpage update), there were 56 Geriatric Certified Specialists across 26 States in the U.S.

GCS certification requires the following. Applicants must submit evidence of 8,000 hours (approximately 4 full-time years with normal annual leave) of general physical therapy practice accrued after successful completion of professional physical therapy education. These hours do not have to be in the specialty area. Applicants must submit evidence of 6,000 hours (approximately 3 full-time years with normal annual leave) of clinical practice in geriatric physical therapy completed within the last 10 years (from August 1, 1988). These hours may be concurrent with general physical therapy practice. Clinical practice in the specialty area includes any aspect of physical therapy practice such as teaching, research, consultation, and administrative duties beyond patient care. At least 4,000 hours (approximately 2 full-time years with normal annual leave) of clinical practice experience in geriatric physical therapy must be in direct patient care (such as patient evaluation and treatment, patient documentation, travel en route to patient care, patient education, rounds/discharge planning conferences). Direct patient care hours in geriatrics must have been completed within the last 6 years. Direct patient care experience must be gained in at least 2 different areas of practice (such as acute care, outpatient, long-term care, home health care, subacute rehabilitation, short-term rehabilitation, wellness center). The Geriatric Specialty Council recommends that specialty area experience be obtained in more than two areas of practice.

References:

• American Physical Therapy Association (APTA) Website, Section on Geriatrics; 1111 N. Fairfax Street, Alexandria, VA 22314-1488. Phone 1-800-999-APTA

1C3(b)iii. Rehabilitation Procedures - Elderly Population With Chronic Conditions Requiring Intervention: Vehicle Modification

Modifying a vehicle for a person with a disability can be as simple as installing a spinner knob on the steering wheel or as complex as a van renovation. Information about a 1987 Ford van conversion was described in a newspaper article "Steering Toward Independence," and is provided here. The client drives from a wheelchair, and therefore, extensive changes were made to the van's interior to accommodate the chair, in addition to the adaptive devices which included special controls for steering, braking, acceleration, and things like windshield wipers. The client was eligible for financial assistance from the state Department of Labor and Industry's Office of Vocational Rehabilitation (OVR), since he needed the van to continue working; acquiring the vehicle, however, was his responsibility. A program such as Bryn Mawr Rehabilitation Hospital's Adapted Driving Program will make recommendations as to what modifications are absolutely needed, and the recommendations are presented to the OVR. This process is required, because, according to an OVR supervisor, sometimes there are items that a person wants that have nothing to do with his or her driving, and shouldn't be reimbursed. The average adaptation for a van is approximately $15,500 (in 1995), but can cost up to $50,000. Equipping a car with basic hand controls, spinner knob, and parking brake extension averages approximately $500.00 (in 1995). In one year (1994-1995), the Office of Vocational Rehabilitation in Rosemont (Chester County, PA) spent approximately $300,000 working with 29 individuals on van modifications, and $100,000 working with 33 people on car adaptations.

To be eligible for State assistance, the changes must have a work-related purpose; the person must pass the State driver's test and have a properly coded license to drive with the adaptations, and must be able to insure the vehicle. The Bryn Mawr Adapted Driving Program Director, Tom Kalina, stated that if there is no impairment in vision, knowledge, and reaction time, a person can learn to drive with the controls in 3 to 15 hours. Once an individual meets Bryn Mawr's performance requirements, he or she must then take and pass the State driver's test. Mr. Kalina reported that the State test is a legal requirement, however, Bryn Mawr bases their findings on much more extensive driving compared to what is contained in the 10-minute State test. The Bryn Mawr adapted driving instructors will not take a client to the State for testing until they have proven their competency to the instructors.

An inventory of the kinds of adaptive equipment for the following five categories is provided below (taken from Transport Canada, 1986): entry and exit aids; seating aids and restraints; steering aids; accelerating and braking aids; and control levers.

Entry and Exit

Adapted Key Holder: A variety of key holders for various limitations of hand use are available for the outside door and for the ignition; the rigid holder provides for easier grasp.

Wheelchair Lift: Several types of lifts are available; electric, gravity, or hydraulic. They are either automatic or semiautomatic, and operate using rotary or swing-down mechanisms. Size and weight of the wheelchair are important considerations when selecting a lift.

Cartop Wheelchair Loader: This loader features push-button operation to automatically fold and store a conventional wheelchair on top of the car under a weather-resistant cover.

Wheelchair Loader (in-car): The lift is installed on either the passenger or driver side of any full-sized two-door automobile. A switch activates the loader, which lifts and stores the chair behind the driver's seat.

Trunk Loader: This consists of an electric hoist attached to the car bumper. It can be used to load a powered scooter or a wheelchair. Manual loaders are also available.

Bumper Rack Loader: This wheelchair loader fits onto the rear of the trunk and can be either hand or power operated. To make use of these loaders, a driver must be able to walk from the rear of the car to the car door, or have someone with them for assistance.

Automatic Door Openers: These are available for vans with sliding or swing doors and consist of separate switches in a control box (or a single key holder for sequential operations.) For those unable to manipulate keys, remote control or magnetically activated switches are available.

Transfer Assists: For those persons unable to transfer in and out of the car easily on their own, a variety of transfer assists are available (transfer boards, overhead handle above the doorway, etc.)

Wheelchair Ramps: These are movable ramps for use with vans or any object with two or three steps.

Seating Aids and Restraints

Torso Restraints: When driving a van from a wheelchair, chest harness and/or lateral trunk supports may be used, together with lap belts and wheelchair restraints, for those with diminished trunk musculature and balance.

Power Driver Seat: A four- or six-way power seat base (front to rear travel, vertical travel for height adjustment and swivel) facilitates a driver's self-transfer from wheelchair to driver's seat and allows for optimal positioning for driving.

Power Pan: A power pan is designed to accommodate the driver with disabilities who cannot transfer from wheelchair to seat without assistance and must drive from a wheelchair. It allows the driver who sits high in his or her wheelchair to lower the line of vision 2.5 to 6 inches (6 to 15 cm), by automatically lowering the vehicle floor in the driver's station.

Power Wheelchair Restraint: This quick lock and release system for the wheelchair enables the driver with disabilities to quickly and easily secure his or her chair in the proper driving position.

Manual Wheelchair Restraint: This model can be used by a wheelchair driver who can physically operate a restraint without power controls, or by a wheelchair passenger.

Wheel Wells: These channels are installed in a vehicle floor to lower the wheelchair driver, thereby correcting visibility problems caused by height.

Removable Seat Base: This is a detachable seat, usually mounted on casters. It allows for easy conversion of the driver's station for a wheelchair driver. It stores in the rear of the van when not in use.

Steering Aids

Steering Column Extension: This extension brings the steering wheel 2 to 6 inches (5 to 15 cm) closer to the wheelchair driver. It provides extra leg room and compensates for reduced range of motion.

Foot Steering Control: This device transfers control of hand-operated driving functions to foot operation. Auxiliary and secondary vehicle controls are also adapted to foot operation.

Low-Effort Steering: This feature reduces the effort to steer the vehicle by approximately 40 percent.

Zero-Effort Steering: This reduces the effort required to steer the vehicle by approximately 70 percent; a back-up steering system is usually recommended. It is available for cars or vans with power steering.

Horizontal Steering Column: This motorized, telescoping steering column allows for adjustment of steering in a variety of planes and positions. It adapts to the reach limitations of a driver, and can be positioned for right- or left-hand use.

Deep-Dish Steering Wheel: This device brings the steering wheel rim approximately 4 inches (10 cm) closer to the wheelchair driver and is normally used with a low-effort steering system. It improves wheelchair accessibility to the steering wheel, and lessens the range of steering motion.

One-Hand Drive Control System: This steering system is designed for persons with limited or no use of lower extremities, but good strength in one arm and hand. Its main component is a knob through which steering, brake, and throttle are activated. Auxiliary switches can be located adjacent to the knob, with toggle switches for convenience.

Steering Spinners: Spinner knobs permit safe operation of the steering wheel by drivers who must steer with one hand, allowing them to remain in contact with the steering wheel at all times. The come in a variety of configurations including an amputee ring, knob, so-called "quad steering cuff," palm grip, tri-pin, and V-grip.

Acceleration/Braking Aids

Hand Controls: There are 3 types of hand controls: push-pull, twist-push, and right angle push (also known as the universal control because it can be used for most disabilities). Recommended for use in vehicles with power brakes and steering, they do not interfere with operation of the vehicle by able-bodied drivers.

Quad Hand Control: This consists of an extra L-shaped attachment for hand control. It is designed for quadriplegic drivers with little wrist or hand strength. It is used with a dimmer switch and horn button.

Hand Clutch Control: The hand clutch is for vehicles with standard transmission. It is recommended for drivers with weakness or loss of use in the left leg only.

Left-Foot Accelerator Pedal: With this pedal, accelerator functions of the vehicle are converted to left-foot use for those with limited or no use of the right foot.

Pedal Extensions: Pedal extensions are used when a driver's legs are too short to reach the gas and brake pedals. These extensions must be light enough not to depress the pedals unless activated, and secure enough not to slip off while the car is being driven. They are often used together with a false floor in order to rest the heels.

Parking-Brake Extension Lever: This lever attaches to a foot-operated parking brake in order to adapt it to hand use. With the lever, the driver still needs a grip sufficient to operate the regular brake and lever.

Servo Controls: These consist of touch controls that provide reduced effort acceleration and/or braking control. Two levels of assistance are available—low effort or zero effort. Emergency back-up systems are available to provide additional safety in case of control failure.

Electric Parking Brake: An electric parking brake offers complete control of the power brake by manipulation of a toggle switch. It is available for cars, vans, and trucks. This unit is usually prescribed for individuals who drive a van from their wheelchair.

Portable Hand Controls: These are to be used on a temporary basis only: very strong arms are required. They are persons traveling with rental cars on which hand controls are not available.

Control Levers

Right-Hand Directional-Signal Extension Lever: This extension lever attaches to the turn signal lever and crosses to the right side of the steering column for persons unable to use their left hand.

Left-Hand Gear-Selector Extension Lever: This extension lever attaches to the gear shift lever and crosses to the left side of the steering column. It is for use only on vehicles with automatic transmission.

Gear-Selector Extension Lever: This extension lever provides more leverage for shifting gears, for persons with disabilities. It can be used with automatic transmission only.

Powered Gear Selector: This allows a driver with an upper extremity dysfunction to shift gears with a toggle switch positioned where most convenient for the driver (usually on the console).

Remote Wiper/Washer, Horn, Dimmer Switch, Directional Signals, and Headlights Control: This control relocates these functions to an easily reached location. It allows the driver to use a switch with the hand, elbow, head, or knee, whichever is most convenient.

Quad Control: This control provides a handy location for all accessory controls and out-of-reach switches normally found on the dash.

Keyless Ignition: A toggle switch provides remote control of ignition for those drivers unable to manipulate an ignition key.

The following table lists specific disabilities, their effects on driving, and driving aids/adaptive equipment to accommodate the disability.

Physical Disabilities (Missing or Non-Functional Body Parts), their Effects on Driving, and Suggested Driving Aids.

Disability	Effects on Driving	Suggested Driving Aids
Left Leg Missing or Non-Functional	• Inability to use left foot on dimmer switch and parking brake • Possible inability to maintain body balance • Inability to use clutch • Possible interference of leg or foot with driving mechanisms	• Hand-operated dimmer switch and parking brake (or center console parking brake) • Shoulder or chest safety belts; arm rests • Automatic transmission • A restraint (e.g., belt, loop, or barrier of some type) to keep the disabled leg or foot from lodging against brake or accelerator
Right Leg Missing or Non-Functional	• Inability to use standard accelerator • Possible inability to maintain body balance • Awkwardness in using left foot dimmer switch (because left foot occupied w/brake and accelerator) • Inability to use clutch • Possible interference of leg or foot with driving mechanisms	• Left-foot accelerator • Shoulder or chest safety belts; arm rests • Hand-operated dimmer switch • Automatic transmission • A restraint (e.g., belt, loop, or barrier of some type) to keep the disabled leg or foot from lodging against brake or accelerator
Both Legs Missing or Non-Functional	• Inability to use brake and accelerator • Inability to use dimmer switch or foot-operated parking brake • Possible difficulty maintaining body balance • Possible interference of legs with driving controls • Possible difficulty entering car	• Hand-operated brake and accelerator, necessitating automatic transmission • Hand-operated dimmer switch and parking brake • Special seat structure, cushions, arm rests, or chest/shoulder safety belts • A restraint (e.g., belt, loop, or barrier) to keep legs clear of brake and accelerator • A grab bar or strap; transfer board. A swivel seat may be helpful
Left Arm Below Elbow Missing or Non-Functional	• Difficulty performing hand-over-hand steering maneuvers • Inability to shift gears while steering • Difficulty grasping and pulling left-hand dash controls • Inability to use turn signal and other controls mounted on lever (wipers, cruise control)	• Power steering and spinner knob attached to steering wheel, mounted at 3 or 4 o'clock position, for the sound hand • Automatic transmission • Rings attached to left-hand dash controls • Right side turn signal modification or electronic signals

Physical Disabilities (Missing or Non-Functional Body Parts), their Effects on Driving, and Suggested Driving Aids (Continued).

Disability	Effects on Driving	Suggested Driving Aids
Right Arm Below Elbow Missing or Non-Functional	• Difficulty performing hand-over-hand steering maneuvers • Inability to shift gears while steering • Difficulty grasping and pulling right-hand dash controls	• Power steering and spinner knob attached to steering wheel, mounted at 8 or 9 o'clock position, for the sound hand • Rings attached to right-hand dash controls • Although a driver with a right-hand hook should be able to operate either a standard or an automatic shift lever, automatic transmission is easier • Presetting auxiliary controls prior to driving
Both Arms Below Elbow Missing or Non-Functional	• Inability to grasp and turn regular steering wheel • Difficulty grasping and pulling dashboard controls • Difficulty grasping and pulling or turning other small devices or control in the car (door locks and handles, window cranks, ashtray, glove compartment, radio knobs, etc.)	With a Prosthesis: • Driving ring or steering knob attached to the steering wheel, on the side of the dominant arm • Rings attached to the dashboard controls • Ring attachments for any small device or controls difficult to operate; electric door locks and power windows No Prothesis: • The driver should be able to maneuver the steering wheel using two arms; if not, an extended/telescopic steering column is recommended • Dashboard extensions • Power door locks and power windows; keyless ignition

Physical Disabilities (Missing or Non-Functional Body Parts), their Effects on Driving, and Suggested Driving Aids (Continued).

Disability	Effects on Driving	Suggested Driving Aids
Left Arm Above Elbow Missing or Non-Functional	• Inability to perform hand-over-hand steering maneuvers • Inability to use left-hand turn signal • Difficulty reaching left-hand dashboard controls • Difficulty releasing left-hand parking brake • Inability to shift gears on standard transmission while right arm is occupied • Difficulty activating horn while right hand is occupied	• Steering knob or other steering aid mounted on the right • Right-hand extension turn signal lever or electrical signal • Right-hand extensions on left-hand dashboard controls, or dashboard models with right-hand controls • Parking brake release adapted for use by the left foot or the right hand • Automatic transmission • Horn ring that can be reached without letting go of the steering knob
Right Arm Above Elbow Missing or Non-Functional	• Inability to perform hand-over-hand steering maneuvers • Difficulty reaching right-hand dashboard controls • Possible difficulty turning ignition key • Inability to use right-hand automatic gear shift • Inability to shift gears on standard transmission	• Steering knob or other device mounted on the left • Left-hand extensions for dashboard controls and/or dashboard model with some left-hand controls • Ignition key reachable with the left hand while parked, or adapted for the left hand • Left-hand extension of gear shift lever • Automatic transmission
Both Arms Above Elbow Missing or Non-Functional	• Inability to use conventional steering wheel • Inability to operate standard transmission • Inability to operate turn signal, ignition key, gear selector, dash controls, horn, parking brake release	• Foot steering controls: a metal boot mounted on a circular disk in the floor-board, by the left foot • Automatic transmission • Gear selector on the floor, by the right foot; horn and turn signal on the floor, or remote controls for knee operation; ignition, lights, windshield wipers, and emergency brake underneath and behind instrument panel

Physical Disabilities (Missing or Non-Functional Body Parts), their Effects on Driving, and Suggested Driving Aids (Continued).

Disability	Effects on Driving	Suggested Driving Aids
Lack of Manual Dexterity	• Limited ability to grasp and turn steering wheel • Limited ability to grasp and operate ignition key and dashboard controls • Difficulty releasing hand-operated parking brake	• Tri-post, "V," of cuff-type steering wheel spinner • Ignition key holder; rings or other adaptations on dashboard controls • Foot-operated parking brake, or extension loop on the parking brake handle
Both Arms and Both Legs Disabled (Quadriplegia) <u>Low Level Quadriplegia</u> - <u>Able to Transfer Into Car</u>	• Inability to use brake, accelerator, dimmer switch, foot-operated parking brake, and clutch • Limited ability to grasp and turn steering wheel • Limited ability to maintain body balance • Possible limited ability to see full field of traffic • Difficulty entering car and storing wheelchair • Possible fatigue • Difficulty using dashboard controls, ignition key, and seat belt fixture	• Hand-operated brake, accelerator, dimmer switch (may be combined with horn switch); extension and loop on parking brake; automatic transmission and parking brake • "Quad" steering device ("V" shaped grip, semicircle, steering pin, or tripost, as necessary); wrist cuff; wrist splint or elbow support • Chest harness safety belt, arm rests, cushions • Side view mirrors and full-range rear-view mirrors if neck rotation is limited • Two-door car; grab bar or strap; transfer board; wheelchair hoist • Instruction in avoiding and dealing with fatigue; driving lessons planned with awareness of student's stamina range • Ignition key holder and adaptations of seat belt fixtures and other small devices

Physical Disabilities (Missing or Non-Functional Body Parts), their Effects on Driving, and Suggested Driving Aids (Continued).

Disability	Effects on Driving	Suggested Driving Aids
Both Arms and Both Legs Disabled (Quadriplegia) <u>High Level Quadriplegia - Driving in Van From Wheel Chair</u>	• Inability to use brake, accelerator, dimmer switch, foot-operated parking brake, and clutch • Limited ability to grasp and turn steering wheel • Limited ability to maintain body balance • Possible limited ability to see full field of traffic • Difficulty entering car and storing wheelchair • Possible fatigue • Difficulty using dashboard controls, ignition key, and seat belt fixture	• Quad hand controls, which may have dimmer-plus-horn and signals incorporated or servo controls. The dimmer switch can be controlled by the elbow; electric parking brake; automatic transmission • "Quad" steering device, if necessary; adjustable height, position, and diameter of steering wheel, as well as adjustable steering column position; "low" or "zero" effort steering with emergency back up • Wheelchair restraint-a safety locking device to prevent the wheelchair from moving; passenger restraint could include a lap belt, chest harness, lateral supports attached to the wheelchair, and a special quad seat belt • Power pan or wheel channels; special mirrors • Automatic wheelchair lift; wheelchair restraint • Instruction in avoiding and dealing with fatigue; air conditioning, cruise control, easy/zero effort controls • Keyless ignition, or ignition relocated to an accessible area; dashboard controls converted to a special quad console with toggle switches and/or dashboard control extensions
Lack of Range of Motion - Arms	• Limited ability to turn steering wheel • Possible difficulty operating dashboard controls, gear shift, turn signal, and/or parking brake release	• Extension of the steering column and a small steering wheel complete with a spinner knob • Extensions on or adaptations of dashboard controls, gear shift lever, turn signal, and parking brake release

Disability	Effects on Driving	Suggested Driving Aids
Lack of Range of Motion - Shoulders	• Limited ability to turn steering wheel • Possible difficulty operating dashboard controls, gear shift, ignition key, and parking brake release • Limited ability to see the full field of traffic	• Extension of steering wheel column and small wheel with spinner knob; or, foot-operated steering if limitation is severe • Extensions or adaptations of dashboard controls, gear shift lever, turn switch and ignition switch, and foot-operated parking brake • Convex or 48° rear and side view mirrors
Lack of Range of Motion - Hips	• Difficulty using brake and accelerator • Difficulty using dimmer switch and parking brake • Difficulty using clutch • Possible difficulty turning to watch rear view while backing up • Possible difficulty entering and leaving car	• Hand-operated brake and accelerator • Hand-operated dimmer switch and parking brake • Automatic transmission • Convex or 48° rear view mirror • Grab bar or strap (swivel seats are also helpful); power seats
Lack of Body Balance	• Danger of falling to one side in turns or sudden motions	• Specially constructed seat for balance; arm rests; cushions and or shoulder or chest safety belts
Poor Muscle Control	• Difficulty controlling steering wheel • Uncontrolled involuntary movement, or spasms of rigidity may present too great a danger for driving	• Tri-post, "V," or cuff-type steering wheel spinner • Persons suffering from uncontrolled muscle activity that is potentially dangerous for driving should consult a driver education specialist before going on the road. If spasms occur in the legs only and hand controls are used, the legs can be secured close to the seat.

The Disabled Driver's Mobility Guide (AAA, 1997) states that in-vehicle and medical evaluations are the best way to determine the most suitable adaptive equipment. Physicians, occupational therapists, and physical therapists may be able to recommend specific vehicle equipment. In addition, State Departments of Vocational Rehabilitation, the local Veteran's Administration health care facility, and rehabilitation hospitals and clinics may offer driver education for the disabled and have direct experience with adaptive equipment.

Adaptive equipment manufacturers may be able to recommend appropriate equipment. AAA (1997) provides listings of VA-approved automobile and van adaptive equipment manufacturers. VA-approved equipment has been tested and meets minimum safety and quality standards.

References:

- Bryn Mawr Adapted Driver Education Program. "Steering Toward Independence," Daily Local News, Chester County, PA Newspaper; November 6, 1995
- Transport Canada (1986)
- AAA (1997)

1C3(b)iv. Rehabilitation Procedures - Elderly Population With Chronic Conditions Requiring Intervention: Functional Status Review Leading to License Restriction

Petrucelli and Malinowski (1992) reported that all jurisdictions issue one or more types of restricted license, the most common restriction being a requirement to wear corrective lenses. A range of other restricted licenses are available including: time of day (daylight only, no late-night to early morning hours driving for novice young drivers); geographic boundaries (certain radius from home, no interstate, no one-way streets, no two-lane streets, to/from doctor's office/shopping/church); class of vehicle; speed limit; special equipment (hand controls, right and left outside rearview mirrors, automatic transmission); licensed drivers over age 21 must be present; and occupational needs (to/from work, only during certain hours).

Drivers may come to the attention of a licensing agency in a number of ways (see *Notebook* Section IC1). Physicians are required to report drivers with specific disorders that may impair driving ability to driver licensing bureaus in a minority of U.S. States/Canadian provinces. Although in many jurisdictions physicians *may* report drivers to a licensing agency (e.g., the State will provide immunity), many consider reporting to be a breech of confidentiality, or fear that the patient will search out a new physician. Hunt (1994) states that a useful strategy is for a physician to refer an individual to a driving program, which will utilize OTs and driving instructors to objectively determine driving ability. After the assessment, the OT will explain performance outcomes to the patient and family, and will provide a written report to the individual's physician. In this way, the family and physician have an objective determination of driving ability to back up any recommendations for driving restriction or driving cessation. The OT may also send a report to the State licensing bureau indicating that the individual's current license to drive should be reevaluated. Hunt (1996) notes that it is important for therapists to report patient road test results to a licensing agency for further testing, because physically and mentally unfit license holders often continue to drive despite medical advice against driving.

In some states, there is a Medical Review Board that assists with licensing decisions. In Maryland, for example, when the licensing agency has reason to believe conditions exist that might impair a person's driving ability, the applicant is required to submit certain medical information, as well as an authorization for release of records and information from physicians or hospitals that have treated the applicant for that medical condition (Petrucelli and Malinowski, 1992). The MVA's administrative staff then summarizes the information and sends a report to the Medical Advisory Board for its review, along with the applicant's case history. The board has the authority not only to interview the applicant, but also to conduct certain tests (e.g., reaction time) to evaluate more effectively the driver's functional capability. Most drivers under review must appear in person before the Medical Advisory Board. The board also has access to the driver's crash and violation records.

In Pennsylvania (where reporting is mandatory), when a report is made to the DMV, restrictions to the person's driving privilege may be added or deleted, the person's license may be recalled or restored, the person may be required to provide more specific medical information or to complete a driver's examination, or no action may be taken. See *Notebook* Sections IC1bix and IC1aiv for descriptions of PA's physician reporting law and PA's re-examination program, respectively. Freedman, Decina, and Knoebel (1986) reported that vision problems are the most frequent reasons for new restrictions and re-exam failures. Fifty-three percent of corrective lens restrictions, 88 percent of outside mirror requirements, and 92 percent of daylight driving only restrictions were instigated by the re-examination program. The proportion of drivers requiring new corrective lens restrictions diminished considerably as a function of increasing age beyond age 70, but the proportion requiring outside mirrors increased with age, from approximately 10 percent of drivers age 60, to more than 40 percent of drivers age 80 and older. A new restriction to daylight driving was rare for drivers younger than age 70, but was imposed on almost 20 percent of the drivers age 80 and older, and 40 percent of newly restricted drivers age 90 and older.

The *Florida Examiner's Manual* provides a chapter to help the examiner identify a physical impairment, understand what physical skills are affected, and what license restrictions and/or adaptive equipment are appropriate. Examiners are authorized to place restrictions of cushions or pads for small people, outside mirrors to deaf people, and mechanical equipment to drivers with physical impairments, unless the applicant requests a road test to prove that mechanical equipment is not necessary. The *Manual* describes physical impairments and limitations, and suggests adaptive equipment for disorders affecting coordination, range of motion, and strength of motion. This information is provided in the table below.

Physical Skill Affected	Disorders	Adaptive Equipment/Restrictions
Coordination Includes all disorders that limit the driver's ability to coordinate motion of bodily members. All body members are present, but cannot be adequately controlled.	• Paraplegia • Quadriplegia • Hemiplegia • Cerebral palsy • Polio	• Hand-operated controls (brake and accelerator) • Low effort power steering • Spinner knobs of cuffs (grip on steering wheel) • Left foot accelerator • Steering column mounted dimmer and horn • Right side turn indicator • Electrical lifts and transfer boards • Automatic transmission • Pedal extensions
Range of Motion Disorders that limit the ability to reach and operate various components of the automobile	• Congenital deformity • Amputation • Dwarfism	• Hand-operated controls (brake and accelerator) • Low effort power steering • Spinner knobs of cuffs (grip on steering wheel) • Left foot accelerator • Steering column mounted dimmer and horn • Right side turn indicator • Automatic transmission • Pedal extensions • Seat cushions • Prosthetic restrictions
Strength of Motion Disorders that limit the strength and endurance of the driver.	• Arthritis, plus a variety of physical problems	• Special mirrors • Mechanical directional signals • Power or low effort steering • Automatic transmission • Spinner knobs • Power brakes

The final test of an applicant's ability to handle the vehicle is a driving demonstration. If any special mechanical devices are required for the driver to maintain safe driving performance, then the applicant must be restricted to driving a vehicle that is so equipped, and an equipment restriction is placed on the applicant's license. Florida's restriction codes and definitions follow:

Restriction Code	Description
A: Corrective Lenses	Corrective lenses must be worn while driving. This includes contact lenses, as there is no special restriction for contacts.
B: Outside Rearview Mirror	Mandatory for all deaf drivers and those who are blind in one eye.
C: Business Purposes Only	This permits any driving necessary to maintain livelihood, including driving to and from work, necessary on-the-job driving, driving for educational purposes, and driving for church and for medical purposes. No pleasure or nonessential driving is permitted.
D: Employment Purposes Only	This restriction permits driving to and from work and any necessary on-the-job driving required by an employer or occupation. No driving for any other purpose is permitted.
E: Daylight Driving Only	This restriction is placed on a license only upon recommendation of a doctor.
F: Automatic Transmission	This restriction is placed on the license when the driver cannot qualify with a standard transmission because of a physical disability.
G: Power Steering	This restriction is placed on the license when a driver exhibits limited strength.
I: Directional Signals	This restriction is placed on the license when the driver cannot give arm signals due to a physical disability.
J: Grip on Steering Wheel	This restriction is placed on the license if one hand is missing or useless, or if the driver's strength is inadequate to control the vehicle without the grip or knob on the wheel.
K: Hearing Aid	This restriction is placed on the license when an applicant is currently wearing a hearing aid.
L: Seat Cushion	This restriction is placed on the license due to short stature of the driver.
M: Hand Control or Pedal Extension	This restriction is placed on the license when the driver cannot otherwise qualify due to a physical disability.
N: Left Foot Accelerator	This restriction is placed on the license when the driver cannot otherwise qualify due to a physical disability (authority of Driver Improvement Hearing Officer).
P: Probation Interlock Device	This restriction mans the vehicle driven must be equipped with an ignition interlock device. The Department will impose this restriction upon recommendation of any court as a rule of probation, or by the Department as a requirement to reinstate a hardship.
S: Other Restrictions	Could include artificial arm, three-wheeled golf-cart type of vehicle, time of day, days of week, driving routes or radius, size of vehicle, etc
X: Medical Alert Bracelet	This restriction means that the driver is required to wear a medical alert bracelet at all times while operating a motor vehicle.

In Wisconsin, restrictions may be added to a license as a result of a physician's recommendation, the recommendation of an optometrist completing a vision report, or a driving evaluation by the personnel (examiners) in the DMV Customer Service Center. Restrictions are used to allow a driver privileges which are limited to some degree. Restrictions must be enforceable (i.e., a law enforcement officer must be able to determine if the restriction on the license is being observed). An example of an unenforceable restriction that is often received on medical forms but cannot be applied is "must take medication (or check blood sugar, eat, etc.) prior to driving." Examiners may only add equipment restrictions if the equipment is in place at the time of the driving examination or evaluation. Upon successful completion of driving examination or evaluation, appropriate restrictions are applied. Restriction codes include:

Code 1 Corrective glasses or contact lenses
Code 2 Hearing aid or vehicle equipped with outside rearview mirror
Code 3 Automatic transmission
Code 4 Automatic turn signals
Code 5 Daylight driving only doctor's recommendation required or based on driving evaluation given at night
Code 7 Proof of financial responsibility
Code 9 Complete hand controls
Code 10 Left outside mirror
Code 11 Right outside mirror
Code 12 Adequate seat adjustment
Code 14 Under 10,000 lbs.
Code 99 Special restriction card

<u>Area and Speed Restrictions</u>

- Radius of home area:
  The residence address must be part of a radius restriction (e.g., 20 mile radius of home at 140 Merry St., Madison, WI). If a doctor recommends a radius restriction, licensing personnel may shorten the radius as a result of a driving examination, but may not increase radius beyond doctor's recommendation.
- No freeway or interstate highway driving (wording must be exact)
- County or town roads: e.g., no driving on Main St. in the city of Sparta
- Not in city (name the city)
- Within city or village limits only
- Highways posted ___mph or less
- Between residence and work

<u>Time of Day</u>

- Daylight driving only
- Certain hours only (e.g., between 9:00 a.m. and 3:00 p.m.)

<u>Special Equipment</u>

- steering knob or power steering; steering cuff
- hand-operated dimmer switch
- power assisted brakes
- re-arrangement of pedals or controls
- artificial arm, hand, or foot
- foot brake extension

•accelerator extension
•Specially equipped van or automobile (specify vehicle make, year, and VIN)

References:

• Florida Examiner's Manual (Ch 11: Restrictions/Adaptive Equipment, 3/1/87, 8/1/91, 6/1/93);
• Freedman, Decina, and Knoebel (1986)
• Hunt (1994, 1996)
• Petrucelli and Malinowski (1992)
• Wisconsin Examiner's Manual, Section 350: Restrictions for Physical Disabilities, 8/90

I.C. DEVELOP TOOLS NEEDED TO IMPLEMENT MODEL PROGRAMS

I.C.4. Alternative Mobility Solutions

(a) Transit/Paratransit/Shared Ride Programs

(b) Volunteer Programs

(c) Private Sector Alternatives

(d) Electric Golf Carts

IC4(a). Transit/Paratransit/Shared Ride Programs

Summary:

Traditional mass transit provides a transportation alternative for the older population. Many transit agencies offer reduced fares or free rides to senior citizens. The Los Angeles County Metro Bus and Rail Systems, for example, offer fare discounts of 45 to 65 percent to senior citizen and disabled passengers on all routes. The Southeastern Pennsylvania Transit Authority (SEPTA) allows senior citizens with valid ID to ride its bus, trolley and subway lines during off-peak hours and on weekends for free.

Some seniors are unable to use mass transit even with these financial incentives in place. Some may have physical limitations which prevent them from gaining access to transit stops. Others may live in rural areas not serviced by mass transit. Paratransit and shared ride services can address these issues. These services offer more flexibility in route and schedule than traditional mass transit services, as described in the examples below.

The Southeastern Pennsylvania Transit Authority (SEPTA) offers two services to older residents of the Philadelphia area. SEPTA Senior Shared Ride is available to Philadelphia residents age 60 and older. Service is available seven days a week from 6:00 a.m. until midnight at a cost of $2.40 each way (10 percent of the full fare), or $1.95 if three or more clients are being transported. Reservations for trips may be made from 1 to 7 days in advance. Drivers will assist clients using steps, getting in and out of the vehicle, and with carrying packages; however, drivers will not enter a residence. Wheelchairs are accommodated. Companions are allowed to use the service, but must pay the same fare as the senior client. Shared-ride vans cross county lines. Clients must register for this service by completing an application and providing proof of age. SEPTA Paratransit annually provides 1.5 million door-to-door rides to Philadelphia residents unable to use public transportation. Senior citizens pay $2.40 each way and disabled persons pay $2.25 each way. Personal care attendants ride for free if registered in advance Service is available from Sunday through Thursday from 6:00 a.m. until 1:00 a.m., and twenty-four hours a day Fridays and Saturdays. Paratransit crosses county lines and goes to approximately 40 different locations outside of Philadelphia. Reservations are required 1 to 7 days in advance. An application must be completed by the client and a physician to register for paratransit service.

The Antelope Valley Transit Authority (AVTA) in California also administers a shared-ride program for seniors. The AVTA's Dial-a-Ride program provides curb-to-curb van service to seniors living in urban and rural areas of Los Angeles County. Vehicles are equipped with wheelchair lifts. Service is available seven days a week in urban areas, and Monday through Friday in rural areas. A special medical shuttle is available on Tuesday for elderly and disabled persons, and serves certain medical facilities in the Los Angeles area. Trips may be booked from 1 to 3 days in advance, but it is advised that the trip be confirmed on the day the service is requested. Same-day service is available, but clients should call at least two hours before they want to travel/ Fares range from $2.00 (Urban zone) to $5.00 (Rural 2 zone) each way. Group rates are half of the individual rate. The exact fare must be paid when boarding, as operators do not carry change, and do not accept IOU's.

The Ohio State University Medical Center publishes a directory of transportation services available to seniors living in central Ohio. Information concerning hours of operation, eligibility, locations serviced, and charges for service are given for each service provider listed. Examples of transportation services include transportation to medical centers and to senior centers (provided by the facilities themselves), curb-to-curb transportation on scheduled days to scheduled locations such as senior centers, malls, and grocery stores (by various community organizations), and reduced-fare bus service provided by Central Ohio Transit Authority.

Shasta Senior Nutrition Programs, Inc. operates a transit system for seniors in Shasta, CA. The service operates from 8:00 a.m. until 4:00 p.m., Monday through Friday, and is available to any person 60 years of age or older. Some of the vehicles in the fleet have a wheelchair lift. The suggested donation is $0.50 per trip. A 24-hour advanced notification is requested for each trip.

The Corona Dial-A-Ride program in Corona, CA offers on-demand shared-ride public transportation to any resident of the city, regardless of age. The service operates Monday through Friday 6:30 a.m. until 6:00 p.m. and Saturdays from 8:00 a.m. until 4:30 p.m. Senior citizens and disabled persons pay $0.50 per ride. Advanced notice of 24 hours is recommended. Dial-A-Ride links to RTA bus stops and Metrolink stations.

The Easy Lift organization in Santa Barbara, California operates a Dial-a-Ride service to provide door-to-door transportation for frail or cognitively impaired seniors and others unable to ride traditional mass transit lines. Easy Lift is the local Consolidated Transportation Service Agency (CTSA), and is a member of the Community Transportation Association of America (see *Notebook* Section IC4b). Clients pay $1.00 for each one-way trip. The actual cost to Easy Lift of transporting someone is approximately $10.00 per trip, which includes the cost for reservation staff, the driver's pay, fuel, maintenance, insurance for the vans, etc. Riders unable to use the steps to board the van will board using a wheelchair lift. Drivers may assist riders with their seat belts if requested, and will also secure tie-downs for wheelchair passengers. Reservations can be made the day of the trip, or up to two weeks in advance. Rides are booked on a first-call, first-served basis, and no priority is given based on trip purpose. Service is available from 6:00 a.m. until midnight weekdays, and 6:30 a.m. until 9:00 p.m. on weekends. During the fiscal year 1995/1996, Easy Lift scheduled over 70,000 rides for over 1,500 mobility-impaired people. The program uses a radio network to dispatch over 40 vans from approximately 12 local non-profit agencies. This "Human Service Radio Network" was established in 1988 by Easy Lift. Easy Lift is a non-profit, charitable organization that is subsidized through fundraising, grant writing, and public transit monies. The program is designed to serve individuals living independently (as opposed to those living in group homes). They will however, provide group rides at group rates, usually billed by the hour. Easy Lift also provides a "Mobility Training Program" where a mobility trainer works one-on-one with an individual to teach skills such as how to read Metropolitan Transit District (RTD) bus schedules and where to catch a bus. The trainer will also ride with a program participant on a repeated basis until he or she feels comfortable navigating fixed route bus service alone.

A 2-year project ($250,000) in Sedgewick County, KS is underway (Fall, 1998), and will provide for long-term coordination of transit services to diverse populations. In a prior demonstration project to identify transportation gaps and specific needs in a tri-county area, it was found was that there was not a need for more vehicles, but instead, a need for the development of an information management system or brokerage, that would allow for coordinated use of transit vehicles to meet the needs of customers. There is currently a lack of coordination statewide that limits the availability of transportation to elderly and disabled customers. This results in clients not getting services they need or desire, due to unavailability of transportation or funding for transportation. In addition, transportation to clients is limited (based on the trip purpose) because of system constraints. Coordinated Transit District #12 developed an information brokerage model that offers one-stop shopping with centralized intake at a coordinating center, and brings all partners and their resources together to maximize capacity. A software package is utilized to coordinate services, and includes information about clients, multiple vendors of transit services, vehicle availability, and multiple billing capabilities. Coordination of transit services and blending of funding sources and populations eliminates duplication of service, maximizes use of vehicles and staff, reduces need to purchase additional new vehicles for specialized transit needs, increases service, and serves more customers. Transit funding sources that will be filtered into the system include Medicaid, Disabled, Mentally Ill, Welfare-to-Work, Grant Resources, Older Adults, and Private Pay. This blending will allow the ability to leverage local funds with Medicaid and waivered payments with private pay/co-pay. The brokerage would mean more subsidized rides for clients who do not qualify for the other funding sources, the ability to mix funding sources and tap the strengths and capacity of all interested vendors. Through innovative coordination, rides can be provided on evenings and weekends, and for social activities, and employment. Older and disabled customers will have the opportunity to participate in social activities within the community which will increase their quality of life and reduce social isolation. Rides are available Monday through Saturday from 6:00 a.m to 10:00 p.m. and on Sunday from 8:00 a.m. to 2:00 p.m.

Project ACTION (Accessible Community Transportation in Our Nation) is a congressionally created national technical assistance program authorized under the Intermodal Surface Transportation Efficiency Act (ISTEA). The foundational work of Project ACTION is in promoting cooperation between the disability community and transportation industry. This work enables improved access to transportation for people with disabilities and the provision of accurate and practical information to help transportation operators implement the Americans with Disabilities Act (ADA). They are an enterprise of the National Easter Seal Society, "bringing transit, disability, and consumer organizations together under one cause," in cooperation with the Federal transit Administration and the U.S. Department of Transportation.

Eighty-four innovative demonstration projects and research initiatives in local communities throughout the nation have been funded. Fourteen technical assistance projects have been funded to create concrete solutions to the pressing ADA accessibility issues faced by public transit operators. Project ACTION provides training, resources and technical assistance to thousands of disability organizations, consumers with disabilities and local transportation operators. It maintains a resource center with the most up-to-date information on transportation accessibility.

Conclusions/Preliminary Recommendations:

Paratransit or shared ride services address many of the barriers preventing the use of public transportation by older individuals. Most of these services provide door-to-door service from the passenger's home to their destination, eliminating the need to gain access to a bus stop. There are limitations to the effectiveness of these services, however. Many paratransit services offer limited hours of operation, not allowing seniors to partake of activities scheduled in the evening. Paratransit services also lack the flexibility in scheduling that many grew accustomed to when driving. Appointments usually need to be scheduled at least 24 hours in advance, and the passenger must know in advance what time a return trip is needed. This can cause problems when a medical appointment runs late, for example. The coordinated transportation brokerage model being piloted in Kansas has promise for solving many of the problems inherent in traditional paratransit programs.

For older persons who fear using public transportation because they have no experience with it, but are functionally able to use this mode of transportation, Easy Lift's "Mobility Training Program" is a good model for other transit agencies to employ.

Project ACTION appears to be a resource that should be explored by jurisdictions implementing model programs. They state that their mission becomes more compelling as transportation operators need reliable sources of information on the most cost-effective means of improving accessibility and achieving ADA compliance. Project ACTION seeks to develop working positive partnerships which allow the work of "making public transportation truly accessible a reality for all Americans." They are a networking resource for members of the transit industry as well as members of the disability community.

References:

- Antelope Valley, CA: Antelope Valley Transit Authority Dial-a-Ride program
- Central Ohio: Transportation Resource Guide
- Corona, CA: Corona Dial-a-Ride
- Los Angeles County, CA: Metro Bus and Rail
- Philadelphia, PA: Southeastern Pennsylvania Transit Authority
- Project ACTION, 700 Thirteenth Street, NW, Suite 200, Washington, DC 20005; phone: (202) 347-3066, 1-800-659-6428, fax: (202) 347-4157; email: project_action@easter-sealsdc.org; web site: www.projectaction.org.
- Shasta, CA: Senior Nutrition Program Transit System (www.tcp-ip.com/ssnp/transport.htm)
- South Santa Barbara County, CA Easy Lift (www.rain.org/~easylift/history.html)
- Transportation Needs for Sedgwick County, Kansas, August 12, 1998; Silver Haired Legislature Testimony, Transportation Brokerage/Information Management System, October 14, 1998. Marsha Gasper, Program Manager, phone: (316) 383-7298; 1-800-367-7298.
- Weaver and Robinett (1994)

"Driving Decisions for Seniors" (DDS), a Eugene, Oregon-based program, provides social support and instruction on alternative transportation to local seniors (see Heckmann and Duke, 1997). This organization was founded by seniors and is run by senior volunteers. Its efforts are directed at assisting seniors facing driving restrictions, either imposed by themselves or by others, and helping current drivers prepare for the day when they can no longer drive. Among other services, DDS organizes group bus trips designed to teach seniors how to use the local mass transit system. Instruction is provided on how to plan a trip using a bus schedule, how to board a bus, transferring between routes, and treating mass transit use as a positive experience.

DDS also conducts monthly meetings at a local senior center. These meetings are designed to introduce new members to the organization in a relaxed and informal manner. Each new member is given the opportunity to tell the group about his or her specific mobility problem, and the group provides support and possible solutions.

The Michigan Department of Transportation has developed the "You Decide: Senior Driving Awareness Program" to assist older drivers in using and locating public or alternative transportation. This program is modeled after the DDS program in Oregon. As in DDS, this program also utilizes older volunteers to assist seniors in driving safely for as long as possible, and to teach those who can no longer drive safely to use alternate or mass transit. This program is presented in Section IB2 of the *Notebook* in greater detail.

In Wichita, KS the Central Plains Area Agency on Aging developed the *Assisted Senior Transportation Volunteer Handbook* as a training guide for volunteers who performed one of three types of volunteer jobs to assist frail/mobility impaired seniors using the Wichita Metropolitan Transit Authority's city bus system (as part of their 2-year demonstration project. Ref. CPAAA, 1996). The Boston Park Recreation Center became the hub for new transportation options to seniors living in southeast Wichita and the new intercounty service from Butler County. The Center is a "rest stop" for Butler County seniors who can connect with transportation services in the Wichita area. Volunteer "greeters" welcome seniors to the Boston Park Hospitality Center, where they can relax in a comfortable chair/sofa while they wait to connect with local transportation. Greeters work with the WMTA Senior Transportation Coordinator to arrange schedules for seniors who visit Boston Park, and also work with the Boston Park Neighborhood van driver to coordinate the van schedule. Volunteer "pilots" are ambassadors of the public bus system who ride with seniors and teach them how to use it. They work one-on-one with new riders of the city bus system, with the goal of assisting at least 10 new users per day, and also will be assigned to accompany a group of seniors on a "Ride the Bus Day" scheduled outing to assist riders in group as needed. The WMTA bus stops at Boston Park, making it easier for those living in the Boston Park area or using the Butler County program to take advantage of the half-price special citizen fare the system offers to seniors. Volunteer "navigators" are escorts during transportation who provide assistance to frail seniors using public transportation. Matches are made based on the residential location of the requestor and the volunteer's location. Navigators will not provide transportation, but will ride with a senior on public transportation like WMTA's Special Transportation Services.

A total of 41 seniors took advantage of the Boston Park Neighborhood Transportation Service between May 1995-September 1995. Post-measures were conducted with five older females to determine their level of satisfaction and the ease of use of the service. All indicated that the service was easy to access, friendly, affordable, and reliable, and indicated that it provided transportation needs that were not being met previously. CPAAA (1996) notes that political problems arose between county and city government agencies in the process of implementing the county/city-sponsored program, and that it is important for others who want to replicate the model to clearly define sponsors' roles and responsibilities in a written agreement prior to program implementation. Although demand for the service existed and was growing as a result of extensive publicity, there was difficulty obtaining long-term financial support. The service was discontinued when the seed money supplied from the grant ran out, and the sponsor who was expected to back the service after the project demonstration ended did not come through.

Connect-a-Ride, provided by the Jewish Council for the Aging, serves as a clearinghouse of information on alternative transportation for seniors in suburban Washington, D.C. (Montgomery County, MD and Arlington County, VA). Since program implementation in April 1996, over 650 seniors have received information and assistance to obtain transportation (*Maximizing Human Potential*, 1998). Free information about costs, routes and availability of both public and private transportation services is provided. Whenever possible, Connect-a-Ride also attempts to link seniors to specific programs which best address their needs. Counselors first work with the senior to identify transportation needs and resources. Then they determine whether any community-based programs are available for which the senior is eligible, and able to use. Older persons may access the agency through a local telephone call. The phone is staffed from 18 to 30 hours per week, and an answering machine is available to record other calls. These calls are returned within 24 hours. Staff spend an average of 40 minutes with each new client. Follow-up calls are made to determine whether clients were able to use the information provided, and that they were successful in making their trip.

The Columbia Association (in Howard County, MD) provides free door-to-door transportation for Columbia seniors who want to attend evening and weekend community events in Columbia (*Senior Connections*, 1998). This service accommodates the needs of seniors who no longer wish to drive at night. Reservations must be made three days in advance of the event.

The "Independent Transportation Network" (ITN) in Portland, ME utilizes both volunteers driving their own automobiles as well as paid drivers to transport seniors who can no longer drive. Transportation to any destination is available to all seniors, regardless of income, 24 hours a day; seven days a week. ITN is a membership organization that offers several ways that members can pay for transportation. Among these options is a program in which local merchants patronized by seniors partially subsidize rides for ITN members.

"Rec Ride Plus" in Bangor, ME utilizes volunteer drivers and dispatchers to provide low cost transportation to seniors within a 60 mile radius of Bangor. Two vans and a wheelchair-accessible bus are used to provide transportation Monday through Friday from 8:30 a.m. until 4:30 p.m.

"Volunteers in Motion" utilizes volunteers as drivers and escorts to seniors living in Brevard County, FL. In 1997, this service provided 2,900 rides to seniors living in Brevard County.

ElderNet of Lower Merion and Narberth (Pennsylvania) is a non-profit organization that was developed in 1976 by representatives of the community, and religious and governmental groups. They serve adults of all ages, including the disadvantaged and those over age 60. ElderNet is staffed by 3 professional social workers and 180 trained volunteers. Funding for the program is received from Montgomery county office on Aging, Lower Merion Township, the Borough of Narberth, community residents, businesses, churches, synagogues, and other groups. Only half of the funding is from government and foundation sources. They are an United Way donor option agency. ElderNet helps older neighbors to remain independent, and provides a variety of practical, free services. These include: (1) Immediate help - to answer questions, asses needs, and find resources to meet the needs; (2) Transportation - volunteers provide rides for medical appointments, banking, shopping, and other trips for those with low-moderate incomes who cannot use public transportation; (3) Help for the homebound - volunteers shop, do odd jobs, help complete forms and balance checkbooks, and serve as visitors, to enable homebound adults to continue to live independently in their homes; (4) Emergency help - for persons of all ages who need money for fuel, rent, food, and other one-time financial emergencies through federal and locally raised funds; (5) Community cooperation - a special Eldercare Committee of business, religious, and educational representatives meets to address the problems faced by older adults in the community; (6) Housing - using emergency funds and housing counseling, ElderNet helps homeless persons of all ages or those who are in danger of eviction, and provides information on housing options that range from rental assistance to nursing homes; (7) Telephone Reassurance - volunteers call homebound people every day, including weekends and holidays, to check on their health and security; and (8) Information - ElderNet studies issues and informs the public about programs and services for the adult community through speaking engagements, information guides, and newspaper articles. In 1997, ElderNet responded to 5,665 calls for help from 1,723 people. Their volunteers gave 7,799 hours of service and provided 1,537 escorted round trips for food, shopping, doctor's visits, or other necessary appointments.

The **Community Transportation Association of America** (CTAA) is an association of organizations and individuals who are "committed to improving mobility for all people." CTAA conducts research, provides technical assistance, offers educational programs, and serves as an advocate in order to make coordinated community transportation available, affordable, and accessible. It is located in Washington, DC where there are 16 full-time staff, and several part-time and consultant staff. There are no branch offices. They define community transportation as "a practical alternative that picks up where the private auto and mass transit leave off, which has evolved as an effective network of community-based agencies and coordinated services that offers the elderly access to needed services, ensures mobility for people with disabilities, and connects the poor and unemployed with jobs and training facilities."

The National Transit Resource Center of CTAA (1-800-527-8279) serves transportation providers, planners, and passengers with publications, peer support, advice, and assistance in the following areas: employment transportation; funding for transportation services, medical transportation, senior transportation, drug and alcohol testing programs, interstate passenger regulations, scheduling and dispatching systems, and vehicle procurement. Services are funded by the U.S. Department of health and Human Services and Federal Transit Administration, and are typically provided at no charge. The USDA sponsors the Community Transportation Development Fund (CTDF). The fund provides low-interest loans up to $150,000 to improve or expand transit programs in rural areas. Private carriers, nonprofits, public agencies, and community organizations are eligible for the program. Loans may be used to: acquire vehicles and provide operating expenses; purchase land for transit facilities; finance terminals, transit offices, or maintenance facilities; acquire communications equipment; or start up innovative entrepreneurial projects (e.g., owner-operator systems). These loans are intended to assist project populations of 25,000 or less whose managers do not have access to conventional financing.

CTAP, the U.S. Department of Health and Human Services Community Transportation Assistance Project, provides information and answers to questions about transportation issues, such as accessibility, coordination, funding opportunities, training, management and legislation and regulations. They offer health and social services planners and providers options for meeting client access needs.

The National Transit Resource Center is CTAP's information clearinghouse. Relevant, up-to-date information on all key human services transportation issues is available through the toll-free hotline or the computer bulletin board. The Resource Center has more than 15,000 computerized entries of publications and databases on a wide range of human services and community transportation topics. Resource Center staff are knowledgeable in the latest federal regulations and pending legislation. CTAP produces a variety of publications, all targeted at
human services agencies and community transportation providers. For a list of these resources, call the Transit Hotline. TAP-Net (Technical Assistance Peer Network) allows human services agencies and transportation providers to draw upon the experience of experts nationwide. Coordination, accessibility, marketing, consumer training and more are common topics addressed by the peers. Technical assistance may be provided by telephone calls, conference workshops and presentations and on-site visits. CTAP has produced two training modules for human services transportation providers. Making Community Transportation Accessible and Coordinating Community Transportation Services contain a planning and implementation handbook as well as a facilitator guide. CTAP also conducts regional training conferences on coordination and accessibility issues. *Community Solutions* is CTAP's newsletter that focuses on transportation and the important role it plays in keeping communities viable and their residents independent. As states assume greater responsibility for health care and welfare, finding cost-effective community transportation solutions will become increasingly important. Community Solutions provides brief descriptions of new transportation designs and models that respond to today's challenges

Conclusions/Preliminary Recommendations:

Programs like DDS and the Boston Park Project are valuable as sources of information for seniors concerning alternative transportation. The social support and counseling provided to seniors by seniors about driving cessation is also important. Furthermore, these programs also help the senior volunteers by giving them the feeling of making a contribution to the well-being of others.

Volunteer ride programs like ITN address some of the limitations of other paratransit or shared ride services. Most notably, the use of volunteer drivers assists in holding down costs while meeting mobility needs using vehicles that are comfortable and (perceived to be) safe by older clients. Personal relationships that develop between clients and their regular drivers also increases user satisfaction with such services. These services do face some of the same problems as other shared ride programs, however, in that hours of operation are restricted and rides usually need to be scheduled at least one day in advance. Volunteer programs such as the Columbia Association provide a means for seniors to stay active in cultural community events that are usually scheduled in the evenings, and allow older drivers to restrict nighttime driving without restricting access to social events.

CTAA is a resource that should be utilized in the development and implementation of a Model Program in any jurisdiction, to help determine where gaps exist in traditional transit service, where there are community-based programs already in existence, and how to implement and creatively fund new programs.

References:

- Bangor, ME: Rec Ride Plus.
- Brevard County, FL: Volunteers in Motion• Heckmann and Duke (1997).

- Community Transportation Association of America (CTAA), 1341 G Street, NW, Suite 600, Washington, DC 20005; phone: (202) 628-1480; fax: (20) 737-9197; http://www.ctaa.org; National Transit Resource Center 1-800-527-8279.
- ElderNet of Lower Merion and Narberth, 9 South Bryn Mawr Avenue, Bryn Mawr, PA 19010, phone (610) 525-0706.
- *Maximizing Human Potential*, volume 6, no. 1, Summer 1998. Quarterly Newsletter of the Aging, Disability and Rehabilitation Network of the American Society on Aging.
- MDOT You Decide - Older Driver Program (based on DDS program).
- Montgomery County, MD/Arlington County, VA: Connect-a-Ride.
- Portland, ME: Independent Transportation Network.
- *The Senior Connection*, volume 4, Number 9, September 1998. Produced by the Howard County Department of Citizen Services/Office on Aging.
- Wichita, KS: Central Plains Area Agency on Aging Boston Park Project

IC4(c)i. Hired Drivers

Summary:

Red Top Cab in Arlington, VA has recently purchased a fleet of five wheelchair-accessible cabs for transport of elderly and disabled passengers. Red Top also offers a 10 percent discount to senior citizens.

Other taxi operators also offer fare discounts to seniors. Alexandria Yellow Cab, for example, allows seniors to purchase pre-paid coupon books, allowing them a 10 percent discount on fares with the use of the coupons. Likewise, Union Cab Company in Madison, WI allows seniors to buy $20 coupon books for rides at a 20 percent discount.

Some seniors in smaller towns may pay nonprofessional drivers for rides to and from medical appointments, etc. Driving people to destinations in exchange for payment is illegal in many towns without a taxi license, however. In 1996 a 67-year-old Oregon woman was convicted of violating one such taxicab ordinance by driving friends to medical appointments in exchange for $4.00 to $5.00 in gas money. A complaint was filed by a local cab company who was losing business to this private driver. It should be noted that the cab company charged significantly higher fares for the same trips, meaning that many seniors on fixed incomes could not afford their services.

USAA, a San Antonio, TX-based insurance company, has developed an innovative new program called "Choice Ride." The idea came about after listening to comments from its members, which often focus on changing lifestyles and the growing need for some type of safe, dependable, and fairly priced alternative transportation. After two years of research and development, Choice Ride began an 18-month field test in the Orlando, FL area on July 1, 1998 (to coincide with "Independence" Day). Choice Ride offers the convenience and privacy of a personal car, without the expense of owning the car or driving the car yourself. The service is being test marketed to members age 65 and older, and to adult members who may have parents or loved ones for whom the service may be of interest. As a door-to-door, personalized service, Choice Ride is intended to operate in suburban areas with large concentrations of USAA members. Subscribers can schedule chauffeured transportation in luxury automobiles without the worry of carrying cash for fares or tips. Choice Ride transportation is being provided by Mears Transportation Group, a recognized provider of high-quality transportation service. Transportation is available 24 hours per day, seven days per week. Subscribers call (up to one day in advance of their trip) to book a reservation to go anywhere in the four-hundred square mile service area. Three pricing plans are available for USAA members. Packages include pre-paid transportation accounts for 30, 60, or 90 rides. USAA also offers a trial program that allows a potential subscriber to "try out" Choice Ride to see if the program will accommodate their lifestyle. In addition, USAA members who sign up for Choice Ride and have an active auto policy with USAA, are eligible to receive a 90 percent premium reduction on one of their insured vehicles, if they agree not to drive that vehicle (except for emergency situations) while using Choice Ride. At the end of the test period, USAA Alliance Services Company will decide when and where to expand the program.

Conclusions/Preliminary Recommendations:

Taxis and hired drivers offer a degree of flexibility in scheduling not available with paratransit or volunteer ride services. Even with senior citizen discounts, however, the cost of these services may be out of reach for many seniors on fixed incomes. On the other hand, services like Choice Ride may actually cost less than the costs associated with owning a car. Unregulated "Gypsy" cabs as described above offer an affordable alternative, but operators of such services face stiff fines if caught.

References:

- Arlington, VA: Red Top Cab
- Alexandria, VA: Alexandria Yellow Cab
- Burkhardt, Berger, Creedon, and McGavock (1998)
- Evelyn Alexander, USAA Insurance Company. 9800 Fredericksburg Road, San Antonio, TX 78288 (1-800-535-8695)
- Madison, WI: Union Cab Company
- Media Release: Cascade Policy Institute

IC4(c)ii. Voucher Programs

Summary:

Aging and disabled citizens of Baltimore are eligible for taxi vouchers funded by the Mayor of Baltimore and the Maryland Department of Transportation.

The Culver City Senior Citizens Center offers a taxi voucher program in addition to van service within a two-mile radius of the center.

Elderly residents of Berkeley, CA who cannot use public transportation can obtain reduced-cost transportation vouchers from the city's Subsidized Taxi and Van Program.

References:

- Baltimore, MD: Baltimore City Commission on Aging and Retirement Education
- Berkeley, CA: Subsidized Taxi and Voucher Program
- Culver City, CA: Culver City Senior Citizens Center

1C4(d). Electric Golf Carts

The University of South Florida Institute on Aging funded a project to establish a baseline of information about the use of "neighborhood electric vehicles" (NEVs) by senior citizens and others who do not have access to personal vehicles, or who prefer to use golf carts. This project reviewed the legislation in Florida (Chapter 316, Florida Statutes) and California (Sections 345 and 21115, California Vehicle Code), because these states represent areas with substantial senior citizen populations, and the climate permits year-round golf-cart use which suggests the potential for integrating NEVs into daily living.

Vendors of golf carts/NEVs include Bombardier NV, Club Car, Columbia Par Car, E-Z-GO, Hyundai, Yamaha, and others. These vehicles carry from 2 to 4 adults. Most include basic safety features, such as rear-view mirrors and brake lights, and some include turn signals, windshields, wipers, headlights, safety belts, radios, etc. The base price ranges from $ 2,500 to $ 3,000.

In Florida, a golf cart operator is exempt from obtaining a driver's license, and may operate a golf cart along roadways designated for golf-cart use, and may only be operated on state roadways with a posted speed limit of 30 mi/h or less. A golf cart may cross a state road only if the location is approved by the Florida DOT. Florida permits the operation of golf carts during daylight hours, although the state, county, or municipality may allow golf carts to be operated between sunrise and sunset if the golf cart is equipped with headlights, brake lights, turn signals, and a windshield. The following equipment is required on all golf carts: "efficient brakes, reliable steering apparatus, safe tires, a rearview mirror, and red reflectorized warning devices in both the front and rear." They may be operated within a self-contained retirement community, unless the governing body of the county or municipality determines that a prohibition is necessary because of safety concerns. FDOT may also prohibit the operation of golf carts on any street or highway under its jurisdiction in the interest of safety. Although golf carts have been seen operating on sidewalks, the statute states that "no person shall drive any vehicle other than by human power upon a bicycle path, sidewalk, or sidewalk area, except upon a permanent or duly authorized temporary driveway." Golf carts may be included under a homeowner's insurance policy and do not need to be insured separately in Florida.

In Sun City, Fl (an unincorporated age-restricted community, located 16 miles south of Tampa), operation of golf carts is allowed for any purpose on county streets within the community. A brochure is given to all residents and potential residents to illustrate some of the criteria for golf cart usage in Sun City Center, and when crossing certain designated areas outside of Sun City Center.

California permits local authorities to designate certain areas of state highway for golf cart operators. Local authorities are also permitted to establish crossing zones on other streets with posted speed limits of 45 mi/h or less, adjacent to golf courses. Golf carts may not be operated on any highway unless the speed limit is 25 mi/h or less.

In Palm Desert, CA, a 5-year program was initiated in 1993 ("Golf Cart Transportation Pilot Program") to develop a convenient transportation system that is safe, environmentally sensitive, and offers zero emissions. It was designed to expand the use of golf carts to more than just transportation to golf and recreational sites, and to provide for broader use on public streets and private roads than is currently allowed for in the California Vehicle Code. Permitted users are allowed to use golf carts to travel to schools, colleges, parks, shopping, businesses, and government offices. The long-term goal is to provide full golf cart access throughout the community. New policies were designed specifying golf cart physical criteria, golf cart operator requirements, and golf cart lane design criteria. In 1997, there were more than 600 miles of golf cart lanes.

Conclusions:

The study authors concluded that the use of electronic golf carts and other NEVs holds great potential as an alternative transportation mode for seniors and other drivers with disabilities who can not, or choose not to drive regular vehicles. However, given concerns about the safe operation of vehicles in mixed traffic, state statutes need to be reviewed and revised. In addition, some decisions will need to be made regarding the functional abilities necessary for the safe operation of golf cart/NEV operators.

References:

- Mathias and Stoffle (1998)

I.C. DEVELOP TOOLS NEEDED TO IMPLEMENT MODEL PROGRAMS

I.C.5. Alternatives to Transportation

(a) Community/Social Support Activities

(b) Internet Access to Services

IC5(a). Community/Social Support Activities

Summary:

The loss of freedom and mobility associated with driving cessation can impact seniors in many different ways. Many suddenly find themselves isolated from social interaction and unable to access services to allow them to continue living independently.

Marottoli et al. (1997) found an association between driving cessation and an increase in depressive symptoms in an older, noninstitutionalized sample. The loss of independence and opportunities for social interaction suffered by those without ready access to alternative forms of transportation can have a severe impact on psychological well-being. A sense of loneliness can overcome a senior who lacks access to transportation. This feeling of loneliness can also trigger depression. One study found that loneliness was a strong predictor of nursing home admissions among older persons (Wallace, Russell, Cutrona, and de la Mora, 1998). These investigators found that older individuals who attend church, experience much lower rates of nursing home admissions, compared to older persons who do not regularly attend services. They concluded that regular involvement in group activities tends to ward of the need for dependent care such as that provided by nursing homes. The study authors suggested the use of community groups are a means of bringing independent individuals together.

Providing nondriving seniors with opportunities for social interaction and the means to address day-to-day needs can prevent the onset of depression. Several organizations have put these types of services in place. In Shasta, CA, for example, the "Shasta Senior Nutrition Program" offers group lunches to those age 60 and over at four centers, located in Anderson, Burney, Lake Shasta City, and Redding. The meals are nutritionally balanced and provide one-third of the recommended dietary allowance. A donation of $2.00 or more is requested. A "Meals on Wheels Program" delivers hot meals to physically disabled or incapacitated seniors who cannot attend the congregate meals, and have no one available to cook for them. Hot meals are delivered Monday through Friday, with the exception of some holidays. Frozen dinners are available on the weekend. The "Senior Brown Bag Program" serves low-income seniors age 60+ nutritious foods that might otherwise go to waste. The meals are distributed twice a month at seven different distribution sites located throughout the Shasta County area. The recipients must be physically able to reach the distribution site. The services of the Shasta Senior Nutrition program are provided largely by volunteers, although the program is operated by a small staff.

Meals-on-Wheels of Greater San Diego home-delivers two meals per day to seniors age 60+ who are unable to prepare meals for themselves or unable to get to a grocery store. Younger disabled adults may also be eligible if they are homebound, and there are openings on a meals on wheels route. Two meals are delivered daily during the lunch hour that include a hot dinner for immediate consumption and a cold "sack" supper for later. Menus are planned by registered dietitians; both meals (together) supply two-thirds of the federal nutritional Recommended Dietary Allowance (RDA), and two-thirds of the recommended calorie intake. When necessary, meals can be prepared for people with special dietary needs. Recipients are charged on a sliding scale with a maximum charge of $5.00 per day. Meals are delivered Monday through Friday during the lunch hour. Meals on Wheels is a nationwide resource that is controlled by local community agencies. The program costs between $10 and $30 per week, depending on the older individual's income. Elders with a low income may be eligible to have the meals for free. Meals on Wheels is available on both a short-term basis (e.g., people recovering from surgery or other temporary problem) and on a continuing basis. The "Immediate Response" service ensures that meals can begin the next week day after being contacted; no one is ever put on a waiting list.

Indiana University runs two volunteer programs of benefit to seniors. The "Friends of Seniors Program" allows volunteers to provide companionship to senior citizens. The volunteer position requires 30 minutes of time on a daily basis, and volunteers must have their own transportation. Volunteers socialize and play games with seniors at an area nursing home. A meal delivery program is also provided for seniors in the Bloomington area. Another service not specifically for older adults is the "Women's Wheels " safety service that provides rides to women of the I.U. Bloomington community as an alternative to walking alone. The service is provided by two volunteers in each minivan: a driver and a navigator. Shifts are two hours in duration, from 8:00 p.m. to 10:00 p.m, and from 10:00 a.m. to 12:00 p.m.

The "Senior Support Program" in Grand Travers/Leelanau County, Michigan provides recreational activities and socialization for socially isolated citizens age 55 and older. Seniors participate in service projects, peer support activities, crafts, discussion groups, and exercise programs. The mission of the program is "to promote better physical and mental health for the frail elderly and those with emotional problems and/or developmental disabilities to help prevent premature out-of-home placements of older 'at risk' adults." The program staff includes a nurse, social worker, occupational therapist, and life skills advocates, who all have training and experience in geriatrics and mental health. Common problems of the individuals who seek their help include grief, depression, medication-related problems, exaggerated fears, difficulty adjusting to loses, and behavior problems. Outreach Counselors see adults regularly in their homes. They assist the client and family gain insight and resolve problems. Client Service Managers provide assessment, advocacy, and links to services for clients who have multiple and complex needs. There is a charge for some services, but it is established according to the person's ability to pay; no one is denied service because he or she can not pay.

Ardmore's "Care for the Elderly" provides home-based support for seniors in the Akron, OH area. They provide a variety of support options to help aging individuals stay in their own homes. They provide transportation, menu planning and meal preparation, light housekeeping, shopping, recreational activities and social support. Each senior receives an individual assessment to identify his or her needs. Referrals to other agencies are provided for any needs this program cannot meet.

"Senior Citizen Services" (SCS) of Pender County, NC provides a range of services to seniors, including home-delivered and congregate meals, transportation, and in-home assistance with activities of daily living. SCS also provides seniors with opportunities for interaction, socialization and education. The program is designed to help older adults maintain the highest level of activity, self sufficiency, and independent living.

The "Division of Long Term Care and Aging" of Snohomish County, WA provides a wide variety of services for seniors. The "Adult Day Health Program" includes social support, therapeutic activities, hot lunches, health monitoring, exercises, and more to improve the overall health and independence of seniors, and to prevent premature nursing home or hospital placement. Adult day health costs $43.07 per day; they accept Medicaid and County Respite clients, and also utilize a sliding fee scale. Case management services are also provided to assist functionally impaired seniors in obtaining the support services they need. Personal care services provide help with activities of daily living, such as assistance with baths, showers, hair washing; assistance with walking (especially outside of the home); assistance with shopping for groceries or preparing meals; and driving a person to a doctor's appointment. The "Daybreak Respite Program" operates at four different sites throughout the county.

This program is designed to allow a rest break for the caregivers of seniors with limitations. Seniors participate in various structured leisure activities, allowing caregivers some time to themselves. The program costs $26.27 per day; individuals may qualify for a reduced rate if they are at a low to moderate income level. The "Retired and Senior Volunteer Program" links seniors with opportunities to donate their time to community agencies needing help. Volunteers can choose to assist in an area where they already possess skills, or use the opportunity to learn new skills. The program will assist with transportation for senior volunteers to and from the site where they are volunteering. Many other services are offered, including discount dental care, depression screening, health maintenance, legal aid, hot meals, volunteer chore services, and senior to senior peer support.

The "Philadelphia Corporation for Aging" funds several adult day care centers in the Philadelphia, PA area. These centers are community-based programs designed to meet the needs of functionally impaired older adults. They provide health and social services as well as congregate meals. They also provide a respite for the primary caregivers of impaired older adults.

The "Getting in Gear Program" in Tampa/St. Petersburg, FL provides case management services to seniors who have ceased driving. Case managers will link seniors with housekeeping, shopping, transportation, and social services with the goal of helping seniors remain independent for as long as possible.

Kennedy Health Center's "ElderCare" program provides older citizens of three New Jersey counties (Burlington, Camden, and Gloucester) with links to in-home assistance, food shopping and transportation. The goal of this program is to allow older patients to continue safely living at home for as long as possible. Kennedy has a network of 15 to 20 health centers that are located in retirement communities and area apartment buildings with a high concentration of seniors. The health centers solve the transportation problems many seniors face by bringing programs and medical services directly to them. Board-certified geriatricians are available at each facility twice per week; medical specialists including podiatrists, ophthalmologists, and ear-nose-throat physicians rotate through the centers, depending on the needs of the residents. Kennedy offers free support groups for older persons and their caregivers, with topics ranging from "Adjustment to Later Life Change" to "Chronic Pain."

"Options for Senior America" offers services to seniors living in the Northeast, Mid -Atlantic, and Southeast regions of the U.S. that include: errand service, housekeeping, hygiene, and meals. Services are available on a live-in or a live-out basis. OPTIONS is a non-medical home care organization that includes directors, managers, social workers, coordinators, and personnel who work with older persons on a daily basis. They can provide 7-day, 24-hour live-in services, or part-time and full-time live-out programs that range from 4 to 24 hours per day.

The "Dallas Lighthouse for the Blind" offers a comprehensive range of accredited rehabilitation programs for people with vision impairments. The multi-service rehabilitation agency serves nearly 1,000 people with vision disabilities each year through employment, vocational rehabilitation, information and referral, independent living rehabilitation, transitional housing and life enrichment services. Lighthouse for the Blind also operates in New Orleans (LA) and in Tampa (FL). The mission of the agency is to provide vision-disabled blind and multi-disabled blind adults and seniors with opportunities to achieve personal, social, and economic independence. They provide industrial center employment and training; vocational rehabilitation; information about and referral to other community agencies; and independent living rehabilitation. For the independent living rehabilitation component social work services provide needs assessment, intake, evaluation, goal-oriented counseling and case management. Peer counseling services match newcomers with trained graduates of Lighthouse services. Independent living skills training gives instruction in activities of daily living such as eating, cooking, sewing, using adaptive aids and managing personal affairs. Orientation and Mobility training, learning to travel using a white cane or dog guide, is taught one-on-one by certified instructors. Students learn to travel safely and become familiar with their environment. Support group services enable clients to adjust to and cope with their vision loss through on-campus and neighborhood group counseling. Life enrichment services enable people to experience independence during their leisure time. Therapeutic recreational services offer opportunities for social independence and enjoyment through instructional classes, fitness activities, special events and outdoor activities. Volunteer services match volunteers with vision-impaired people needing assistance in certain tasks. Volunteer opportunities may include readers, drivers, sighted escorts and shopping guides. Volunteers may also give administrative or professional services, helping the agency to serve others.

References:

- Akron, OH: Ardmore's Care for the Elderly
- Bloomington, IN: Indiana University Honors Division Volunteer Programs
- Burlington, Gloucester, and Camden County, NJ: Kennedy Health System's ElderCare Program.
- Grand Traverse and Leelanau Counties, MI: Senior Support Program
- Lighthouse for the Blind (Dallas, TX; Tampa, FL; New Orleans, LA)
- Marottoli, Mendes de Leon, Glass, et al. (1997)
- Options for Senior America: 1-800-2-OPTIONS
- Pender County, NC: Senior Citizen Services
- Philadelphia, PA: Adult Day Care Centers
- Shasta County, CA: Shasta Senior Nutrition Program; National Meals on wheels Foundation: 1-800-999-6262
- Snohomish County, WA: Division of Long Term Care and Aging
- Tampa/St. Petersburg, FL: Getting in Gear
- Wallace, Russell, Cutrona, and de la Mora (1998)

IC5(b). Internet Access to Services

Summary:

Valuable information and services for seniors who no longer drive can be found on the internet. Several World Wide Web sites cataloging services and information of interest to seniors have been developed. Furthermore, many retailers operate web sites which allow individuals to shop for groceries or other products without leaving home. This type of service could benefit seniors who no longer drive. However, according to a 1998 Department of Commerce study by the National Tele-Communications Information Administration, only 21 percent of seniors own PCs and only 8.8 percent are connected to the internet (*Philadelphia Inquirer*, October 18, 1998).

Microsoft created the Microsoft Senior Initiative to "bring generations and communities together by helping to provide access to technology to people of all ages." Their website at **www.microsoft.com/seniors** provides information to assist seniors in the following areas: (1) Communication - writing e-mail and sending pictures via e-mail to family and friends; (2) Employability - being able to job share, telecommute, or be retrained; (3) Creativity - creating a family tree, calendar, or Web page; (4) Financial Independence - Accessing information about investments or conducting commerce over the internet; (5) Connectivity - continuing to contribute to society through a mentoring program; and (6) Learning - attending on-line seminars, researching information, or taking a virtual trip. Recently, Microsoft's Learning Pavilion was one of the 300 exhibits at the Philadelphia Corporation for Aging (PCA) "Age Expo" (10/98).

For seniors just getting started on the internet, SeniorNet is a nonprofit organization that offers 350 chat rooms and discussions on travel, gardening, and health. They are the largest on-line network and computer training program designed and taught by older adults (**www.seniornet.org**). Membership is $35.00 for an individual and $40.00 for a couple. Most discussion areas are accessible to non-members. A book called Young@heart Computing for Seniors (by Mary Furlong, the founder of SeniorNet and Stefan B. Lipson; McGraw-Hill, 1996, $22.95) offers basics on computer fundamentals and getting connected to the internet.

Seniors can also find guides to specialized services, health care, and housing online. One such source of this information is Senior Options (http://**www.senioroptions.com**). It bills itself as the "most comprehensive and complete guide to senior services on the Internet". Information on a wide range of services can be accessed on this site: housing options, home health providers, case management, legal services, etc. Searches can be conducted by geographic area to produce lists of service providers for any area of the country. Other sites geared to seniors include the SeniorCom site (**www.senior.com**) that provides information about retirement communities; the American Association of Retired Persons (AARP) site (**www.aarp.org**); ThirdAge (at **www.thirdage.com**) which features news and advice on health, money, romance, work, technology, family and living; the Senior Search site (at **www.seniorsearch.com**) which contains information about health, housing, and legal resources; and the Senior Center (at **www.senior-center.com**) that offers free items, bargains, and late breaking news.

At least two companies currently offer online grocery shopping. Oncart online grocery shopping allows customers to choose from thousands of grocery items (**www.oncart.com**). Customers are given a password for access to the system. A variety of payment options are in place for customers, and Oncart provides delivery of the order at a time and day selected by the customer.

Peapod online (**www.peapod.com**) offers similar service in the Boston, MA area. Members pay a $4.95 per month membership fee, and another fee for each purchase. Orders can be picked up or delivered to the home. Shoppers can choose from a variety of payment options, and can specify delivery times and instructions.

Wal Mart retail stores offer an online shopping service as well (**www.wmonline.wal-mart.com**). Orders are shipped via UPS or USPS. Payment is limited to credit card.

Conclusions/Preliminary Recommendations:

There are many services available on the internet which could benefit nondriving seniors. A major obstacle, however, is making seniors comfortable in accessing these services. Education provided by computer-literate older volunteers could facilitate seniors in gaining access to this potentially valuable source of information and assistance. One concern with many on-line shopping sites, is the requirement to supply a credit card number on-line for payment, at the time the order is placed.

References:

- Lorek, L. (October 15, 1998). "Many Sites for Seniors on Web." *Sun Sentinel, South Florida.*
- Microsoft Senior Initiative (Craig Spiezle, director), in *The Philadelphia Inquirer,* Special Advertising Section (October 18, 1998), "Microsoft Demonstrates Computer and Internet Technologies at the Age Expo."
- Oncart Online Grocery Shopping
- Peapod Online Grocery Shopping
- Senior Options
- Wal Mart Online

I.D. REFERENCES

D. REFERENCES

Adrian, M.J. (1981). "Flexibility In the Aging Adult." In: *Exercise and Aging*. E.L. Smith and R.C. Serfass, (Eds.), Hillside, NJ.

Aizenberg, R. and Anapolle, J. (1996). *High Risk Older Drivers: State Reporting Requirements and Practices, and Information Outreach*.

Alcee, J.V., Jernigan, J.D., and Stoke, C.B. (1990). *Identifying At Risk Drivers: A Survey of State Programs*. Virginia Department of Motor Vehicles (VTRC 91-R12).

American Academy of Neurology, American Epilepsy Society, and Epilepsy Foundation of America. (1994). "Consensus Statements, Sample Statutory Provisions, and Model Regulations Regarding Driver Licensing and Epilepsy." *Epilepsia*, 35(3), 696-705.

American Academy of Ophthalmology (1984). *Cataract*.

American Academy of Ophthalmology (1984). *Diabetic Retinopathy*.

American Academy of Ophthalmology (1984). *Macular Degeneration*.

American Academy of Ophthalmology (1983). *Glaucoma*.

American Association of Motor Vehicle Administrators (1997). *Communications Resource Guide*.

American Association of Retired Persons (1995). *Where We Stand: AARP's Views on Important Issues*.

American Association of Retired Persons (1996). *AARP 55 Alive Fact Sheet*.

American Association of Retired Persons (1992). *Older Driver Skill Assessment and Resource Guide*.

American Automobile Association (1998). *Safe Driving for Mature Operators: Course Manual*. AAA Driver Improvement Program.

American Automobile Association (1997). *Older and Wiser Driver*. AAA Foundation for Traffic Safety.

American Automobile Association (1997). *The Disabled Driver's Mobility Guide*. AAA Traffic Safety, Heathrow, FL.

American Automobile Association. (1993). *Straight Talk for Older Drivers: Maintaining your Vehicle*.

American Automobile Association. (1992). *Straight Talk for Older Drivers: Good Vision...Vital to Good Driving*.

American Automobile Association. (1992). *Straight Talk for Older Drivers: Meeting the Challenge*.

American Automobile Association. (1992). *Straight Talk for Older Drivers: Rx for Safe Driving.*

American Automobile Association (undated). "Driver Test and Training Equipment." AAA Traffic Safety Division.

American Occupational Therapy Association (1998). "Standards for an Accredited Educational Program For the Occupational Therapist." Final Draft Revision from the Accreditation Council for Occupational Therapy Education of the American Occupational Therapy Association, Inc. www.aota.org.students/accred.html

American Occupational Therapy Association (1994a). "Uniform Terminology for Occupational Therapy (3rd ed.)." *American Journal of Occupational Therapy*, vol. 48, pp. 1047-1054.

American Occupational Therapy Association (1994b). "Definition of Occupational Therapy Practice for State Regulation." The AOTA Policy Manual, Policy 5.3.1.

American Occupational Therapy Association (1993). "Occupational Therapy Roles." *American Journal of Occupational Therapy*, 47, pp. 1087-1099.

American Occupational Therapy Association (undated). *Able Driving is Safe Driving: How Occupational Therapy Can Assist the Older Driver.*

American Optometric Association (1996). *Definition of Doctor of Optometry.* AOA VisionFax Information-on-Demand, Document #0002.

American Optometric Association (1996). *Fact Sheet: Vision Screening vs. Vision Examination.* AOA VisionFax Information-on-Demand, Document #0026.

Ball, K. and Owsley, C., (1991) "Identifying Correlates of Accident Involvement For The Older Driver." *Human Factors, 33(5)*, pp. 583-595.

Ball, K., Owsley, C., Sloane, M., Roenker, D., and Bruni, J. (1993). "Vision Attention Problems as a Predictor of Vehicle Crashes in Older Drivers." *Investigative Ophthalmology and Visual Science, 34(11)*, 3110-3123.

Ball, K., Owsley, C., Stalvey, B., Roenker, D.L., Sloane, M.E., and Graves, M. (1998). "Driving Avoidance and Functional Impairment in Older Drivers." *Accident Analysis and Prevention, 30(3)*, 313-322.

Bassior, J. (1998). "Sure, You'll Get Older. So What?" *Parade Magazine.* November 22, 1998. p. 20.

Bates, B. (1983). *A Guide to Physical Examination.* 3rd Ed. J.B. Lippincott Company: Philadelphia, PA.

Bogdonoff, S.M. (1997). "Driver Skill Enhancement (DSE): A Program for the Older Driver." Unpublished Paper.

Bogdonoff, S.M. (1998). "Driving Better, Safer, and Longer: The Driver Skill Enhancement Program." *The Older Learner.* Quarterly Newsletter of the Older Adult Education Network of the American Society on Aging, Vol 6(3), Summer, 1998.

Bowerman, D. (1998). "The Older Athlete: Exercise Will Keep You Healthier As You Age." *Health and Fitness Magazine*. November, 1998. p. 19-20.

Bracy, O.L. (1985). Cognitive Rehabilitation Programs for Head Injured, Learning Disabled and Stroke Patients (Foundations II). Psychological Software Services, Inc.: Indianapolis, IN.

Bracy, O.L. (1982). Cognitive Rehabilitation Programs for Brain-Injured and Stroke Patients (Foundations I). Psychological Software Services, Inc.: Indianapolis, IN.

Brenton, M. (1986). *The Older Person's Guide to Safe Driving*. Public Affairs Committee, Inc.

Brown, J., Greaney, K. Mitchel, J. and Lee, W.S. (1993). *Predicting Accidents and Insurance Claims among Older Drivers*. Research performed by ITT Hartford Insurance Group (Hartford CT) and AARP (Washington, DC); Available from ITT Hartford Insurance Group: Southington, CT.

Burg, A. (1966). "Visual Acuity as Measured by Dynamic and Static Tests." *Journal of Applied Psychology, 50(6)*, pp. 460-466.

Burg, A. (1967). *The Relationship Between Test Scores and Driving Record: General Findings*, Report 67-24 Los Angeles, Department of Engineering, University of California at Los Angeles, Department of Engineering, Los Angeles, CA.

Burg, A. (1968). *The Relationship Between Vision Test Scores and Driving Record: Additional Findings*. Publication 68-27, University of California at Los Angeles, Department of Engineering, Los Angeles, CA.

Burg, A. (1971). "Vision and Driving: A Report on Research." *Human Factors, 13*, pp. 79-87.
California Department of Motor Vehicles. (1992). *Tips you Can Give to a Mature Driver*.

Burt, M.R. (1993). Hunger Among the Elderly: Local and National Comparisons. Washington, DC: Urban Institute.

California Department of Motor Vehicles. (1990). Summary of Proceedings of the Conference on Driver Competency Assessment (CAL-DMV-RSS-91-132).

Cantor, M. (1995). *WayPoint Research Information Sheet*. WayPoint Research, Inc.: Atlanta, GA.

Capar, J. (1995). "Steering Toward Independence," *Daily Local News*, Chester County, PA: November 6.

Carr, D.B. (1998). "Driving and the Older Adult." In: *Care of the Elderly: Clinical Aspects of Aging* (ed. Gallo J.J.). 5th Edition. Baltimore: Williams & Wilkins.

Carr, D.B. (1993). "Assessing Older Drivers for Physical and Cognitive Impairment." *Geriatrics, 48* (5), 46-51.

Central Plains Area Agency on Aging (1996). *Tri-County Coordinated Senior Transportation Program: Final Report.*

Cobb, R.W. and Coughlin, J.F. (1997). "Regulating Older Drivers: How Are The States Coping?" *Journal of Aging and Social Policy*, 9(4), 71-87.

Coleman, S. (1994). "Rehabilitation of Elderly Drivers." In: *Licensing Older Drivers, Transportation Research Board Circular Number 429.*

Cooper, P.J., Tallman, K., Tuokko, H., and Beattie, B.L. (1993). "Vehicle Crash Involvement and Cognitive Deficit in Older Drivers." *Journal of Safety Research, 24,* 9-17.

Cushman, L (1992). *The Impact of Cognitive Decline and Dementia on Driving in Older Adults.* AAA Foundation for Traffic Safety: Washington, DC

Cushman, L. (1988). Unpublished pilot study data cited in: Cushman (1992), *The Impact of Cognitive Decline and Dementia on Driving in Older Adults.* AAA Foundation for Traffic Safety.

Davies, A. (1968). "The Influence of Age on Trail-Making Test Performance." *Journal of Clinical Psychology*, 24, 96-98.

Decina, L.E. and Staplin, L. (1993). "Retrospective Evaluation of Alternative Vision Screening Criteria for Older and Younger Drivers." *Accident Analysis and Prevention, 25*(3), 267-275.

Decina, L., Staplin, L, Gish, K., and Kirchner, A. (1996). *Feasibility of New Simulation Technology to Train Novice Drivers.* DTNH22-95-C-05104. National Highway Traffic Safety Administration.

Decina, L.E., Staplin, L., and Lococo, K. (1997). *Literature Review: Self Evaluation Guides/Materials for Older Drivers.* PennDOT Project No. 96-13.

Decina, L.E., Staplin, L., and Lococo, K. (1998). *Summary of Focus Group Discussions: "Self-Evaluation Guide and Tips for the Older Driver."* PennDOT Project No. 96-13.

Decina, L.E., Staplin, L., Lococo, K., and Hughlett, J. (in press). *Older Driver Self-Evaluation Guide*, PennDOT Project No. 96-13.

Decina, L. E., Staplin, L., and Spiegel, A., (1990). Correcting Unaware Vision Impaired Drivers. PennDOT, Bureau of Driver Licensing, 730009.

Diller, E., Cook, L., Leonard, D., Reading, J., Dean, J.M., and Vernon, D. (*in press*). *Evaluating Drivers with Medical Conditions in Utah, 1992-1996.* NHTSA Technical Report, Contract DTNH22-96-H-59017. *Preliminary Report, Utah CODES Project.*

Dobbs, A.R. (1997). "Evaluating the Driving Competence of Dementia Patients." *Alzheimer Disease and Associated Disorders, 11*, Supplement 1, 8-12.

Dobbs, B. (in press). "The Older Driver: Driving and Driving Cessation. Part II: Driving Cessation."

Drachman, D.A., and Swearer, J.M. (1995). *Screening for Dementia: The Cognitive Assessment Screening Test (CAST).*

DrivAble Testing, Ltd. (1997). *Evaluations for At-Risk Experienced Drivers*. Edmonton, Alberta, Canada.

Duchek, J.M., Hunt, L., Ball, K., Buckles, V., and Morris, J.C. (1997). "The Role of Selective Attention in Driving and Dementia of the Alzheimer Type." *Alzheimer Disease and Associated Disorders*, *11* (suppl. 1), 48-56.

Engel, G.R. (1991). "Implications of CDL Performance Test Development for Passenger Vehicle Driver Testing." In: *Summary of Proceedings of the Conference on Driver Competency Assessment*. Sacramento: California Department of Motor Vehicles.

Engel, G.R. and Townsend, M. (1984). *Commercial Driver Tractor Trailer Driving Ability Test Manual*. Ottawa, Ontario: Transport Canada.

Engum, E.S., Lambert, E.W., and Scott, K. (1990). "Criterion-Related Validity of the Cognitive Behavioral Driver's Inventory: Brain-Injured Patients Versus Normal Controls." *Cognitive Rehabilitation*, 8(2), 20-26.

Engum, E.S., Lambert, E.W., Scott, K., Pendergrass, T.M., and Womac, J. (1989). "Criterion-Related Validity of the Cognitive Behavioral Driver's Inventory." *Cognitive Rehabilitation*, *7*(4), 22-31.

Engum, E.S., Lambert, E.E., Womac, J., and Pendergrass, T.M. (1988). "Norms and Decision-Making Rules for the Cognitive Behavioral Driver's Inventory." *Cognitive Rehabilitation*, *6*(6), 12-18.

Engum, E.S., Pendergrass, T.M., Cron, L., Lambert, E.W., and Hulse, C.K. (1988). "The Cognitive Behavioral Driver's Inventory." *Cognitive Rehabilitation*, 6(5), 34-50.

Evans, D., Funkenstein, H., Albert, M., Scheer, P., Cook, N., Herbert, L., Hennekens, C., and Taylor, J. (1989). "Prevalence of Alzheimer's Disease in a Community Population of Older Persons". *Journal of the American Medical Association*, 262, 2551-2556.

Federal Highway Administration. (1997). "Moving Safely Across America." FHWA Offices of Highway Safety and Technology Applications and Avalon Integrated Services Corporation. (factsheet)

Fields, R. and Valtinson, G. (1998). "Assessment of Older Drivers: Neuropsychological Predictors and State Laws." *The Clinical Neuropsychologist*, 12, 270-71 (abstract).

Florida Department of Highway Safety and Motor Vehicles. (1987/1991/1993). *Florida Examiner's Manual* (Ch 11: Restrictions/Adaptive Equipment).

Foley, D.J., Wallace, R.B., and Eberhard, J. (1995). "Risk Factors for Motor Vehicle Crashes Among Older Drivers in a Rural Community." *Journal of the American Geriatrics Society*, 43(7), 776-781.

Folstein, M.F., Folstein, S., and McHugh, P.R. (1975). "The Mini-Mental State. A Practical Method for Grading the Cognitive States of Patients for the Clinician." *Journal of Psychiatric Research*, *12*, 189-198.

Freedman, M., Decina, L. E., & Knoebel, K. Y. (1986). *Analysis of Pennsylvania's Driver Re-examination Program*. Pennsylvania DOT, (PR 84-7).

Gebers, M. and Peck, R. (1992). "The Identification of High-Risk Older Drivers Through Age-Mediated Point Systems." *Journal of Safety Research, 23,* 81-93.

Gianutsos, R. (1994). "Elemental Simulator for Driving Advisement." *Behavior Research Methods, Instrumentation, and Computers*, *26*, 1-5.

Gianutsos, R. and Campbell, A. (1991). *Driving Advisement: Different Approaches Described and Evaluated*. Paper presented at the annual meeting of the American Occupational Therapy Association: Cincinnati, OH.

Gianutsos, R. and Campbell, A. (1988). *A Computer-Assisted Driving Advisement System (DAS) for Addressing Underlying Cognitive Skills Necessary for Safe Driving*. Paper presented at the annual meeting of the Association of Driver Educators for the Disabled: Louisville, KY.

Gianutsos, R., Campbell, A., Beattie, A., and Mandriota, F. (1992). "The Driving Advisement System: A Computer-Augmented Quasi-Simulation of the Cognitive Prerequisites for Resumption of Driving after Brain Injury". *Assistive Technology*, *4*(2), pp. 70-86.

Glynn, R.J., Seddon, J.M., Krug, J.H., Sahagian, C.R., Chiavelli, M.E., Campion, E.W. (1991). "Falls in Elderly Patients with Glaucoma." *Archives of Ophthalmology*, *109*, 205-210.

Goode, K.T., Ball, K.K., Sloane, M., Roenker, D.L., Roth, D.L., Myers, R.S., Owsley, C. (1998) "Useful Field of View and Other Neurocognitive Indicators of Crash Risk in Older Adults." *Journal of Clinical Psychology in Medical Settings*, 5: pp. 425-440.

Guralnik, J.M., Simonsick, E.M., Ferrucci, L., Glynn, R.J., Berkman, L.F., Blazer, D.G., Scherr, P.A., Wallace, R.B. (1994). "A Short Physical Performance Battery Assessing Lower Extremity Function: Association with Self-Reported Disability and Prediction of Mortality and Nursing Home Admission." *Journal of Gerontology*, *49*, M85-M94.

Gurgold, G.D. and Harden, D.H. (1978). "Assessing the Driving Potential of the Handicapped." *The American Journal of Occupational Therapy*, *32(1)*, pp. 41-46.

Gutman, G. and Milstein, S. (1988). *Focus Group Study of Older Drivers*. Gerontology Research Center, Simon Fraser University: Burnaby, B.C., Canada.

Hagge, R.A. (1994). *The California Driver Performance Evaluation Project: An Evaluation of a New Driver Licensing Road Test*. Report No. 150. Sacramento: California Department of Motor Vehicles.

Heaton, R., Grant, I. and Matthews, C. (1991). *Comprehensive Norms for an Expanded Halstead Reitan Battery: Demographic Corrections, Research Findings, and Clinical Applications*. Psychological Assessment Resources, Inc., Odessa, FL.

Heckmann, T. and Duke, L.F. (1997). *Driving Decisions for Seniors: A Practical Model of Elders Assisting One Another to Manage Their Own Mobility Choices*. Publication No. R&D-8649 General Motors Corporation, Research & Development Section. Warren, MI.

Hemmelgarn, B., Suissa, S., Huang, A., Boivin, J., and Pinard, G. (1997). "Benzodiazepine Use and the Risk of Motor Vehicle Crash in the Elderly." *Journal of the American Medical Association, 278*(1), 27-31.

Henderson, R.L. and Burg, A. (1974). *Vision and Audition in Driving*. Department of Transportation (DOT-HS-801-265).

Hennessy, D. (1995). *Vision Testing of Renewal Applicants: Crashes Predicted When Compensation for Impairment is Inadequate*. Publication No. RSS-95-152, California Department of Motor Vehicles.

Hills, B.L. and Burg, A. (1977). *A Reanalysis of California Driver Vision Data: General Findings*. University of California, Los Angeles, Transport and Road Research Laboratory, Crowthorne, England.

Hu, P.S., Trumble, D.A., Foley, D.J., and Eberhard, J.W. (Draft manuscript). *Vehicle Crashes Among Older Drivers: A Panel Data Analysis*. Phase II Report prepared for USDOT/NHTSA contract DTNH22-92-X-05475, "Establish the Crash Risk for Specified Medical/Functional Conditions."

Hu, P.S., Trumble, D.A., Foley, D.J., Eberhard, J.W., and Wallace, R.B. (1998). "Crash Risks of Older Drivers: A Panel Data Analysis." *Accident Analysis and Prevention, 30(5)*, 569-582.

Hu, P.S., Young, J.R., and Lu, A. (1993). *Highway Crash Rates and Age-related Driver Limitations: Literature Review and Evaluation of Data Bases*. ORNL/TM-12456. Oak Ridge National Laboratory, Oak Ridge, TN.

Hunt, L.A. (1996). "A Profile of Occupational Therapists as Driving Instructors and Evaluation for Elderly Drivers." *IATSS Research 20*(1), 46-47.

Hunt, L.A. (1994). "Driving and the Demented Person." in John C. Morris (ed). *Handbook of Dementing Illnesses*. Published by Marcel Dekker, Inc.

Hunt, L.A. (1991). "Dementia and Road Test Performance." Paper presented at the International Conference on Strategic Highway Research Program and Traffic Safety on Two Continents, Gothenburg, Sweden, September 18-20, In: *Proceedings of the Conference, Part 3*, Swedish Road and Traffic Research Institute.

Hunt, L.A. (1990). "The Role of the Occupational Therapist" Paper presented at the Conference on Driver Competency Assessment. San Diego, CA, October 24-26.

Hunt, L.A., Morris, J., Edwards, D., and Wilson, B. (1993). "Driving Performance in Persons with Mild Senile Dementia of the Alzheimer Type." *Journal of the American Geriatrics Society*, *41*(7), 747-753.

Hunt, L.A., Murphy, C.F., Carr, D., Duchek, J.M., Buckles, V., and Morris, J.C. (1997a). "Reliability of the Washington University Road Test: A Performance-Based Assessment for Drivers with Dementia of the Alzheimer Type." *Archives of Neurology*, *54*, 707-712.

Hunt, L.A., Murphy, C.F., Carr, D., Duchek, J.M., Buckles, V., and Morris, J.C. (1997b). "Environmental Cueing May Affect Performance on a Road Test for Drivers with Dementia of the Alzheimer Type." *Alzheimer Disease and Associated Disorders, 11* (suppl. 1), 13-16.

Hunt, L. and Weston, K. (in press). "Assessment of Driving Capacity." In P. Lichtenberg (Ed.), Handbook of Geriatric Assessment, Chapter 21.

Hunter-Zaworski, K. (1990). "T-Intersection Simulator Performance of Drivers with Physical Limitations." *Transportation Research Record, 1281*, 11-15.

Illinois Retired Teachers Association, Inc. (1990). "*Report of the Driver Safety Advisory Committee.*" Submitted to the Secretary of State (Jim Edgar). Springfield, IL.

Janke, M. (1994). *Age-Related Disabilities That May Impair Driving and Their Assessment*. Cooperative agreement between USDOT/NHTSA and CA DMV, Contract No. DTNH22-93-Y-5330. CA DMV Publication No. RSS-94-156. Sacramento, California.

Janke, M. And Eberhard, J. (1998). "Assessing Medically Impaired Older Drivers in a Licensing-Agency Setting." *Accident Analysis and Prevention, 30(3)*, 347-361.

Janke, M and Hersch, S.W. (1997). *Assessing the Older Driver: Pilot Studies*. Cooperative agreement between USDOT/NHTSA and CA DMV, Contract No. DTNH22-93-Y-5330. CA DMV Publication No. RSS-97-172. Sacramento, California.

Johansson, K.J. (1997). *Older Automobile Drivers: Medical Aspects*. Doctoral Dissertation, Karolinska Institute: Stockholm, Sweden.

Johansson, K., Bronge, L., Lundberg, C., Persson, Seideman, M., and Viitanen, M. (1996). "Can a Physician Recognize an Older Driver with Increased Crash Potential?" *Journal of the American Geriatrics Society, 44*, 1198-1204.

Jones, M.H. (1978). *Safe Performance Curriculum: Performance Measures Development. Final Report*. Los Angeles: University of Southern California.

Katzman, R., Brown, T., Fuld, P., Peck, A,. Schechter, R., and Schimmel, H. (1983). "Validation of a Short Orientation-Memory-Concentration Test of Cognitive Impairment." *American Journal of Psychiatry, 140*, 734-739.

Keyl, P.M., Rebok, G.W., Bylsma, F.W., Turn, L. Brandt, J., Teret, S., Chase, G.A., and Sterns, H.L. (under review) . "Cognitive Function, Driving Simulator Performance, and Crash History in Alzheimer's Disease Patients and Elderly Controls."

Klavora, P., Gaskovski, P., Heslegrave, R.J., Quinn, R.P. and Young, M. (1995). "Rehabilitation of Visual Skills Using the Dynavision: A Single Case Experimental Study." *Canadian Journal of Occupational Therapy*, *62*(1), 37-43.

Klavora, P., Gaskovski, P, Martin, K., Forsyth, R.D., Heslegrave, R.J., Young, M., and Quinn, R.P. (1995). "The Effect of Dynavision Rehabilitation on Behind-The-Wheel Driving Ability and Selected

Psychomotor Abilities of Persons Post-Stroke." *American Journal of Occupational Therapy*, *49*(6), 534-542.

Klavora, P., Heslegrave, R.J., and Young, M. (1997). "Assessment of Driving Skills of Persons Poststroke." In *Proceedings of the Canadian Multidisciplinary Road Safety Conference X. Rherson Polytechnic University*, Toronto, Ontario, 255-264.

Klavora, P. and Warren, M. (1998). "Rehabilitation of Visuomotor Skills in Poststroke Patients Using the Dynavision Apparatus." *Perceptual and Motor Skills*, *86*, 23-30.

Klavora, P., Warren, M., and Leung, M. (undated). *Dynavision for Rehabilitation of Visual and Motor Deficits: A User's Guide*. Published by visABILITIES Rehab Services, Inc., 12008 W. 87th Street, Suite 349, Lenexa, KS 66215.

Koepsell, T.D., Wolf, M.E., McCloskey, L., Buchner, D.M., and Louie, D. (1994). "Medical Conditions and Motor Vehicle Collision Injuries in Older Adults." *Journal of the American Geriatrics Society*, 42(7), 695-700.

Kokmen, E., Bossemeyer, R.W., and Williams, W.J. (1978). "Quantitative Evaluation of Joint Motion Sensation in an Aging Population." *Journal of Gerontology*, *33(1)*, pp. 62-67.

Lange, J.E., and McKnight, A.J. (1996) "Age-Based Road Testing Policy Evaluation." *Transportation Research Record*, 1550, pp. 81-87.

Laux, L. and Brelsford, J. (1990). *Age-Related Changes in Sensory, Cognitive, Psychomotor and Physical Functioning and Driving Performance in Drivers Aged 40 to 92.* AAA Foundation for Traffic Safety, Washington, DC.

LePore, P. (1998). *Survey of Families and Caregivers Concerned about the Safety of an Older Driver.* New York State Office for the Aging.

Lindal, E. and Stefansson, J. G. (1993). "Mini-Mental State Examination Scores: Gender and Lifetime Psychiatric Disorders." *Psychological Reports, 72*, 631-641.

Liu, L. and Miyazaki, M. (in press). "Preliminary Data on the Norms and Validity of the driVR for Use with Brain-Injured Persons."

Lorek, L. (October 15, 1998). "Many Sites for Seniors on Web." *Sun Sentinel, South Florida*. p 43.

Lundberg, C., Johansson, K., Ball, K., Bjerre, B., Blomqvist, C., Braekhus, A., Brouwer, W.H., Bylsma, F.W., Carr, D.B., Englund, L., Friedland, R.P., Hakamies-Blomqvist, L., Klemetz, G., O'Neill, D., Odenheimer, G., Rizzo, M., Schelin, M., Seideman, M., Tallman, K., Viitanen, M., Waller, P., and Winblad, B. (1997). "Dementia and Driving: An Attempt at Consensus." *Alzheimer Disease and Associated Disorders*, *11*(1), 28-37.

Mader, J. (1994). "When do Driving Skills of the Elderly Become Impaired?" *Circleville (OH) Herald*, Jan. 27.

Malfetti, J.L. and Winter, D.J. (1991). *Concerned About an Older Driver? A Guide for Family and Friends*. AAA Foundation for Traffic Safety.

Malfetti, J.L. & Winter, D. J. (1987). *Safe and Unsafe Performance of Older Drivers: A Descriptive Study*. AAA Foundation for Traffic Safety.

Marottoli, R.A. (1993). "Driving Safety in Elderly Individuals." *Connecticut Medicine*, 57(5), 277-280.

Marottoli, R.A., Cooney, L.M., Wagner, D.R., Doucette, J., and Tinetti, M.E. (1994). "Predictors of Automobile Crashes and Moving Violations Among Elderly Drivers." *Annals of Internal Medicine, 121*, 842-846.

Marottoli, R. and Drickamer, M. (1993). "Psychomotor Mobility and The Elderly Driver." *Clinics in Geriatric Medicine, 9*, 403-411.

Marottoli, R.A., Mendes de Leon, C.F., Glass, T.A., et al. (1997). "Driving Cessation and Increased Depressive Symptoms: Prospective Evidence from the New Haven EPESE." *Journal of the American Geriatric Society, 45*, 202-206.

Marottoli, R.A. and Richardson, E.D. (1998). "Confidence In, and Self-Rating Of, Driving Ability Among Older Drivers." *Accident Analysis and Prevention*, Vol 30(3), pp. 331-336.

Marottoli, R.A., Richardson, E.D., Stowe, M.H., Miller, E.G., Brass, L.M., Cooney, L.M., and Tinetti, M.E. (1998). "Development of a Test Battery to Identify Older Drivers at Risk for Self-Reported Adverse Driving Events." *Journal of the American Geriatrics Society*, 46(5), 560-568.

Maryland Motor Vehicle Administration. (1997). *Maryland's Guide for Drivers Over 55*.

Massie, D. L. and Campbell, K. L. (1993). Analysis of Accident Rates by Age, Gender, and Time of Day Based on the 1990 Nationwide Personal Transportation Survey. Publication No. UMTRI-93-7. Insurance Institute for Highway Safety.

Massie, D.L., Campbell, K.L., and Williams, A.F. (1995). "Traffic Accident Involvement Rates by Driver Age and Gender." *Accident Analysis and Prevention*, 27(1), pp. 73-87.

Mathias, R.G. and Stoffle, B. (1998). *Use of Electric Golf Carts as Alternative Transport for Senior Citizens, Persons with Disabilities, and Others*. Prepared for 8th International Conference on Mobility and Transport for Elderly & Disabled People, Perth, Australia, September 1998.

Mattis, S. (1976). "Mental Status Examination for Organic Mental Syndrome in the Elderly Patient." In: L. Bella and T.B. Karusu (Eds.) *Geriatric Psychiatry* (Second Edition). New York: Oxford University Press.

MAVIS (1998). *Driving Ability Assessment*. Mobility Advice and Vehicle Information Service, Department of the Environment, Transport and the Regions, Crowthorne, Berkshire, England.

McCloskey, L.W., Koepsell, T.D., Wolf, M.E., and Buchner, D.M. (1994). "Motor Vehicle Collision Injuries and Sensory Impairments of Older Drivers." *Age and Aging*, 23(4), 267-273.

McEwan, K.L. (1997). *A Review of the Medical Review Program, Motor Vehicle Branch.*

McKnight, A.J. and Adams, B.B. (1970). *Driver Education Task Analysis, Volume 1: Task Descriptions*. Human Resources Research Organization, Alexandria, VA.

McKnight, A.J. and McKnight, A.S. (Accepted for publication, 1998). "Multivariate Analysis of Age-Related Driver Ability Deficits". *Accident Analysis and Prevention.*

McKnight, A.J., Simmone, G.A., and Weidman, J.R. (1982). *Elderly Driver Retraining*. National Public Service Institute, NHTSA (DOT-HS-806 336).

McKnight, A.J. and Stewart, M.A. (1990). *Development of a Competency Based Driver Licensing Testing System.* National Public Services Research Institute. Prepared under contract to California Department of Motor Vehicles.

McKnight, A.J. and Urquijo, J. I. (1993). "Signs of Deficiency Among Elderly Drivers." *Transportation Research Record, 1405.*

McPherson, K. and McKnight, A.J. (1981). *Automobile Driver On-Road Performance Test, Volume I: Final Report*. National Highway Traffic Safety Administration. Publication No. DOT-HS-806-207.

McPherson, K., Ostrow, A.C., and Shaffron, P. (1988). *Physical Fitness and The Aging Driver, Phase I.* AAA Foundation for Traffic Safety, Falls Church, VA.

McPherson, K., Ostrow, A.C., and Shaffron, P. (1989). *Physical Fitness and the Aging Driver-Phase II*, AAA Foundation for Traffic Safety: Falls Church, VA.

Medgyesi, M., and Koch, D. (1994) *Medical Impairments to Driving*. Unpublished manuscript. Saskatchewan Government Institute.

National Center for Health Statistics. (1989). Vital and Health Statistics: Current Estimates from the National Health Interview Survey, 1988, 10, MD.

National Highway Traffic Safety Administration. (1998). "The Traffic Safety Box." NHTSA Impaired Driving Division, ComTel Productions, Inc. (factsheet)

National Highway Traffic Safety Administration (1992). *Model Driver Screening & Evaluation Program.*

National Highway Traffic Safety Administration.(1980). *Functional Aspects of Driver Impairment: A Guide for State Medical Advisory Boards*. U.S.DOT/NHTSA in cooperation with American Association of Motor Vehicle Administrators. Publication No. DOT HS 805 460.

Nevada Office of Traffic Safety. (undated) *Tips to Help Older Drivers Ease on Down the Road: Alcohol. and Medications.*

Nevada Office of Traffic Safety. (undated) *Tips to Help Older Drivers Ease on Down the Road: Safety Belts.*

Nevada Office of Traffic Safety. (undated) *Tips to Help Older Drivers Ease on Down the Road: Vision.*

Odenheimer, G.L., Beaudet, M., Jette, A.M., Albert, M.S., Grande, L., and Minaker, K.L. (1994). "Performance-Based Driving Evaluation of the Elderly Driver: Safety, Reliability, and Validity." *Journal of Gerontology /Medical Sciences*, *4*, M153-M159.

O'Shea, M. (1998). "Parade's Guide to Better Fitness: If You Have a Bum Knee or Arthritis, All You Need to Work out Is a Chair." *Parade Magazine*. May 17, 1998. p. 23.

O'Shea, M. (1998). "Parade's Guide to Better Fitness: Most Falls Can Be Prevented and Injuries Can Be Minimized" *Parade Magazine*. September 6, 1998. p. 15.

Ostrow, A.C., Shaffron, P., and McPherson, K. (1992). "The Effects of a Joint Range-of-Motion Physical Fitness Training Program on the Automobile Driving Skills of Older Adults." *Journal of Safety Research. 23(4)*, pp. 207-219.

Ottolenghi-Barga, C. (1993). "Older Driver Testing is Ticket to Mobility." *Business First*, May 3, p. 1.

Owsley, C., Ball, K., McGwin, G., Jr., Sloane, M.E., Roenker, D.L., White, M.F., Overley, E.T. (1998). "Visual Processing Impairment and Risk of Motor Vehicle Crash Among Older Adults." *Journal of the American Medical Association*, 279: pp.1083-1088.

Owsley, C., Ball, K., Sloane, M., Roenker, D., and Bruni., J. (1991). "Visual/Cognitive Correlates of Vehicle Accidents in Older Drivers." *Psychology and Aging*, *6(3)*, 403-415.

Owsley, C., McGwin, G., and Ball, K. (1998). "Vision Impairment, Eye Disease, and Injurious Motor Vehicle Crashes in the Elderly." *Ophthalmic Epidemiology,* 5(2), pp. 101-113.

Owsley, C., Stalvey, B., Wells, J., and Sloane, M.E. (1999). "Older Drivers and Cataract: Driving Habits and Crash Risk." *Journal of Gerontology: Medical Sciences*, 54A: M203-M211.

Packard, Stuart, and Associates. (1998). *Evaluation of the 1998 Mature Driver Retraining Workshop Program.*

Pennsylvania Department of Aging. (undated). *Getting Older...And Going Places: Benefits for Older Drivers & Older Riders.*

Pennsylvania Department of Transportation. (undated). *PA Special Point Examination Driver's Handbook.*

Pennsylvania State University, Milton S. Hershey Medical Center. (undated) *Vehicle Selection Guidelines.*

Persson, D. (1993). "The Elderly Driver: Deciding when to Stop." *Gerontologist, 33*, 88-91.

Petrucelli, E. and Malinowski, M. (1992). *Status of Medical Review in Driver Licensing: Policies, Programs, and Standards.* NHTSA (DOT HS 807 892).

Piscopo, J. (1981). "Aging and Human Performance." In: *Exercise, Science, and Fitness*. E.J. Burke (Eds.), Ithaca, NY.

Platt, F. N. (1996). *Going on 80: Tune up your Driving Skills.*

Ponza M, Ohls JC, Millen BE (1996). Serving Elders at Risk: The Older Americans Act Nutrition Programs, National Evaluation of the Elderly Nutrition Program, 1993-1995. Washington, DC: Mathematica on Policy Research, Inc; 1996.

Ranney, T.A. (in press). "Good Driving Skills: Implications for Assessment and Training."

Ranney, T.A. and Hunt (1997). "Researchers and Occupational Therapists Can help Each other to Better Understand What Makes a Good Driver: Two Perspectives." *Work 8*, 293-297.

Ranney, T.A. and Pulling, N.H. (1990). "Performance Difference On Driving and Laboratory Tasks Between Drivers of Different Ages." *Transportation Research Record 1281.*

Recer, P. (1998). "Alzheimer's Screening Test Developed." *The Morning Call*, March 13.

Richardson, E.D., and Marottoli, R.A. (1996). "Education-Specific Normative Data on Common Neuropsychological Indices for Individuals Older Than 75 Years." *The Clinical Neuropsychologist*, Vol 10 (4), pp. 375-381.

Rizzo, M., Reinach, S., McGehee, D., and Dawson, J. (1997). "Simulated Car Crashes and Crash Predictors in Drivers with Alzheimer Disease." *Archives of Neurology*, *54*, 545-551.

Rizzo, M. and Dingus, T. (1996). "Driving in Neurological Disease." *The Neurologist*. 150-168.

Rock, (1998). " Impact From Changes in Illinois Drivers License Renewal Requirements for Older Drivers" *Accident Analysis and Prevention*, *30*, 69-74.

Roenker, D.L., Cissell, G.L., and Ball, K. (Submitted). "The Effects of Useful Field of View Training on Driving Performance." Submitted to *Psychology and Aging*.

Romanowicz, P.A. and Hagge, R.A. (1995). *An Evaluation of the Validity of California's Driving Performance Evaluation Road Test*. Research & Development Section, Division of Program & Policy Administration, California Department of Motor Vehicles Publication No. Rss-95-154.

Reuben, D. (1993). "Assessment of Older Drivers." *Clinics in Geriatric Medicine*, *9*, 449-459.

Sabo, S. and Shipp, M. (1989). *Disabilities and Their Implications for Driving*. Louisiana Tech University, Center for Rehabilitation Science and Biomedical Engineering.

Salzberg, P. and Moffat, J. (1998). *The Washington State Department of Licensing Special Exam Program: An Evaluation*. Washington Traffic Safety Commission. Olympia, WA.

Schiff, W. and Oldak, R. (1993) *Functional Screening of Older Drivers Using Interactive Computer-video Scenarios*. Washington, DC, AAA Foundation for Traffic Safety.

Schultheis, M.T. and Chute, D.L. (1998). "Development of a Computerized Ecologically Valid Driving Program: The Neurocognitive Driving Test." UMI Dissertation Services, 300 N. Zeeb Road, Ann Arbor, MI 48106.

Serfass, R.C. (1980). "Physical Exercise and the Elderly." In: *Encyclopedia of Physical Education, Fitness, and Sports: Training, Environment, Nutrition, and Fitness*. G.A. Stull, (Eds.), Salt Lake City, UT.

Shinar, D., Mayer, RM, and Treat, J.R. (1975). "Reliability and Validity Assessment of a Newly Developed Battery of Driving Related Vision Tests." *American Association for Automotive Medicine Conference Proceedings.*

Shinar, D, McDowell, E.D., and Rockwell, T.H. (1977). "Eye Movements in Curve Negotiation." *Human Factors, 19(1)*, pp. 63-71

Shipp, M.D. (1998). "Potential Human and Economic Cost-Savings Attributable to Vision Testing Policies for Driver License Renewal, 1989-1991." *Optometry and Vision Science, 75*, 103-118.

Sims, R.V., Owsley, C., Allman, R.M., Ball, K., Smoot, T.M. (1998). "Medical and Functional Factors Associated with Vehicle Crashes in Older Adults." *Journal of the American Geriatric Society*, 46: pp. 556-561.

Smith, M.F. (1994). *Research Agenda for an Improved Novice Driver Education Program*, NHTSA.

Solomon, P.R., Hirschoff, A., Kelly, B., Relin, M., Brush, M., DeVeaux, R.D., and Pendlebury, W.W. (1998). "A 7 Minute Neurocognitive Screening Battery Highly Sensitive to Alzheimer's Disease. *Archives of Neurology, 55*, 349-355.

South Carolina Dept. of Highways and Public Transportation, SC Commission on Aging. (undated). *Mature Driving: Some Serious Thoughts for Older Drivers.*

Staplin, L., Ball, K., Park, D., Decina, L., Lococo, K., Gish, K., and Kotwal, B. (1997). *Synthesis of Human Factors Research on Older Drivers and Highway Safety, Volume I: Older Driver Research Synthesis*. USDOT/FHWA Publication No. FHWA-RD-97-094. Washington, DC.

Staplin, L., Gish, K.W., Decina, L.E., Lococo, K., and McKnight, A.S. (1998). *Intersection Negotiation Problems of Older Drivers, Volume I: Final Technical Report*. USDOT/NHTSA Contract No. DTNH22-93-C-05237. Washington, DC.

Staplin, L. and Lococo, K., (1998). *AAMVA/NHTSA Survey of United States and Canadian Provinces: Feasibility of Driver Screening Activities.*

Staplin, L., Lococo, K., McKnight, A.J., McKnight, A.S., and Odenheimer, G. (in press). *Intersection Negotiation Problems of Older Drivers, Volume II: Background Synthesis on Age and Intersection Driving Difficulties*. USDOT/NHTSA Contract no. DTNH22-93-C-05237. Washington, DC.

Sterns, H.L., Sterns, R., Aizenberg, R., and Anapolle, J. (1997). *Family and Friends Concerned About an Older Driver. Final Non-Technical Report*. USDOT/NHTSA Contract no. 22-95-C-05162.

Stewart, R.B., Moore, M.T., Marks, R.G., May, F.E., and Hale, W.E. (1993). *Driving Cessation and Accidents in the Elderly: An Analysis of Symptoms, Diseases, Cognitive Dysfunction and Medications*. AAA Foundation for Traffic Safety.

Stutts, J.C. (1998). "Do Older Drivers with Visual and Cognitive Impairments Drive Less?" *Journal of the American Geriatric Society, 46*, 854-861.

Stutts, J.C., Stewart, J.R., and Martell, C.M. (1998). "Cognitive Test Performance and Crash Risk in an Older Driver Population." *Accident Analysis and Prevention, 30(3), 337-346.*

Stutts, J.C., Stewart, J.R., and Martell, C.M. (1996). *Can Screening for Cognitive Impairment at License Renewal Identify High Risk Older Drivers*? Paper Presented at the 40th Annual Proceedings of the Association for the Advancement of Automotive Medicine, October 7-9, 1996. Vancouver, British Columbia.

Stutts, J.C., Wilkins, J.W., and Schatz, S. (submitted). "The Decision to Stop Driving: Results of Focus Groups with Seniors and Family Members." Submitted to the Transportation Research Board.

Szlyk, J. P., Brigell, M., and Seiple, W. (1993). "Effects of Age and Hemianopic Visual Field Loss on Driving." *Optometry and Vision Science*, *70*, 1031-1037.

Tallman, K. Tuokko, H., and Beattie, B. (1993). *Driving Performance in the Cognitively Impaired Elderly*. Final Report. NHRDP Project No. 6610-1759, Health and Welfare Canada.

Tarawneh, M.S., McCoy, P.T., Bishu, R.R., and Ballard, J.L. (1993). "Factors Associated with Driving Performance of Older Drivers." *Transportation Research Record, 1405*, 64-71.

Terhune, C. (1998). "USAA to Unveil Taxi Plan to Get Elderly Off the Road." *The Wall Street Journal*, Texas Edition, May 13.

Texas Medical Association/Texas DOT. (1991). *The Physician, the Older Patient, and Driving Safety: A Physician's Guide.*

Transport Canada. (1986). *Vehicles and Adaptive Aids for Elderly and Disabled Drivers: A Buyer's Guide*. Produced by les Communications, MVM, Inc. Montreal.

Underwood, M. (1992). "The Older Driver. Clinical Assessment and Injury Prevention." *Archives of Internal Medicine*, *152*, 735-740.

USAA. (1990). *Adaptive Driving: Safe at any Age.*

USAA. (1992). *Helpful Tips to Reduce your Risks while Driving.*

Vanosdall, F.E. and Rudisill, M.D. (1979). "The New Michigan Driver Performance Test." *Proceedings of the American Association for Automotive Medicine*, October: Louisville, KY.

Wallace, R.B., Russell, D.W., Cutrona, C.E., and de la Mora, A. (1998). "Loneliness and Nursing Home Admission Among Rural Older Adults." *Psychology and Aging*, *12*(4), 574-589.

Weaver, P. and Robinett, G. (1994). *Auxiliary Transportation Systems: Linking Rural and Urban Services for the Elderly*. University of Kansas Transportation Center, Lawrence, KS.

Wechsler, D. (1987). *The Wechsler Memory Scale - Revised*. New York: The Psychological Corporation.

Wilkins, J.W., Stutts, J.C., and Schatz, S. (1999). "Premature Reduction and Cessation of Driving: Preliminary Study of Women Who Choose Not to Drive or to Drive Infrequently." *Transportation Research Record*, 1693, pp 86-90.

Wisconsin Department of Transportation. (1990). *Wisconsin Examiner's Manual*, Section 350: Restrictions for Physical Disabilities.

Zimmerer, L. (in press). *Older Drivers: Cues for Law Enforcement*. NHTSA.

-------(1998). "Checkups: Are you getting what you need?" *Consumer Reports*, August, 1998, 17-19.

-------(1998). On the Road Again." *OT Week*.

II. ANNOTATED RESEARCH COMPENDIUM OF DRIVER ASSESSMENT TECHNIQUES FOR AGE-RELATED FUNCTIONAL IMPAIRMENTS

This section of the *Notebook* provides backup for the preliminary conclusions and recommendations presented in the earlier, topic area discussions relating to assessment tools and risk factors. Studies included in this section were selected on the basis of two criteria: (1) the inclusion of older drivers in the study sample; and (2) the use of crash data—or driver performance measures accepted as surrogates for crash data—as the outcome variables. For each study cited, the study's authors and study location are identified; and a summary of the study methodology and an overview of key findings are presented.

Material in the Research Compendium is organized according to type of functional test:

A. Vision
B. Attention/Perception/Cognition
C. Physical Capabilities
D. Multiple Factors
E. On-Road Dependent Measures of Safe Driving Performance

Tabs are provided at this level of organization to help locate information in the Compendium. Each tabbed page then presents a more detailed list of topics and subtopics covered in this section.

II.A. VISION

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1. Static Acuity

(a) *MultiCAD*
(b) Rosenbaum Card
(c) Snellen E Chart
(d) Snellen E (Computerized Presentation)
(e) Snellen Letter Chart (Modified)

2. Dynamic Acuity

(a) *MultiCAD*
(b) Snellen E (Computerized Presentation)

3. Static Contrast Sensitivity

(a) *MultiCAD*
(b) Pelli-Robson Test of Low Contrast Acuity
(c) Smith-Kettlewell Low Luminance Card (SKILL)
(d) Vistech Contrast Sensitivity Gratings/Optec 1000

4. Static Contrast Sensitivty/Glare

(a) Berkeley Glare Tester

5. Dynamic Contrast Sensitivity

(a) *MultiCAD*

6. Peripheral Visual Fields

(a) Goldman Perimeter
(b) Manually Operated Perimeter

7. Eye Disease

(a) Cataracts
(b) Diabetic Retinopathy
(c) Glaucoma

8. Multiple Visual Capabilities

(a) Keystone Telebinocular Testing Device
(b) Sight Screener II

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Acuity: *MultiCAD*	82 "referred" subjects aged 60-91 (26 of which were identified as probably being cognitively impaired to some degree). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment.	This test used *MultiCAD* to measure drivers' ability to resolve fine detail on a stationary target under high contrast conditions. The subject was shown a driver's eye view of travel along a suburban arterial, approaching and then stopping at an intersection with a traffic signal in plain view. The image centered and then zoomed on the signal until it filled the screen, while the subject was instructed to use the 3-button response pad to identify which face on the (conventional, 3-face) signal looked different than the other two. Instead of solid red, yellow, and green circles, however, the signal faces contained acuity test stimuli. Square wave gratings with vertical bars were used, such that one signal face contained a high contrast test stimulus (90% contrast) and the other two faces showed a uniform luminance (without bars). The ability to discriminate which two signal faces are were"blank" versus which one contained the vertical bars defined the subject's static acuity level. Three levels of testing were conducted--20/40 (15 cycles per degree), 20/80 (7.5 cycles per degree), and 20/200 (3 cycles per degree)--with a pass/fail score assigned at each level. A passing score was defined as at least 2 correct responses out of the 3 presentations for each level tested. Mean response time was also calculated for correct responses at each level. Three replications of each measurement were performed. Scoring was also conducted on a "gross" level across all stimulus characteristics. Average response time and average error score were calculated across all 9 trials. Multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance (weighted error score) on a standard DMV road test (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium), and comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance.	California DMV Field Office	•Correlation between gross static acuity errors and weighted errors on driving test was not significant ($r=.0983$, $p<.395$) •Correlation between gross static acuity time and weighted error score on road test was significant ($r=.3519$, $p<.002$) •Correlations between static acuity score (20/20, 20/80, and 20/200) and weighted errors on driving test were not significant. •Correlations between static acuity *time* at each level of acuity and weighted error scores on driving exam were as follows: 20/40 time: $r=.3395$ ($p<.004$) 20/80 time: $r=.4230$ ($p<.000$) 20/200 time: $r=.1970$ ($p<.090$) •Neither gross or precise scoring of static acuity accuracy or time differentiated between cognitively impaired and cognitively unimpaired referral subjects. •Using the precise MultiCAD measures a multiple linear regression model using knowledge test score, Auto Trails time, Doron Cue Recognition 2 score, MultiCAD Static Contrast Sensitivity time with the high contrast 20/80 target, and MultiCAD Static Acuity time for correct responses at 20/80 accounted for 56.4% of the variance in performance on the road test (weighted road test error score). •Using gross MultiCAD measures, a model including knowledge test score, Auto Trails time, Doron Cue Recognition 2 score, MultiCAD static acuity time, and MultiCAD static contrast sensitivity time accounted for 47.7% of the variance in performance on the road test (weighted road test error score).	Janke & Eberhard (1998) Staplin, Gish, Decina, Lococo, and McKnight (*in press*)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Acuity: **Rosenbaum Card**	283 community-dwelling individuals age 72 to 92 (mean age = 77.8) from the Project Safety cohort living in New Haven, CT who drove between 1990 and 1991. 57% were males.	Rosenbaum Card was used to measure corrected static near visual acuity. Performance was measured as 20/40 or better vs worse than 20/40 The outcome variable was self-reported involvement in automobile crashes, moving violations, or being stopped by police in the year following administration of the test battery.	New Haven, CT. Subjects were interviewed and given the assessments in their homes by a trained research nurse.	The occurrence of adverse events did not substantially differ between persons with better than 20/40 (13% had adverse events) or worse than 20/40 (14% had adverse events) near static visual acuity.	Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Acuity: **•Snellen E Chart** **•Snellen E (Computerized Presentation)**	Matched pair case-control study, with close (1 year) age matching conducted in Sweden • 37 drivers age 65+ (mean age 75.5) with temporarily-suspended licenses due to crashes (23 drivers) or other moving violations (14 drivers). Moving violations were: speeding (2), running stop sign (4), running red light (4) run off the road (4). Mean distance driven/yr = 12000 km; # males = 30, # females = 7 • 37 matched controls age 65+ (mean age 74.8) with no license suspensions within the past 5 yrs; mean # miles driven = 9200 km; # males = 30, # females = 7	Static Visual Acuity was measured with a standard letter chart (SVA:L) at a distance of 4 m, and was measured as the smallest row of 10 letters read binocularly with no errors. Static Visual Acuity was also measured using Snellen E's (SVA:E), using a (PC) computerized system including a slide projector which projected the optotypes on a white screen using first-surface mirrors. Luminance of E's was 85 cd/m^2, background was 195 cd/m^2, and contrast was 0.39. Snellen E's were shown in any of 4 possible directions (up right, up left, down right, down left), and subject responded by pressing corresponding orientation printed on a button on the response box. Each E was shown for 6 s. A logarithmic scale was used with the different object sizes (equivalent to Snellen acuity) of 0.10 (10 min of arc), 0.13, 0.16, 0.20, 0.25, 0.32, 0.50, 0.63, 0.79, 1.0, 1.3, and 1.6. SVA:E was measured with 3 randomly chosen directions on each size of the target, starting at 0.10, and increasing stepwise. A pass was a correct response on all 3 readings of a particular size. Two trials on each acuity size were allowed. The SVA:E was measured with non-moving optotypes (mirror remained still). Subjects were also given the Trail Making Test (Part A), the Mini Mental Status Examination, and a cube copying task . **FINDINGS (Cont'd)** • Correlation between drop in acuity from SVA:L to SVA:E and scores on the cube copy test were significant ($p<0.002$). • Using a decrease in acuity of more than 2 steps from SVA:L to SVA:E as a cut-off limit, the ability to detect drivers with crashes had a low sensitivity (21%) but a specificity of 98%. • Drivers with conspicuously low results on the SVA:E were cognitively impaired, which implies, according to the authors, that acuity testing with Snellen E's (or Landolt C's perhaps), might also be a simple test for identifying persons with moderate cognitive impairment and subsequent increased crash risk.	Hospital clinic (Unit of Traffic Medicine, Section of Geriatric Medicine, Department of Clinical Neuroscience & Family Medicine, Karolinska Institutet, Stockholm, Sweden)	• No differences between cases and controls with respect to Static Visual Acuity measured with the standard letter chart (SVA:L). Mean SVA:L for case group = 0.79, and for controls = 1.0. Also, no differences between cases with crashes and their controls or cases with violations and their controls. • No significant differences between all cases (across crashes and violations) and controls in visual acuity measured with automated Snellen E test (SVA:E). • 3 drivers with crashes performed well on SVA:L (acuities of 0.60, 0.80, and 1.0) but performed very poorly ($\leq$0.10) on SVA:E. These drivers (ages 72, 76, 78) showed cognitive impairment on the Mini Mental Status Exam (scores of 24, 27, and 20), and clinical dementia ratings (CDR) of questionable dementia (2 drivers) and mild (1 driver) dementia. None of them were able to copy a cube design. Psychomotor speed (Trails A) was low (79, 90, and 388 s) compared to controls. One fulfilled DSM IV criteria for dementia, the other 2 were suspected of having a dementing disease. • Visual performance of drivers with crashes measured with SVA:E was significantly lower than that of controls ($p=0.017$), but removal of above 3 drivers reduced the difference to a tendency ($p=0.087$). In violation group, there was no difference in SVA:E between cases and controls).	Johansson, Seideman, Kristoffersson, Lundberg, Lennerstrand, Hedin, and Viitanen (*submitted*) Johansson (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Acuity: **Snellen Letter Chart (Modified)**	• 102 "referred" subjects aged 60-91 (34 of which were identified as probably being cognitively impaired to some degree). 47% of the noncognitively impaired referred drivers had visual impairment noted on their record, and 24% of the cognitively impaired had a visual disability noted). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment. • 33 paid "volunteers" aged 56-85, recruited through signs posted at study site or word of mouth.	Chart contained 5 lines of letters at 20/40 size, viewed at a distance of 6 m. Snellen errors and Snellen failures were measured. Three tiers of analyses were conducted in this research: (1) logistic regressions to determine what combination of tests, observations, or survey variables, with what weightings, would best predict whether a subject was a volunteer or referral; (2) multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance on road tests; and (3) comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance on nondriving tests and driving tests. (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium)	California DMV Field Office	The referral group performed significantly worse than the volunteer group. Average Snellen error score for referrals = 2.42, for volunteers = 0.09. Average Snellen failure (0=pass, 1=fail) for referrals = 0.57, for volunteers = 0.03. There was no significant difference in performance on Snellen errors or Snellen failures as a function of cognitive impairment Correlations between Snellen performance and weighted error score on the test performance were significant when combining referrals and volunteers (n=135). Correlations between weighted error score and Snellen errors = .3360 ($p<.000$), between weighted error score on road test and Snellen failure = .3553 ($p<.000$). Correlations between Snellen performance and weighted error score on drive test were lower (.1704, and .1846) for Snellen errors and failure respectively and not significant, when considering performance of the referrals only This variable was also significantly correlated with age: correlation of age with snellen errors = .402; age and snellen failure = .401)	Janke & Eberhard (1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Dynamic Acuity: ***MultiCAD***	82 "referred" subjects aged 60-91 (26 of which were identified as probably being cognitively impaired to some degree). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment.	This test used *MultiCAD* to measure drivers' visual acuity, for a target that was moving relative to the observer, under high contrast conditions. The subject was shown a driver's eye view of travel along a suburban arterial, approaching and then stopping at an intersection with a traffic signal in plain view. The image centered and then zoomed on the signal until it filled the screen, while the subject was instructed to use the 3-button response pad to identify which face on the (conventional, 3-face) signal looked different than the other two. Instead of solid red, yellow, and green circles, however, the signal faces contained acuity test stimuli. Square wave gratings with vertical bars were used, such that one signal face contained a high contrast test stimulus (90% contrast) and the other two faces showed a uniform luminance (without bars). The ability to discriminate which two signal faces are were"blank" versus which one contained the vertical bars defined the subject's dynamic acuity level. The rate of movement across the screen (12 degrees per second) corresponded to a driver trying to read a street sign posted at roadside while passing by at a moderate (25-40 mi/h) rate of speed. Three levels of testing were conducted--20/40 (15 cycles per degree), 20/80 (7.5 cycles per degree), and 20/200 (3 cycles per degree)--with a pass/fail score assigned at each level. A passing score was defined as at least 2 correct responses out of the 3 presentations for each level tested. Mean response time was also calculated for correct responses at each level. Three replications of each measurement were performed. Scoring was also conducted on a "gross" level across all stimulus characteristics. Average response time and average error score were calculated across all 9 trials. Multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance (weighted error score) on a standard DMV road test, (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium), and comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance.	California DMV Field Office	•Correlation between gross dynamic acuity errors and weighted errors on driving test was significant ($r=.2346$, $p<.040$). •Correlation between gross dynamic acuity response time and weighted errors on driving test was significant ($r=.3346$, $p<.003$). •Correlations between dynamic acuity score (20/20, 20/80, and 20/200) and weighted errors on driving test were not significant. •Correlations between dynamic acuity *time* at each level of acuity and weighted error scores on driving exam were as follows: 20/40 time: $r=.3092$ ($p<.010$) 20/80 time: $r=.3256$ ($p<.005$) 20/200 time: $r=.3297$ ($p<.004$) •Neither gross or precise scoring of dynamic acuity accuracy or time differentiated between cognitively impaired and cognitively unimpaired referral subjects.	Janke & Eberhard (1998) Staplin, Gish, Decina, Lococo, and McKnight (*in press*)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Dynamic Acuity: **Snellen E (Computerized Presentation)**	Matched pair case-control study, with close (1 year) age matching conducted in Sweden • 37 drivers age 65+ (mean age 75.5) with temporarily-suspended licenses due to crashes (23 drivers) or other moving violations (14 drivers). Moving violations were: speeding (2), running stop sign (4), running red light (4) run off the road (4). Mean distance driven/yr = 12000 km; # males = 30, # females = 7 • 37 matched controls age 65+ (mean age 74.8) with no license suspensions within the past 5 yrs; mean # miles driven = 9200 km; # males = 30, # females = 7	Dynamic visual acuity (DVA) was measured using the apparatus described for Johansson et al. (submitted) for Static Visual Acuity (SVA), using a (PC) computerized system including a slide projector which projected the optotypes on a white screen using first-surface mirrors. Luminance of E's was 85 cd/m^2, background was 195 cd/m^2, and contrast was 0.39. Snellen E's were shown in any of 4 possible directions (up right, up left, down right, down left), and subject responded by pressing corresponding orientation printed on a button on the response box. Each E was shown for 6 s. A logarithmic scale was used with the different object sizes (equivalent to Snellen acuity) of 0.10 (10 min of arc), 0.13, 0.16, 0.20, 0.25, 0.32, 0.50, 0.63, 0.79, 1.0, 1.3, and 1.6. DVA was measured with 3 randomly chosen directions on each size of the target, starting with 0.10 and increasing stepwise. A pass was a correct response on all 3 readings of a particular size. Two trials on each acuity size were allowed. Using a system of mirrors, where one was rotating and angled in relation to the optic axis, the Snellen' s E described a circular movement on the screen; however, the orientation of the E was not influenced by the circular movement. The test was repeated with 3 different angle velocities: 10 °/s, 30 °/s, and 50°/s, performed after each other. The circular movement used a diameter of 0.8 m and an observation distance of 3 m. The dependent measures included dynamic visual acuity and response time. Subjects were also given the Trail Making Test (Part A), the Mini Mental Status Examination, and a cube copying task .	Hospital clinic (Unit of Traffic Medicine, Section of Geriatric Medicine, Department of Clinical neuroscience & Family Medicine, Karolinska Institutet, Stockholm, Sweden)	• There was a significant difference in DVA for the case drivers as a group compared to the controls at an angular velocity of 30°/s. This difference was eliminated when the 3 case drivers with dementia were eliminated (see SVA:E study by Johansson et al.). There was no significant difference at 10°/s or 50°/s. • Comparing only case drivers with crashes to their matched controls showed significantly lower DVA performance among drivers with crashes at 30°/s, even when the 3 drivers with dementia were eliminated. • Comparing only drivers with violations to their matched controls revealed no difference in DVA performance at any velocity. • Drivers with crashes took significantly longer to respond to the Snellen E's than drivers with only violations and drivers in the control group. • Drivers with conspicuously low results on the DVA were cognitively impaired, which implies, according to the authors, that acuity testing with Snellen E's (or Landolt C's perhaps), might also be a simple test for identifying persons with moderate cognitive impairment and subsequent increased crash risk.	Johansson, Seideman, Kristoffersson, Lundberg, Lennerstrand, Hedin, and Viitanen (*submitted*) Johansson (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Contrast Sensitivity: ***MultiCAD***	82 "referred" subjects aged 60-91 (26 of which were identified as probably being cognitively impaired to some degree). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment.	This test used *MultiCAD* to measure drivers' sensitivity to differences in brightness, as required to detect edges between adjacent lighter and darker areas in the roadway environment. The subject was asked to use the 3-button response pad to indicate which of three signal faces contained a test pattern. The traffic signal image remained stationary during this test. The test patterns were the same as used for the static acuity test for 20/40 (15 cycles per degree) and 20/80 (7.5 cycles per degree), and were presented at 2 contrast levels (medium contrast=20.6%; low contrast = 4.9%). Three replications of each measurement were performed with a pass/fail score assigned at each level. A passing score was defined as at least 2 correct responses out of the 3 presentations for each level tested. Mean response time was also calculated for correct responses at each level. Scoring was also conducted on a "gross" level across all stimulus characteristics. Average response time and average error score were calculated across all 12 trials. Multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance (weighted error score) on a standard DMV road test, (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium), and comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance	California DMV Field Office	•Neither gross static contrast sensitivity errors nor response time was significantly correlated with on-road weighted error score •Static contrast sensitivity response time for the high contrast 20/80 target was significantly correlated with weighted error score on the driving test ($r = .3884$ $p < .001$) •Neither gross or precise scoring of static contrast sensitivity accuracy or time differentiated between cognitively impaired and cognitively unimpaired referral subjects. •Using the precise MultiCAD measures a multiple linear regression model using knowledge test score, Auto Trails time, Doron Cue Recognition 2 score, MultiCAD Static Contrast Sensitivity time with the high contrast 20/80 target, and MultiCAD Static Acuity time for correct responses at 20/80 accounted for 56.4% of the variance in performance on the road test (weighted road test error score). •Using gross MultiCAD measures, a model including knowledge test score, Auto Trails time, Doron Cue Recognition 2 score, MultiCAD static acuity time, and MultiCAD static contrast sensitivity time accounted for 47.7% of the variance in performance on the road test (weighted road test error score).	Janke & Eberhard (1998) Staplin, Gish, Decina, Lococo, and McKnight (*in press*)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Contrast Sensitivity: **Pelli-Robson Test**	• 102 "referred" subjects aged 60-91 (34 of which were identified as probably being cognitively impaired to some degree). 47% of the noncognitively impaired referred drivers had visual impairment noted on their record, and 24% of the cognitively impaired had a visual disability noted). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment. • 33 paid "volunteers" aged 56-85, recruited through signs posted at study site or word of mouth.	48-letter test designed by Pelli, Robson, and Wilkins, 1988, of contrast sensitivity at one spatial frequency. The contrast between letters and background decreases as one moves down and toward the right of wall-mounted chart, viewed at dist. of 2 m under normal room illumination. The letters from left to right and from top to bottom progressively fade out as if they must be read in thicker and thicker fog. Letters (in groups of 3) range from 90% contrast (upper left) to 0.5% contrast (lower right). Testing requires no more than 3 minutes Rather than standard scoring (number correct), errors were counted to conform with scoring of other tests. Three tiers of analyses were conducted in this research: (1) logistic regressions to determine what combination of tests, observations, or survey variables, with what weightings, would best predict whether a subject was a volunteer or referral; (2) multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance on road tests; and (3) comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance on nondriving tests and driving tests. (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium).	California DMV Field Office	Referral group performed significantly worse than the volunteer group (correlation with group = .484). Pelli-Robson error score for referrals = 15.87; for volunteers = 10.33 Note: this variable was also significantly correlated with age (correlation = .436). There was no significant difference in performance on Pelli-Robson test as a function of cognitive impairment (mean Pelli-Robson errors for cognitively impaired group = 16.64; for cognitively unimpaired = 15.48) Correlation between Pelli-Robson errors and weighted error score on road test was significant (r=.4009, p,.000) for combined referrals and volunteers (n=135). For referral group only (n=102), correlation between Pelli-Robson errors and weighted error score on road test was also significant (r= .2069, p,.044). A model using number of observed problems plus Pelli-Robson errors with a cut-point of p=.80 of being a referral, gave specificity of 97 percent (32 of 33 volunteers classified correctly) with sensitivity of 71.4 percent (70 of 98 referrals in the model correctly classified).	Janke & Eberhard (1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Contrast Sensitivity: **Pelli-Robson Test**	3,669 randomly-selected Class C license renewal applicants, licensed in California for at least 12 years, and unable to renew by mail. Four driver age groups were studied: 26-39, 40-51, 52-69, and 70+.	48-letter test designed by Pelli, Robson, and Wilkins, 1988, of contrast sensitivity at one spatial frequency. The contrast between letters and background decreases as one moves down and toward the right of wall-mounted chart, viewed at dist. of 2 m under normal room illumination. The letters from left to right and from top to bottom progressively fade out as if they must be read in thicker and thicker fog. Letters (in groups of 3) range from 90% contrast (upper left) to 0.5% contrast (lower right). Testing requires no more than 3 minutes 5 experimental vision tests were employed: • Pelli-Robson Low-Contrast Acuity Test (measures loss in low contrast acuity; ability to see objects and borders) • Smith-Kettlewell Low-Luminance Card (measures high-contrast near-acuity loss and low-contrast near-acuity loss) • Berkeley Glare Tester (measures low-contrast near acuity loss, and low-contrast near-acuity loss in the presence of glare) • Modified Synemen Perimeter (measures standard visual field-integrity loss and attentional visual field-integrity loss • Visual Attention Analyzer (measures loss in UFOV, the area of the visual field in which useful information can be rapidly extracted from a complex visual display) The dependent measure was the crash frequency during the previous 3-year period, extracted from the DMV database. Drivers also completed a Driving Habits Survey measuring level of restriction (never, sometimes, often or always) for night driving, rain or fog, sunrise or sunset, driving alone, left turns, and heavy traffic.	California DMV Field Offices: Carmichael El Cerrito Roseville	Study subjects rated test as face valid (clear instructions, safety-related, and fair in requiring driver license applicants to pass similar sensory tests to get full driving privileges). For all age groups combined, test score was not significantly associated with total prior 3-year crash involvement when considered in isolation. There was a very small percentage of drivers age 70+ with good low-contrast acuity. Using a pass-fail criterion of 36 or more correctly identified letters as pass and less than 36 letters fail, Pelli-Robson specificity=53%, sensitivity=29% in predicting citations for age 70+ drivers, and accuracy of predicting citation occurrence=6.5%. For S's age 52-69, specificity=65%, sensitivity=19%, and positive prediction=7%. Approximately 5% of the variation in reported level of self-restriction was explained by test performance or age (the worse the visual performance or the older the driver, the more restriction). 5.3% of the variation in crash involvement for S's age 70+ was explained by low Pelli-Robson scores and the avoidance of heavy traffic.	Hennessy (1995)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Contrast Sensitivity: **Pelli-Robson Test**	1,475 ITT Hartford Insurance Co. policyholders for whom past driving histories were available through insurance records, divided into two groups based on the presence or absence of recent at-fault accidents. Driver age ranged between 50 and 80+ and was distributed as follows: • 26 percent of the sample were between 50-64, • 54 percent were between 65-74, • 20 percent were over 75. Participants were active drivers who had (generally) been pre-screened for risk in the insurance underwriting process. Also, participants who came in for testing appeared confident in their driving abilities.	Subjects participated in a 2-hour testing session consisting of visual, perceptual, and cognitive performance tests, and completed a self-report questionnaire. Contrast Sensitivity was measured using the Pelli-Robson Test, which is a 48-letter test designed by Pelli, Robson, and Wilkins (1988), of contrast sensitivity at one spatial frequency. The contrast between letters and background decreases as one moves down and toward the right of wall-mounted chart, viewed at dist. of 2 m under normal room illumination. The letters from left to right and from top to bottom progressively fade out as if they must be read in thicker and thicker fog. Letters (in groups of 3) range from 90% contrast (upper left) to 0.5% contrast (lower right). Testing requires no more than 3 minutes Insurance and motor vehicle department records provided information about the following variables: at-fault accidents, non-fault accidents, non-accident claims, violations and convictions, miles driven, age, gender and marital status.	Testing rooms in hotels in 15 cities throughout Connecticut, Florida, and Illinois	Results showed that 42 percent of the sample had an at-fault accident between 1989-1991. Univariate correlations and multiple regression analyses were computed to determine the relationships between the variables and accidents. The Pelli-Robson Letter Sensitivity Chart consistently yielded the highest correlation to accidents in the sample during 1989-1991 ($r=-0.11$, $p<0.05$). Results indicated the following relationship between Pelli-Robson test scores and accident involvement: 45% of the drivers with scores of 1.95 were involved in accidents; 50% of drivers with scores of 1.80 were involved in accidents; 55% of drivers with scores of 1.65 were involved in accidents; 65% of drivers with scores of 1.50 were involved in accidents, and 70% of drivers with scores of 1.35 were involved in accidents. The Pelli-Robson was relatively highly correlated to age, and thus the observed correlation between test performance and accidents is likely to be understated.	Brown, Greaney, Mitchel, and Lee (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Contrast Sensitivity: **Smith-Kettlewell Low-Luminance (SKILL) Card** (high-contrast near-acuity loss and low-contrast near-acuity loss)	3,669 randomly-selected Class C license renewal applicants, licensed in California for at least 12 years, and unable to renew by mail. Four driver age groups were studied: 26-39, 40-51, 52-69, and 70+.	A letter chart viewed at a distance of 40 cm (16 in). From the top of the chart to the bottom, each line of letters is smaller than the line preceding it. One of the SKILL Card charts shows black letters on a white background (high-contrast letters); the other card shows black letters on a dark gray background (low contrast letters on a low-luminance background). The low-contrast SKILL Card chart is likened to viewing the worn-darkened lane striping at a busy intersection. 5 experimental vision tests were employed: • Pelli-Robson Low-Contrast Acuity Test (measures loss in low contrast acuity; ability to see objects and borders) • Smith-Kettlewell Low-Luminance Card (measures high-contrast near-acuity loss and low-contrast near-acuity loss) • Berkeley Glare Tester (measures low-contrast near acuity loss, and low-contrast near-acuity loss in the presence of glare) • Modified Synemen Perimeter (measures standard visual field-integrity loss and attentional visual field-integrity loss • Visual Attention Analyzer (measures loss in UFOV, the area of the visual field in which useful information can be rapidly extracted from a complex visual display) The dependent measure was the crash frequency during the previous 3-year period, extracted from the DMV database. Drivers also completed a Driving Habits Survey measuring level of restriction (never, sometimes, often or always) for night driving, rain or fog, sunrise or sunset, driving alone, left turns, and heavy traffic.	California DMV Field Offices: Carmichael El Cerrito Roseville	Study subjects rated test as face valid (clear instructions, safety-related, and fair in requiring driver license applicants to pass similar sensory tests to get full driving privileges). For all age groups combined, test score was not significantly associated with total prior 3-year crash involvement when considered in isolation. Best-corrected near acuity of drivers age 70+ differs on average only 3 letters for that of drivers ages 40-51, when tested under optimal conditions (well-illuminated, high-contrast text). When contrast was reduced by making the black letters gray, 70+ year old drivers read 2-3 lines (5 letters per line) less than 40-51 year old drivers (a marked reduction). There was a very small percentage of drivers age 70+ with good low-contrast acuity. Approximately 5% of the variation in reported level of self-restriction was explained by test performance or age (the worse the visual performance or the older the driver, the more restriction).	Hennessy (1995)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Contrast Sensitivity: **Vistech Contrast Sensitivity Gratings/Optec 1000**	12,400 drivers in Pennsylvania, who came to Photo ID centers for license renewal, who were unaware that their vision would be tested when they arrived at the photo license facility. Ages ranged from 16 to 76+.	An Optec 1000 (Stereo Optical Company, Inc., Chicago, Il) vision screener was used to test contrast sensitivity at spatial frequencies of 6, 12, and 18 cycles per degree. Also tested with this device were visual acuity (Sloane letters at 20/20, 20/30, 20/40, 20/50, 20/70, 20/100, and 20/200 acuity ranges) and horizontal visual field (mini-lamps set at the horizontal peripherals of 85, 75, 55, and 45 [nasal] degrees on each side of the nasal region). Conduct of these 3 tests required 3 to 5 minutes per driver. In the contrast sensitivity test, drivers were required to choose between one of three orientations of a test patch with line gratings that pointed either diagonally up to the left, to the right, or straight up and down. Contrast sensitivity measurements show that the ability to see targets of low spatial frequency is statistically independent of the ability to see high spatial frequency targets, such as those presented in routine vision tests. Statistical analyses of the relationship between visual performance at the time of screening and prior (3.67-year) crash experience were performed.	Three PennDOT Photo ID Centers (Northeast Philadelphia/ urban area; Schuylkill County/ rural area; and Delaware County/ suburban area)	• No significant relationships were found between binocular visual acuity, horizontal visual field scores, or contrast sensitivity at any particular spatial frequency and crash frequency (Chi square). • Chi square analysis comparing observed vs expected crash counts for drivers who failed the vision test (static visual acuity worse than 20/40 and/or horizontal visual field less than 140 degrees), was significant: relative overinvolvement in accidents was found for drivers with "good" vision in age groups 16-20 and 21-25, and by drivers with "poor" vision in age groups 66-75 and 76+. • Failure on the combined criteria that incorporates the current PennDOT standard (binocular acuity of 20/40 and horizontal visual field of 140 degrees) and a broadly defined contrast sensitivity criterion (scores below normal for 1 or more of the 3 spatial frequencies tested) produced the strongest relationship linking poor vision and high crash involvement, especially for 66-75 and 76+ driver age groups. • Using the current PA standard, there is a modest upturn in crash experience for drivers age 76+ who pass, and a larger increase for drivers who fail; however, using the combined criteria (PA standard plus contrast sensitivity), the increase in crash rates for drivers age 76+ rises steeply, and the biggest difference in rates between passed and failed drivers in this group is found using combined criteria. No increase in crash rate with age was found for drivers who passed according to the combined criterion.	Decina and Staplin (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Static Contrast Sensitivity/Glare: **Berkeley Glare Tester (BGT Chart)** (low-contrast near acuity loss, and low-contrast near-acuity loss in the presence of glare)	3,669 randomly-selected Class C license renewal applicants, licensed in California for at least 12 years, and unable to renew by mail. Four driver age groups were studied: 26-39, 40-51, 52-69, and 70+.	A letter chart viewed at a distance of 40 cm (16 in). From the top of the chart to the bottom, each line of letters is smaller than the line preceding it. The letters on the BGT chart are gray on a white background (low-contrast letters). The chart is mounted on a translucent screen behind which are lights; the chart is read in the presence and in the absence of glare. Testing requires no more than 3 minutes, and is administered in a dark or very dimly-lit room. Reading the chart is likened to viewing a white car in a fog. 5 experimental vision tests were employed: • Pelli-Robson Low-Contrast Acuity Test (measures loss in low contrast acuity; ability to see objects and borders) • Smith-Kettlewell Low-Luminance Card (measures high-contrast near-acuity loss and low-contrast near-acuity loss) • Berkeley Glare Tester (measures low-contrast near acuity loss, and low-contrast near-acuity loss in the presence of glare) • Modified Synemen Perimeter (measures standard visual field-integrity loss and attentional visual field-integrity loss • Visual Attention Analyzer (measures loss in UFOV, the area of the visual field in which useful information can be rapidly extracted from a complex visual display) The dependent measure was the crash frequency during the previous 3-year period, extracted from the DMV database. Drivers also completed a Driving Habits Survey measuring level of restriction (never, sometimes, often or always) for night driving, rain or fog, sunrise or sunset, driving alone, left turns, and heavy traffic.	California DMV Field Offices: Carmichael El Cerrito Roseville	Study subjects rated test as face valid (clear instructions, safety-related, and fair in requiring driver license applicants to pass similar sensory tests to get full driving privileges). For all age groups combined, test score was not significantly associated with total prior 3-year crash involvement when considered in isolation. Best-corrected near acuity of drivers age 70+ differs on average only 3 letters for that of drivers ages 40-51, when tested under optimal conditions (well-illuminated, high-contrast text). When luminance and contrast were reduced by adding glare, 70+ year old drivers read 2-3 lines (5 letters per line) less than 40-51 year old drivers (a marked reduction). There was a very small percentage of drivers age 70+ with good low-contrast acuity. Approximately 5% of the variation in reported level of self-restriction was explained by test performance or age (the worse the visual performance or the older the driver, the more restriction).	Hennessy (1995)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Dynamic Contrast Sensitivity: *MultiCAD*	82 "referred" subjects aged 60-91 (26 of which were identified as probably being cognitively impaired to some degree). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment.	This test used *MultiCAD* to measure drivers' contrast sensitivity for a target that is moving relative to the observer. Immediately following the *Multi*CAD static contrast sensitivity test, exactly the same type of stimuli were shown while moving at a predetermined rate (12 degrees per second) from one side of the screen to the other. The same "which signal face is different?" discrimination was required of the subject, using the 3-button response pad. Three replications of each measurement were performed with a pass/fail score assigned at each level. A passing score was defined as at least 2 correct responses out of the 3 presentations for each level tested. Mean response time was also calculated for correct responses at each level. Scoring was also conducted on a "gross" level across all stimulus characteristics. Average response time and average error score were calculated across all 12 trials. Multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance (weighted error score) on a standard DMV road test, (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium), and comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance	California DMV Field Office	•Correlation between gross dynamic contrast sensitivity errors and weighted error score on road test was significant ($r=.2420$, $p<.034$) •Correlation between gross dynamic contrast sensitivity time and weighted error score on road test was not significant. •Correlation between dynamic contrast sensitivity time for the high contrast 20/80 target and weighted errors on the road test was significant ($r=.2466$, $p<.049$). •Neither gross nor precise scoring of dynamic contrast sensitivity errors or response time differentiated between cognitively impaired and cognitively unimpaired referral subjects.	Janke & Eberhard (1998) Staplin, Gish, Decina, Lococo, and McKnight (*in press*)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Peripheral Visual Fields: **Goldman Perimeter** (II/4e, III/4e and V/4e targets)	21 Retinitis Pigmentosa Patients age 29-67 (mean age 42 yrs) 9F, 12M 4 major peripheral field loss profiles were represented: • partial concentric restriction (n=5) • residual temporal islands (n=5) • ring scotoma (n=7) severe peripheral restriction (n=4) 31 Controls with normal vision age 21-64 (mean age 40 yrs) 16F, 15M All S's held unrestricted driving licenses and drove at least 1000 miles/year.	<u>Visual function measures</u>: Peripheral Visual Field Loss - Visual field tested using Goldman Perimeter to produce a binocular, three dimensional map of the visual field. Additionally, the total scotomatous area of the binocular visual field and total horizontal field extent were calculated. [S's were required to have visual acuity of 0.2 LogMar (Snellen equivalent of 20/40) or better in at least 1 eye tested with Bailey-Lovie (ETDRS) charts.] <u>Visuocognitive and motor performance measures</u>: S's performed in driving simulator as described in Szlyk et al. (1993) to collect data on simulator accidents, RT to stop sign, reaction distance, brake and gas pressure, out-of-lane events, etc. <u>Psychosocial factors</u>: Risk-Taking Questionnaire State-Trait Anxiety Inventory. <u>Dependent measures</u>: • Self-reported accident involvement in the past 5 years • State-recorded accident involvement in the past 5 years • Driving simulator accidents **FINDINGS (cont'd)** • In simulator measures, RP patients slow down at greater dist. than controls ($p<.02$) to peripheral landmarks (stop signs). Smaller horiz. visual field extent related to longer reaction dist. in RP's ($r=-0.51$). Reaction dist marginally related to state-recorded accidents [$r(30)=.31$, $p=.07$]. • Smaller horiz. visual field extent to II/4e target related to longer reaction dist {$r(19)=-.52$, $p<.02$} but not signif. for III/4e or V/4e targets. • RP subjects were also strayed out of lane more often than controls ($p<.02$). Out-of-lane events signif. related to state-recorded accidents + violations. • RP patients report less risk-taking behavior than controls ($p<.001$). Trait anxiety signif. related to self-reported accidents ($r=0.28$), while state anxiety was not. No difference in trait or state anxiety found between groups. Mult. regress. anal.: for RP's- reaction dist, deviation in lane position, out-of-lane events, braking pressure, simulator accidents, acuity, and residual visual field accounted for 71% of var in self-reported accidents; RP's + controls: gas press., out-of-lane, horiz. eye mvmt., acuity, residual visual field account for 46% of variance. (Visual function alone not a signif. predictor of self-reported accidents)	Univ. Illinois at Chicago Eye Center	• RP patients self-report more accidents in general ($p<.02$) than normals; and more peripheral accidents--not detecting other cars when changing lanes, pulling out of driveways, in parking lots-- ($p<.001$) than normals. • RP patients self-report more accidents under low contrast/adverse weather conditions--rainy, snowy, nighttime, dusk-- ($p<.06$) than normals. • No difference between groups in state reported accidents. • RP patients had more simulator accidents than controls, but this difference was nonsignificant. • Significant correlation found between total remaining horizontal field extent and self-reported accidents for RP group ($r=-0.58$, $p<.01$; $r=-0.50$, $p<.05$; $r=-0.40$, $p<.05$) for the three targets (V/4e, III/4e, and II/4e). A significant negative correlation reflects increased accident risk as remaining intact visual field extent decreases. • Field extents measured with all three targets also significantly (and negatively) correlated with self-reported peripheral accidents [V/4e, $r(20)=-.58$, $p<.01$; III/4e, $r(20)=-.61$, $p<.01$; II/4e, $r(20)=-.50$, $p<.05$]. • Measure of binocular scotomatas area ro V/4e target (in sq in) significantly related to self-reported accidents and peripheral accidents • Significant correlation also found between field profile and self-reported accidents in RP group [$r(50)=0.42$, $p<.01$)] between field profile and peripheral accidents [$r(50)=.66$, $p<.01$]. S's with severe field restriction (profile 4) are at greater crash risk than those with partial restriction (profile 1)	Szlyk, Severing, and Fishman (1991)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Peripheral Visual Fields: **Manually Operated Perimeter**	97 drivers age 55+ recruited from CA DMV driving records	In this pilot study, a manually operated perimeter (not described) was used to measure peripheral visual fields with and without attentional demand, along with several other Smith-Kettlewell vision tests, to discriminate between accident-free and accident-involved drivers. Subjects were divided into 2 groups: no accidents on record vs 2 or more accidents on record, within the preceding 3 years. An accident-proneness index was used to account for whether the subject was at fault in the accident. For each accident, a score was assigned as follows: 4=driver primarily at fault; 3= subject contributed to the fault; 2 =fault undetermined; 1=subject not at fault; 0=no accidents. Drivers also completed questionnaires to evaluate driving habits, difficulties while driving, and standard ocular and medical history.	Smith-Kettlewell Eye Research Institute, San Francisco, CA	• The relationship between overall decreased performance on the vision tests and the increased accident-proneness index was significant ($p=.04$). • The skills with the strongest statistical relationship to accident involvement included low contrast low luminance visual acuity; disability glare; the extent of the standard visual field directly to the right, and down and to the right; and the extent of the attentional visual field directly down and to the right, or to the left. • A comparison of 10 people with the worst vision scores with 10 people having the best vision scores, showed that people with the worst scores on the attentional visual field, standard visual field, and bright glare tests were several times more likely to be in the accident group than in the nonaccident group. • Although the accident-involved drivers had more difficulty on vision tests, they were unaware of any problems with their vision.	Brabyn (1990)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Eye Disease: **Cataracts**	<u>279 drivers with cataract</u> mean age=71 53% male 86% White/13% African-American <u>105 drivers with no cataract</u> mean age = 67 48% male 84% White/16% African-American	The project is an intervention evaluation study to determine how improvement in vision impacts crashes and driving habits. Other Objectives: To determine the natural progression of crash frequency and driving habits in a group of older adults who, at the outset of the project, are in good eye health. To determine whether certain factors serve as effect modifiers, thus altering the relationship between improvement in visual sensory function and crash frequency/driving habits. Prospective study where all subjects are assessed once annually, with the 1st visit before cataract surgery, then annually after surgery for 2 years. Crash data from 5 years prior to enrollment and 3 years following enrollment are obtained from Alabama Dept. of Public Safety. Visual functional status was measured as follows: Distance Acuity - ETDRS Chart Contrast Sensitivity - Pelli-Robson Chart Visual Field - Humphrey Field Analyzer 81-point screening program for the central 60 degrees Cataract was the only diagnosed eye condition (other than refractive error) in 75% of subjects in the cataract group. For this report, crash data for the previous 5 years were obtained from the Alabama Department of Public Safety, and at-fault crashes were used as the dependent measure. --- **FINDINGS (Cont'd)** •When adjusted for impaired health, the association between cataract and crash involvement remained significant (relative risk = 2.49, 95% CI = 1.0-6.27).	University of Alabama, Birmingham	•Subjects in the cataract group averaged 20/60 and 20/40 in the worst and best eye respectively, compared to the no cataract group who averaged 20/25 and 20/20 respectively. This difference was significant ($p<.001$). •Contrast sensitivity was significantly worse in both eyes for subjects with cataracts ($p<.001$). Age adjusted log CS for cataract group was 1.39 (best eye) and 1.19 (worst eye) compared to 1.61 (best eye) and 1.52 (worst eye) for no cataract group. •Cataract subjects detected fewer points in their visual field than the no cataract subjects. •Proportionately more cataract subjects preferred to have someone else drive when they travelled in a car, drove slower than the general traffic flow, and received advice that they limit or stop driving (self-reports on driving habits questionnaire). •Cataract was associated with reduced number of days driving per week and a reduced number of destinations. (Cataract drivers 2 X more likely to reduce driving) •Subjects with cataracts were (2 times) less likely to drive beyond their neighboring towns than subjects without cataracts. •Cataract was significantly associated with driving difficulty in the rain, driving alone, making left turns across traffic, driving on interstates, in high traffic, in rush hour, and at night (Cataract drivers 4X more likely to report these difficulties). •After adjusting for driving exposure, the association between cataract and at-fault crash involvement was significant (relative risk = 2.48, 95% CI = 1.0-6.14).	Owsley, Stalvey, Wells, and Sloane (1999)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Eye Disease: **•Diabetic Retinopathy** **•Glaucoma**	294 older drivers, ages 56-90 years at enrollment, drawn from the population of licensed drivers in Jefferson County over age 55. 33% had 0 crashes on record 49% had 1 to 3 crashes over the prior 5 year period 18% had 4 or more crashes over the prior 5 year period	Objective: To identify measures of visual processing associated with crash involvement by older drivers, in a prospective follow-up study. •Subjects received the following sensory tests: Letter Acuity - ETDRS chart Contrast Sensitivity - Pelli-Robson chart Stereoacuity - TNO Test Disability Glare - MCT-8000 (VisTech) Visual Field Sensitivity - Humphrey Field Analyzer 120-point program for central 60 degree radius field •Subjects received comprehensive eye exam resulting in a primary diagnosis (cataract, age-related maculopathy, **glaucoma, diabetic retinopathy**) •Mental status was assesses using the MOMSSE •Visual Attention was measured with the Vision Attention Analyzer: •"On the road" exposure was estimated using questionnaire data on number of days/week subjects drove and annual number of miles driven. Subjects were asked if anyone had ever suggested they limit or stop driving. Dependent variable: Motor vehicle crash occurrence during the 3 years following clinic assessment, obtained from Alabama Department of Public Safety. Person-years to first crash was calculated from enrollment date; Person-miles of travel was calculated by multiplying person-years times reported annual mileage.	University of Alabama, Birmingham Ophthal-mology clinic	•56 S's had at least 1 crash in the 3-year follow-up period, and 11 of these had 2 or more. •Estimated annual crash rate was 7.4 per 100 person-years of driving and 7.1 per million person-miles of travel. •Crash involvement in prior 5-year period was significantly associated with increased crash risk (Risk ratio = 2.0) •Significant, independent associations with crash risk in 3-year follow-up were found only for: •UFOV reduction of $\geq$ 40%: RR=2.3; 95% CI = 1.27 - 4.29) •Driving < 7 days/week: 48% decreased crash risk (95% CI = 0.27 - 1.01). •Dx of **diabetic retinopathy** (5X greater risk, 95% CI = 1.13 - 21.8). •Dx of **glaucoma**: (RR=5.20, 95% CI = 1.19-22.72). Relationship for glaucoma and crashes stronger for males (RR=9.81) than females (RR=5.14). *<u>Correction</u>: The findings reported above for diabetic retinopathy and glaucoma were cited from a manuscript under review, but not yet published. Due to concerns with small sample sizes, the analyses supporting these findings were subsequently excluded from the final, published manuscript. The reported relationahips must therefore be regarded as tentative and should not be further cited.* (February 2004).	Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Multiple Visual Capabilities: **Keystone Telebinocular Testing Device**	105 drivers licensed in Nebraska, aged 65-88 (mean age = 71.4). 54 were females (mean age = 70.5 years); 51 were males (mean age = 72.2 years). All subjects were volunteers, and were paid $25.00 for participating. 36 had taken a driver education course in the past 10 years.	Vision was assessed using a Keystone telebinocular testing device to measure near acuity, depth perception, left and right peripheral vision, color vision, and lateral and vertical phoria. The driving performance of the subjects was evaluated using the on-street driving performance measurement (DPM) technique developed by Vanosdall and Rudisill (1979). The subjects were evaluated by a driver education expert trained in the use of the DPM technique, while they drove in their own cars. The DPM route was a 19-km circuit designed to evaluate the subjects in the situations that are most often involved in the accidents of older drivers. Therefore, their performance was evaluated at 7 intersections where they were required to make left turns at 5 intersections and right turns at the other 2 intersections. Four of the left turns were made from left-turn lanes onto four-lane divided arterial streets in suburban areas, and one was made from a left turn lane onto a two-lane one-way street in an outlying business district. Performance on the DPM was evaluated as follows. Each of the 7 turning maneuvers was divided into 3 segments; (1) the approach to the intersection, (2) the turning maneuver itself, and (3) the departure form the intersection. Performance in each segment was evaluated as being either satisfactory or unsatisfactory; 1 point was given for satisfactory performance and 0 points were given for unsatisfactory performance. The criteria for determining satisfactory or unsatisfactory performance were in terms of the subject's search pattern and control of the vehicle's speed and direction. Since subjects made 2 trips around the route, the maximum score was 42. The measure of driving performance used in the analysis was a percentage of 42.	Cognitive measures: University laboratory. Driving measures: business district and residential street networks	Results of the correlational analysis showed that among the vision factors, only depth perception and right visual field correlated significantly with driving performance ($p < 0.05$); the correlational coefficients for these factors were .35 and .22 respectively.	Tarawneh, McCoy, Bishu, and Ballard (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
VISION Multiple Visual Capabilities: **Sight Screener II (AO Safety Products)**	1,475 ITT Hartford Insurance Co. policyholders for whom past driving histories were available through insurance records, divided into two groups based on the presence or absence of recent at-fault accidents. Driver age ranged between 50 and 80+ and was distributed as follows: • 26 percent of the sample were between 50-64, • 54 percent were between 65-74, • 20 percent were over 75. Participants were active drivers who had (generally) been pre-screened for risk in the insurance underwriting process. Also, participants who came in for testing appeared confident in their driving abilities.	Subjects participated in a 2-hour testing session consisting of visual, perceptual, and cognitive performance tests, and completed a self-report questionnaire. Tests of visual function were performed using a *Sight Screener II* (AO Safety Products) and included: • Acuity (far and near) left eye, right eye and binocularly • Stereopsis (far and near) • Color perception (severe and mild) Insurance and motor vehicle department records provided information about the following variables: at-fault accidents, non-fault accidents, non-accident claims, violations and convictions, miles driven, age, gender and marital status.	Testing rooms in hotels in 15 cities throughout Connecticut, Florida, and Illinois	Results showed that 42 percent of the sample had an at-fault accident between 1989-1991. Univariate correlations and multiple regression analyses were computed to determine the relationships between the variables and accidents. The visual acuity measures were among the predictors which did not reach significance.	Brown, Greaney, Mitchel, and Lee (1993)

II.B. ATTENTION/PERCEPTION/COGNITION

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1. **Angular Motion Sensitivity**
    - (a) *MultiCAD*

2. **Attentional Search & Sequencing**
    - (a) AARP Reaction Time Test
    - (b) Auto-Trails
    - (c) Trail Making Test
    - (d) WayPoint

3. **Attention Switching**
    - (a) Digit Symbol Subscale of WAIS
    - (b) Washington University Attention Switching Task

4. **Attentional Visual Field**
    - (a) Smith-Kettlewell Modified Synemen Perimeter
    - (b) Visual Attention Analyzer (UFOV)

5. **Divided Attention**
    - (a) *MultiCAD*

6. **Driving Knowledge**
    - (a) Rules of the Road
    - (b) Traffic Sign Recognition

7. **Immediate/Delayed Recall**
    - (a) Logical Memory Subscale of Wechsler Memory Scale

8. **Language Abilities/Naming Behavior**
    - (a) Boston Naming Test

9. **Mental Status**
    - (a) Mattis Organic Mental Status Syndrome Examination (MOMSSE)
    - (b) Mini-Mental State Evaluation (MMSE)
    - (c) Short Blessed Cognitive Screen

10. **Perceptual Speed**
    - (a) Cue Recognition (Doron Driver Analyzer)

11. **Selective Attention**
    - (a) Auditory Selective Attention Test

12. **Sustained Attention**
    - (a) Continuous Performance Task

13. **Visual Perception**
    - (a) Benton Visual Retention Test
    - (b) Motor-Free Visual Perception Test
    - (c) WAIS-R Picture Completion

14. **Multiple Capabilities**
    - (a) Cognitive Behavioral Driver's Inventory (CBDI)
    - (b) Cognitive Screen (DrivAble Testing, Ltd.)
    - (c) Driving Advisement System (DAS)
    - (d) Easy Driver
    - (e) Elemental Driving Simulator (EDS)
    - (f) University of Iowa/Atari Interactive Driving Simulator
    - (g) University of Nevada, Las Vegas (UNLV) Subtests
    - (h) Washington University Visual Attention Tests

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Angular Motion Sensitivity: ***Multi*CAD**	82 "referred" subjects aged 60-91 (26 of which were identified as probably being cognitively impaired to some degree). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment.	This test used *MultiCAD* to measure drivers' ability to rapidly detect changes in the relative motion of their own versus other vehicles. A video of suburban driving scenes was used which presented a driver's eye view of travel along an arterial route with light traffic, following a lead vehicle (that the subject was told to pay attention to) at varying distances. Subjects were required to depress the "brake" assembly whenever the vehicle directly ahead in the same lane applied its brakes or at any other time it would be advisable to stop or slow down under actual driving conditions (e.g., an adjacent-lane driver encroaches into the lane of travel). The lead vehicle brake lights were illuminated when it slowed for 12 of the angular motion sensitivity trials. For 3 other angular motion sensitivity trials, the lead vehicle's brake lights were disabled during filming of the video, so that the subject was required to detect the change in headway without the additional brake light cue. These 3 trials were intermingled with the trials in which the brake lights were illuminated. Measures of effectiveness were: (1) mean brake reaction time across 12 trials, to slowing/stopping lead vehicle <u>with</u> brake light activation, for <u>correct responses</u>; (2) percent error for these trials (e.g. percent of the trials where the vehicle ahead slowed <u>and</u> the brake lights were clearly visible, but the subject did <u>not</u> press the brake pedal; (3) mean brake reaction time across 3 trials, to slowing/stopping lead vehicle with <u>no</u> brake light activation, for <u>correct responses</u>; and (4) percent error for these three trials. A gross measure was also employed, which was a count of the number of times the word "error" appeared on the printout of results. This measurement ignored any varying stimulus characteristics. Multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance on road tests; (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium), and comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance on nondriving tests and driving tests.	California DMV Field Office	•A gross measure of the number of errors made in the driving video significantly correlated with weighted error score on the road test ($r=.3462$, $p< .002$). •Mean brake time (in response to a lead vehicle braking with or without brake lights activated) was not significantly correlated with weighted error score on the drive test. •The correlation between proportion of errors on trials where brake lights were visible and weighted error score on the drive test was significant ($r=.2801$, $p<.013$). •The correlation between proportion of errors on trials where brake lights were not visible and weighted error score on road test was not significant. •Using gross errors on the driving video, cognitively impaired referral subjects made significantly more errors (average = 7.50) than did the cognitively unimpaired referrals (average = 3.36). •Looking at the proportion of errors for trials where the brake lights activated, cognitively impaired referrals had a significantly higher error proportion (they did not brake in 47.3% of the trials) compared to cognitively unimpaired referral subjects (who did not brake in 21% of the trials) •Response time did not discriminate between cognitively impaired referrals and cognitively unimpaired referrals, neither did proportion of errors when the brake lights did not activate (although there were only 3 trials for this last measure).	Janke & Eberhard (1998) Staplin, Gish, Decina, Lococo, and McKnight (*in press*)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Search & Sequencing: **AARP Reaction Time Test**	3,238 drivers ages 65+, who applied for renewal of North Carolina driver's license	This test is based on the reaction time test presented in the AARP *Older Driver Skill Assessment and Resource Guide*, which is similar to Trails A. The test consists of a photo of a driving scene onto which 14 numbers are overlaid; the subject must touch the numbers in order. The test was modified by increasing its size to 15 by 23 in (to widen field of visual search) and instead of timing for 10 seconds and scoring the last number touched, scoring was based on total time to locate and touch all 14 numbers. Dependent variable: involvement in a police-reported motor vehicle crash during the three-year period immediately preceding license renewal	Eight NC driver's license offices, representing a mix of urban and rural locations in the western, central, and eastern portions of the State.	Performance declined significantly as a function of increasing age (time to complete test increased with increasing age). Correlational coefficient with number of crashes = 0.046 ($p<0.001$). Annual crash involvements increased with increasing (poorer) cognitive scores.	Stutts, Stewart, and Martell (1996)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Search & Sequencing: **Auto-Trails**	• 69 "referred" subjects aged 60-91. The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment. • 31 paid "volunteers" aged 56-85, recruited through signs posted at study site or word of mouth.	A modified and automated version of Trails A of Reitan's (1958) Trail Making Test, developed by Frank Schieber (Univ of SD). 14 numbers are presented on a computer monitor arranged randomly against the background of a traffic scene, as observed by the driver through the windshield of a car. The subject must touch the numbers (touch screen display) in numerical order as rapidly and accurately as possible. Timing is done by the computer. The score used was total time, as very few subjects made errors. Three tiers of analyses were conducted in this research: (1) logistic regressions to determine what combination of tests, observations, or survey variables, with what weightings, would best predict whether a subject was a volunteer or referral; (2) multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance on road tests; and (3) comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance on nondriving tests and driving tests. (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium).	California DMV Field Office	Referral group performed significantly worse than the volunteer group (Correlation between Auto-Trails time and Group = .405, $p < .05$). Auto-Trails mean time for referrals = 24.26 s, for volunteers = 16.91 s Note: this variable was also significantly correlated with age (correlation = .364) Auto-Trails time correlated significantly with weighted error score on the road test, for combined referrals and volunteers ($r = .4523$, $p < .000$) and for referrals only ($r = .3748$, $p < .002$). Auto-Trails time did not discriminate the cognitively impaired referral subjects from the cognitively unimpaired referral subjects. A model using number of observed problems + Pelli-Robson errors + Auto Trails time, with a cut-point of $p = .86$ of being a referral, gave specificity of 96.8% (30 of 31 volunteers classified correctly) with sensitivity of 63.1% (41 of 65 referrals correctly classified). However, the number of subjects in the model was only 96. A multiple linear regression model using knowledge test score, Auto Trails time, Doron Cue Recognition 2 score, MultiCAD Static Contrast Sensitivity time with the high contrast 20/80 target, and MultiCAD Static Acuity time for correct responses at 20/80 accounted for 56.4% of the variance in performance on the road test (weighted road test error score).	Janke & Eberhard (1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Search & Sequencing: **Trail Making Test** (Parts A and B)	3,238 drivers ages 65+, who applied for renewal of North Carolina driver's license	Paper-and-pencil test of general cognitive function. It measures speed of visual search, attention, mental flexibility, and motor function (Reitan, 1958). Part A involves connecting in order 25 encircled numbers randomly arranged on a page. Part B includes both numbers (1-13) and letters (A-L), and requires connecting the two in alternating order (1 to A to 2 to B, etc.). The score on either test is the overall time (seconds) to complete the connections. Mistakes are pointed out by the test administrator and are corrected as they occur; their effect is to increase the overall time required. Dependent variable: involvement in a police-reported motor vehicle crash during the three-year period immediately preceding license renewal --- **FINDINGS (Cont'd)** Of the measures examined, Trails A & B generally performed the best; both are sensitive to milder levels of cognitive impairment. The increase in crash risk observed from the lowest to the highest levels of test performance was very gradual, so that there was no clear cutpoint for identifying a particularly high risk subgroup of drivers. A multivariate model providing the best fit to the crash data was one containing Trails B time as the cognitive predictor, and self-reported driving frequency, annual mileage, and age as additional explanatory variables. The model accounts for only 3.3% of the total deviance. Estimated 3-year crash totals for selected levels of these 4 variables predict higher crash totals for older drivers (compared to younger drivers) who drive daily as opposed to less often, and for those who drive more miles/yr. Also, subjects who take slightly more than 2 minutes to complete Trails B are at nearly twice the crash risk level. A second model substituting Trails A for Trails B was almost as strong, as was a third model using Traffic Sign time, driving frequency and age.	Eight NC driver's license offices, representing a mix of urban and rural locations in the western, central, and eastern portions of the State.	Performance declined significantly as a function of increasing age for both Trails A and Trails B (time to complete test increased with increasing age). Average completion times were below (better than) published norms, suggesting a healthy or well educated sample. <u>Trails A Results</u>: Correlational coefficient with number of crashes = 0.065 ($p<0.001$). Subjects who scored in best quartile had 47% fewer crashes (.037 crash involvements per year) than drivers who scored in the worst quartile (.054 crash involvements per year). <u>Trails B Results</u>: Drivers in the poorest decile of performance have a predicted average annual crash rate of 1.5 times that of drivers in the highest decile of cognitive performance. Correlational coefficient with number of crashes = 0.072 ($p<0.001$). Annual crash involvements increased with increasing (poorer) cognitive scores.	Stutts, Stewart and Martell (1996, 1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Search & Sequencing: **Trail Making Test** (Parts A and B)	105 drivers licensed in Nebraska, aged 65-88 (mean age = 71.4). 54 were females (mean age = 70.5 years); 51 were males (mean age = 72.2 years). All subjects were volunteers, and were paid $25.00 for participating. 36 had taken a driver education course in the past 10 years.	Paper-and-pencil test of general cognitive function. Part A involves connecting in order 25 encircled numbers randomly arranged on a page. Part B includes both numbers and letters, and requires connecting the two in alternating order (1 to A to 2 to B, etc.). The score on either test is the overall time (seconds) to complete the connections. Mistakes are pointed out by the test administrator and are corrected as they occur; their effect is to increase the overall time required. The driving performance of the subjects was evaluated using the on-street driving performance measurement (DPM) technique developed by Vanosdall and Rudisill (1979). The subjects were evaluated by a driver education expert trained in the use of the DPM technique, while they drove in their own cars. The DPM route was a 19-km circuit designed to evaluate the subjects in the situations that are most often involved in the accidents of older drivers. Therefore, their performance was evaluated at 7 intersections where they were required to make left turns at 5 intersections and right turns at the other 2 intersections. Four of the left turns were made from left-turn lanes onto four-lane divided arterial streets in suburban areas, and one was made from a left turn lane onto a two-lane one-way street in an outlying business district.	Cognitive measures: University laboratory. Driving measures: business district and residential street networks	Only the Trail Making Part B test showed a significant correlation to performance on the driving task, with a correlation coefficient of -0.42 ($p<.0001$). The correlation between Trails A and driving performance was -0.03 ($p<.7329$). The TMB showed the highest correlation of all factors (visual, visual perception, cognitive, range of motion) included in the analysis. All factors investigated were included in a stepwise procedure of regression analysis. The only significant factors were Trails B, trunk rotation to the right, Trails A, overall visual perception response-time score, and spatial relationship error score, which together accounted for 45 percent of the total variability in driving performance. According to the signs of the regression coefficients in this model, better driving performance was associated with better cognition as measured by the Trail Making Tests, better range of motion in trunk rotation, and better visual perception.	Tarawneh, McCoy, Bishu, and Ballard (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Search & Sequencing: **Trail Making Test** (Part A)	• Healthy elderly controls (n=13); mean age = 73.5; CDR score =0 • Subjects with very mild dementia (n=12) ; mean age = 72.5; CDR score = 0.5 • Subjects with mild dementia (n=13); mean age = 73.4; CDR score = 1.0 Subjects came from the Washington University Longitudinal Studies population Dementia severity measured w/ Washington University's Clinical Dementia Rating	Attentional and visuospatial assessments were conducted prior to the road test. The standard Trails A test was among these pre-driving assessments. The in-vehicle, on-road driving ability of participants was scored independently by a driving instructor (blind to study design and dementia status of the subjects), and an unblinded occupational therapist. The vehicle was a standard model car w/ automatic transmission and equipped with dual brake pedals. Each subject drove for 1 hour on a pre-designed route using urban streets and highways, that included common driving situations (stop signs, traffic signals, left turns at intersections, entering and exiting an interstate highway, changing lanes, merging, diagonal and parallel parking). Subjects drove in low volume conditions. A gestalt "pass/fail" rating was given by each observer in the vehicle.	Washington University Alzheimer's Disease Research Center.	Five subjects--all in the CDR 1 stage--"failed" the in-car on-road test. There was 100% agreement between the driving instructor and principal investigator in their pass/fail ratings for all 38 drivers. The ability to follow the driving instructor's directions, the demonstration of appropriate decision-making ('judgment') in traffic, and interpretation of traffic signs were highly correlated with overall driving performance. Other behaviors demonstrated by subjects who "failed" the in-car exam included coasting to a near stop in the midst of traffic, drifting into other lanes of traffic, stopping abruptly without cause, simultaneously pressing the brake and accelerator while driving, delay in changing lanes when an obstacle appeared, and failure to understand why other drivers signaled them in frustration or exaggeration. The correlation between the pass/fail outcome on the road test and performance on Trails A was significant at the $p<.02$ level.	Hunt, Morris, Edwards, and Wilson (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Search & Sequencing: **Trail Making Test** (Part B)	121 licensed drivers forming groups composed of : • 47 normal/nondemented elderly (mean age 72.9) • 29 middle-aged/nondemented controls (mean age 40.6) • 45 cognitively impaired drivers (mean age 73.3) • 28 with mild dementia • 8 with moderate dementia • 9 with cognitive impaired but not meeting the criteria for dementia	Paper-and-pencil test of general cognitive function. Part B includes both numbers and letters, and requires connecting the two in alternating order (1 to A to 2 to B, etc.). The score on either test is the overall time (seconds) to complete the connections. Mistakes are pointed out by the test administrator and are corrected as they occur; their effect is to increase the overall time required. [6 other psychometric tests were included in this study: letter cancellation, stroop, choice reaction time, WAIS-R picture completion, WAIS-R comprehension subtest, and Direct Assessment of Functional Status] Two operational level dependent measures were collected using the Computerized Driving Assessment Module (CDAM): simulator brake reaction time and simulator steering accuracy. The CDAM consists of an automobile seat, dashboard with speedometer, brake and gas pedals, steering wheel, computer monitor for display of instructions, and a double arc of light-emitting diodes (LEDs) set at eye-level subtending 190° of visual field which generate stimuli for steering tasks. The brake RT measure comprised the average of three trials, where the subject was instructed to maintain a "speed" of 50 kph while monitoring a screen for the appearance of a STOP sign. RT corresponded to the interval between the appearance of the word STOP and the time the brake pedal was fully depressed. Steering accuracy was computed by summing the areas of deviation between the curve describing the position of computer generated lights and the curve generated by the steering actions of the driver. Maneuvering level measures were assessed on the Motor Vehicle Branch (MVB) Road Test and on a measure of stopping distance in response to a moving hazard. Strategical level measures were related to the accuracy of subjects' self appraisals and comprised the Cone Avoidance Task and a comparison between self-ratings and collateral ratings of driving problems. The cone avoidance task required a subject to maneuver a test vehicle through a course of traffic cones, hitting as few as possible.	Cognitive battery given at Clinic for Alzheimer's Disease and Related Disorders (University Hospital, Vancouver B.C), CDAM testing performed at a local Rehab Center, MVB Road test conducted by license examiners on a class 5 course. Cone Avoidance test conducted on off-road course.	Performance on the Trails Test was only significantly correlated with steering deviation performance in the simulator (correlation = .47 $p<.05$). On the steering deviation task, the demented performed significantly less well than did either of the two control groups. Additionally, the mean steering deviation score for the normal elderly was significantly larger than that of the mid-age group. The only other psychometric measure significantly related to driving performance was WAIS-R picture completion, which was only correlated with brake time on the driving simulator. In both cases, the psychometric tests accounted for less than 25% of the variance in driving behavior. A note of interest: Although the demented had on average, 10 more demerit points than the normal elderly on the MVB road test, 75% of the demented drivers passed the road test. There was no significant correlation between these two tests and performance on the motor vehicle branch test, or on stopping distance or cone avoidance.	Tallman, Tuokko, and Beattie (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Search & Sequencing: **Trail Making Test** (Part B)	20 drivers age 55+ S's were primarily recruited through local news media; some were referred by physicians to a driver evaluation service	S's were administered the following measures: • Snellen visual acuity test • A continuous performance task (CPT) that used a single letter as a target • Simple reaction time • 15 items from Boston Naming Test • Trail Making Part B • Wechsler Memory Test (Mental control and Orientation subtests) • A recognition memory test • A word fluency test (F-A-S) • Embedded Figures Test • Visual Search Test • Motor Free Visual Perception Test Dependent measures included the DMV official summary of driver records for each subject and a standard driving assessment that included paper and pencil tests and a behind-the-wheel examination.	Laboratory (Univ. Of Rochester School of Medicine and Dentristy)	Six subjects were classified as below minimum standards in driving performance (a total of 19 or more errors on the NY State Driving Exam). These 6 subjects scored more poorly on Trails B (mean Trails B total time =130.5 s) than the subjects whose on-road driving performance was at least adequate (mean total Trails B time = 93.07 s) The large interindividual variance resulted in lack of statistical significance for the small sample. The Trail Making Test (Part B) was the only test that was significantly correlated with driving performance for all subjects ($r=0.61$, $p<0.01$). 1 of the 6 below-standard S's had been involved in a road traffic accident in the past 3 years, and another had a conviction for failure to yield while turning left.	Cushman (1988)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Search & Sequencing: **Trail Making Test** (Part B)	17 subjects (age 57-97; mean age = 75) 6 females and 11 males. 8 S's were referred from local mental disorder clinics or from local physicians because of possible dementia and associated driving problems. 9 S's were community residents who did not have suspected dementia or driving problems.	Paper and pencil test where subjects must connect an alternating series of numbers and letters as quickly as possible. The scores are the total time to complete the task and number of errors. An on-road driving assessment was performed with the subject driving with a certified driving examiner in a dual-brake vehicle. Simple maneuvers were first performed in a parking lot, then subjects joined the flow of traffic and traveled over a prescribed route in moderate to heavy traffic. Subjects were scored on the basis of errors or omissions that correspond to points on the State of New York road test exam; higher scores indicate poorer performance. Therefore a total score was used as well as a determination of whether the subject met or exceeded state standards ("pass") or failed to meet standards ("fail"). In addition, a pass/fail rating was given for the subjects' performance in steering control, braking, acceleration, judgment in traffic, observation skills, and turning skills (particularly left turning).	Clinical tests: University Laboratory On-road driving evaluation: parking lot and in-traffic (moderate to heavy traffic situations)	Results of the driving exam indicated that eight subjects passed, eight failed (scored 19 or more errors on the on-road exam), and one could not complete the exam because of poor vision. The analyses conducted in this study compared the subjects who met the driving exam standards with the eight who did not. There was no significant difference in average age of subjects who passed the exam compared to those who failed. Drivers who failed drove significantly fewer miles, however. The below standard group took significantly longer to complete the Trail Making Part B test (mean = 266 s for S's who failed road test; mean =117 s for S's who passed road test, $t(4.5)=3.21$, $p=0.027$). A regression analysis to determine which variables predict driving status was not possible, because some subjects did not complete all measures and because the sample size was relatively small. An exploratory analysis using total score on the road test as the criterion measure and using five preselected variables determined that age, total time on Trail Making Test, and the number of omission errors on the continuous performance AX test were possible predictors, and when average reaction time is added, account for 93% of the variance in the road test scores. Of the 8 persons referred for possible dementia, 5 failed the road test, 2 passed the test, and 1 was unable to complete the evaluation.	Cushman (1992)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Search & Sequencing: **WayPoint** (a derivative Trails B procedure)	Six validation studies with 102 drivers age 20-60: • passenger vehicle drivers • fuel truck drivers • transit bus operators • long distance tractor trailer drivers • emergency response trainees • race car drivers	Four-minute, paper-and-pencil test, where subjects connect alternating numbers and letters in sequence. WayPoint presents 6 exercises in pamphlet form. The first 4 exercises contain 8 numbers and 7 letters which are to be connected in alternating number-letter order by means of a continuous pencil line; the last two exercises contain 5 numbers and 4 letters to be connected in the same way. Some exercises have small pictures used as irrelevant distractors. Subjects are instructed to keep going if they make a mistake. Performance on each exercise is timed with a stopwatch. Can be administered one-on-one or in a group. Uses a (proprietary) windows-based scoring program to assess accident risk (high or low), and a narrative about the person's strengths and weaknesses.	(1) Emergency Response Course and Non-Emergency Response Vehicle Operations Course at the Federal Law Enforcement Training Center (FLETC), Brunswick, GA. (2) Road Atlanta Race Course (3)MARTA - Metropolitan Atlanta Rapid Transit Authority	Based on 207 driver subjects (bus, car, truck, race car drivers), WayPoint correctly classified 72% as high or low accident drivers, missed 18% of the high accident drivers, and falsely labeled 9.2% of the drivers as high accident when they were actually low accident. Results were interpreted to show that errors on WayPoint were directly related to (1) technical errors on a closed course (a high speed drive circuit), (2) directly related to line-of-travel errors, and (3) positively correlated with lap speed. In addition, technical errors were correlated with WayPoint Focus, a measure of a person's "Big Picture." On the non-emergency test, WayPoint errors were positively correlated with driving errors and with the number of traffic cones contacted on the obstacle course. Crash frequency was obtained through self-report in some validation studies and through driver record files in other validation studies.	Michael Cantor WayPoint Research, Inc. Atlanta, GA

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Search & Sequencing: **WayPoint**	101 licensed drivers (39 females and 62 males) age 72-90 (mean age = 78.3) who were members of a preexisting study cohort engaged in longitudinal studies of a community-dwelling cohort of older people (at Buck Center for Research in Aging)	WayPoint presents 6 exercises in pamphlet form. The first 4 exercises contain 8 numbers and 7 letters which are to be connected in alternating number-letter order by means of a continuous pencil line; the last two exercises contain 5 numbers and 4 letters to be connected in the same way. Some exercises have small pictures used as irrelevant distractors. Subjects are instructed to keep going if they make a mistake. Performance on each exercise is timed with a stopwatch. In this study, WayPoint was administered twice (in succession) to see if drivers with presumed cognitive impairment either failed to improve from the first administration to the second, or did not improve as much as subjects without presumed cognitive impairment. The scoring system determines (1) channel capacity or information-processing rate, defined as the average speed per exercise on the first administration over two of the exercises and (2) high vs low risk of preventable and non preventable collisions, reflecting the driver's situational awareness. An on-road driving exam was given by the project driving instructor (owner/operator of a driving school in San Francisco) based on the California Driving Performance Evaluation (DPE), and using the same scoresheet as used for the MDPE given in San Jose by these researchers. (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium). A weighted error score was calculated as total # of unweighted errors, plus twice the sum of critical and hazardous errors. Concentration errors were also noted. Critical errors = errors which would in normal circumstances cause test termination (turning from improper lane, dangerous maneuver, examiner intervention needed). Hazardous errors = dangerous maneuver or examiner intervention. Concentration errors = subject unable to proceed to field office at end of test, or drove past the street on which the field office was located and did not recognize their error.	Novato, Marin County California; Buck Center for Research in Aging	•Average time per exercise on the first administration of WayPoint was strongly related to road test weighted errors (r=.37) as was channel capacity (r=.35). These correlations were significant. •A substantial but not significant correlation was found between overall average time per exercise on the second administration of WayPoint and weighted road test errors (r=.31). •The difference in number of errors from WayPoint 1 to WayPoint 2 was not significant, but the difference in time (5.2 s less on WayPoint 2) was significant. •Two of the 3 cognitively impaired subjects failed to improve their time scores from the first administration to the second. •A multiple regression model using 98 subjects using age, average time per exercise on WayPoint 1, Perceptual Response Time (Part 1 of the UFOV), and average number of cognitive domains on the MMSE in which subjects made 1 error yielded a significant prediction of weighted error score on the drive test (Multiple R = .484, adjusted R^2 =0.202. •Substituting channel capacity for WayPoint average time reduced the number of subjects to 92, and yielded a multiple R of .475 and adjusted R^2 of 0.190. •Eliminating age and using Waypoint average time, MMSE error areas and PRT yielded a multiple R of .462, and adjusted R2 of 0.188. Substituting channel capacity for average WayPoint time yielded Multiple R of .451, adjusted R2 of 0.176. Using only WayPoint 1 average time and PRT as predictors of weighted error score on the road test yielded multiple R = .428; adjusted R^2=0.166.	Janke and Hersch (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attention Switching: **Digit Symbol Subscale of Wechsler Adult Intelligence Scale**	• Healthy elderly controls (n=13); mean age = 73.5; CDR score =0 • Subjects with very mild dementia (n=12) ; mean age = 72.5; CDR score = 0.5 • Subjects with mild dementia (n=13); mean age = 73.4; CDR score = 1.0 Subjects came from the Washington University Longitudinal Studies population Dementia severity measured w/ Washington University's Clinical Dementia Rating	The Digit Symbol subscale of Wechsler Adult Intelligence Scale was given to participants prior to the on-road drive test. This symbol substitution task demands rapid switching of attention between different sources of information. In the WAIS booklet, four rows of blank squares are presented, with each square having above it a randomly assigned number form 1 to 9. At the top of the page is a "key row" that pairs each number, in order, with a different abstract symbol. Following practice trials, the subject must fill in each blank square with the symbol corresponding to its number. The subject is instructed to do this as quickly as possible. After 90 seconds, the test is terminated, and the subjects score is the number of squares filled in correctly. The Digit Symbol test taps visuomotor coordination, fine motor speed, speed of mental operation, visual short-term memory, and visual incidental learning. The in-vehicle, on-road driving ability of participants was scored independently by a driving instructor (blind to study design and dementia status of the subjects), and an unblinded occupational therapist. The vehicle was a standard model car w/ automatic transmission and equipped with dual brake pedals. Each subject drove for 1 hour on a pre-designed route using urban streets and highways, that included common driving situations (stop signs, traffic signals, left turns at intersections, entering and exiting an interstate highway, changing lanes, merging, diagonal and parallel parking). Subjects drove in low volume conditions. A gestalt "pass/fail" rating was given by each observer in the vehicle.	Washington University Alzheimer's Disease Research Center.	Five subjects--all in the CDR 1 stage--"failed" the in-car on-road test. There was 100% agreement between the driving instructor and principal investigator in their pass/fail ratings for all 38 drivers. The ability to follow the driving instructor's directions, the demonstration of appropriate decision-making ('judgment') in traffic, and interpretation of traffic signs were highly correlated with overall driving performance. Other behaviors demonstrated by subjects who "failed" the in-car exam included coasting to a near stop in the midst of traffic, drifting into other lanes of traffic, stopping abruptly without cause, simultaneously pressing the brake and accelerator while driving, delay in changing lanes when an obstacle appeared, and failure to understand why other drivers signaled them in frustration or exaggeration. The correlation between the pass/fail outcome on the road test and performance on the Digit Symbol Test was significant at the $p < .007$ level.	Hunt, Morris, Edwards, and Wilson (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attention Switching: **Washington University Attention Switching Task**	• Healthy elderly controls (n=13); mean age = 73.5; CDR score =0 • Subjects with very mild dementia (n=12) ; mean age = 72.5; CDR score = 0.5 • Subjects with mild dementia (n=13); mean age = 73.4; CDR score = 1.0 Subjects came from the Washington University Longitudinal Studies population Dementia severity measured w/ Washington University's Clinical Dementia Rating	Attentional and visuospatial assessments were conducted prior to the road test. In attention switching, subjects were given a sheet of paper with rows of randomly intermixed numbers and letters in large print. Subjects were asked to circle only numbers until instructed to switch and circle only letters until again instructed to switch. Alternating commands (letters or numbers) were given every 30 seconds for 2 minutes. Subjects failed this test if they independently switched (i.e., without the command), circled both numbers and letters without discrimination, or were unable to complete the task. The in-vehicle, on-road driving ability of participants was scored independently by a driving instructor (blind to study design and dementia status of the subjects), and an unblinded occupational therapist. The vehicle was a standard model car w/ automatic transmission and equipped with dual brake pedals. Each subject drove for 1 hour on a pre-designed route using urban streets and highways, that included common driving situations (stop signs, traffic signals, left turns at intersections, entering and exiting an interstate highway, changing lanes, merging, diagonal and parallel parking). Subjects drove in low volume conditions. A gestalt "pass/fail" rating was given by each observer in the vehicle.	Washington University Alzheimer's Disease Research Center.	Five subjects--all in the CDR 1 stage--"failed" the in-car on-road test. There was 100% agreement between the driving instructor and principal investigator in their pass/fail ratings for all 38 drivers. The ability to follow the driving instructor's directions, the demonstration of appropriate decision-making ('judgment') in traffic, and interpretation of traffic signs were highly correlated with overall driving performance. Other behaviors demonstrated by subjects who "failed" the in-car exam included coasting to a near stop in the midst of traffic, drifting into other lanes of traffic, stopping abruptly without cause, simultaneously pressing the brake and accelerator while driving, delay in changing lanes when an obstacle appeared, and failure to understand why other drivers signaled them in frustration or exaggeration. All 5 CDR 1 subjects who failed the road test performed poorly on the attention switching task. The correlation between the pass/fail outcome on the road test and performance on the attention switching task was significant at the $p<.0001$ level.	Hunt, Morris, Edwards, and Wilson (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Smith-Kettlewell Modified Synemen Perimeter** (Optifield II) visual field-integrity loss and attentional visual field-integrity loss	3,669 randomly-selected Class C license renewal applicants, licensed in California for at least 12 years, and unable to renew by mail. Four driver age groups were studied: 26-39, 40-51, 52-69, and 70+.	The perimeter looks like half a large globe 2.5 ft in diameter. The subject is seated looking into the globe, to view a small spot of red light at the far end of the globe. For the Standard Visual Field test, subject focuses eyes on red spot and releases a button each time a green light is flashed. Test spots (green lights) are presented 5 times at 8 different distances from the red focal light along each of 5 meridia (e.g., spokes of a wheel). The meridia stretched to the upper right (rear-view mirror location), the far left and the far right, and the lower left and lower right (where lane boundaries would be seen in one's side vision). For the Attentional Visual Field test, the red fixation light blinked on and off, irregularly. In addition to pressing a button each time a green light appeared, the subject was required to count and remember how many times the red fixation-light blinked. Both tests must be given in a dimly-lighted room, and each requires about 6 minutes to administer. 5 experimental vision tests were employed: • Pelli-Robson Low-Contrast Acuity Test (measures loss in low contrast acuity; ability to see objects and borders) • Smith-Kettlewell Low-Luminance Card (measures high-contrast near-acuity loss and low-contrast near-acuity loss) • Berkeley Glare Tester (measures low-contrast near acuity loss, and low-contrast near-acuity loss in the presence of glare) • Modified Synemen Perimeter (measures standard visual field-integrity loss and attentional visual field-integrity loss) • Visual Attention Analyzer (measures loss in UFOV, the area of the visual field in which useful information can be rapidly extracted from a complex visual display) The dependent measure was the crash frequency during the previous 3-year period, extracted from the DMV database. Drivers also completed a Driving Habits Survey measuring level of restriction (never, sometimes, often or always) for night driving, rain or fog, sunrise or sunset, driving alone, left turns, and heavy traffic.	California DMV Field Offices: Carmichael El Cerrito Roseville	<u>Standard field</u>: S's rated test as face valid (clear instructions, safety-related, and fair in requiring driver license applicants to pass similar sensory tests to get full driving privileges). <u>Attention field</u>: clarity of instructions rated high, but safety-relatedness and fairness of requirement to pass were not rated as high as for sensory tests. Regression analyses showed that S's who performed more poorly on attentional tests tended to rate them more negatively. •For all age groups combined, test score was not significantly associated with total prior 3-year crash involvement when considered in isolation. •Standard field integrity was excellent for all age groups, but, when an attentional task was added, the S's age 70+ showed a marked deterioration. They also showed high variability in attentional field-integrity loss. •Poor perf. on the standard field test showed small, but statistically significant predictive value for S's aged 26-39 and 70+. •After adjusting for gender, age, and exposure, the standard field test explained 1.9% of the variance for all age groups, and the attention field test explained 1.6% of the variance. Approx. 5% of the variation in reported level of self-restriction was explained by test performance or age (the worse the visual perf. or the older the driver, the more restriction). There was no significant association between vision score and avoiding heavy traffic or driving alone for standard field, or for heavy traffic for attentional field. 11.4% of the variation for age 70+ S's was accounted for by the avoidance of left turns and low attention-field scores.	Hennessy (1995)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	Drivers are referred by the State DMV (PennDOT) for a driving evaluation As of 12/8/95, 48 subjects ages 64-84 were screened. Results presented here are for these 48; however as of 10/11/96, 55 subjects were screened, and their results strengthen the trend.	**In Progress Study:** "Enhancing Mobility in the Older Driver through Improving the Useful Field of View." Older drivers are referred (physician or PennDOT) to Bryn Mawr for a driving evaluation. UFOV screening was added to the existing driving protocol, which includes an on-road driving assessment. The drivers who fail the UFOV screening are eligible for recruitment into the UFOV screening study. UFOV will be assessed post-training, and participants will be given a repeat driving evaluation. A model 2000 Visual Attention Analyzer was used to measure the detection, localization and identification of suprathreshold targets in complex displays. The size of a person's UFOV is determined by manipulating three variables: target presentation duration, the competing attentional demands of the central and peripheral task, and the salience of the peripheral target. Three subtests provide a measure of the percentage reduction of a maximum 35 degree radius field. During the first subtest (measuring processing speed capability and vigilance), the test participant must identify a centrally located object which varies in duration, by pressing an icon of a truck or a car (whichever was presented) on the touch-screen display. The second subtest (measuring divided attention capabilities) requires the same identification, in addition to locating a simultaneously presented peripheral target of varying eccentricity. A third subtest (measuring selective attention capabilities) required the same two responses required for subtests 1 and 2 while the peripheral target is embedded in distractors. The composite measure of UFOV reduction is recorded as a percentage ranging from 0% to 90%, and the basis for the loss can be determined by considering the percentages of loss on the three subtests.	Bryn Mawr Rehabilitation Center (Pennsylvania)	Results of the UFOV screening are strongly correlated with on-road driving evaluation; of the clients who pass the UFOV test (less than 40% reduction in UFOV), the majority pass the on-road evaluation, and of the clients who fail the UFOV test (have > 40% reduction in UFOV), the majority fail the on-road evaluation. Of the 23 drivers who passed the UFOV, 18 passed the on-road, 4 failed on-road, and 1 is pending. Of the 25 drivers who failed UFOV screening, 6 passed the on-road eval., 16 failed the on-road, and 3 are pending. [It was noted that for many of the older subjects, the UFOV protocol was tedious and tended to undermine their confidence; they carried this loss of confidence over to the driving exam. Therefore the test protocol was changed to that the driving examination was conducted first, and was followed by the UFOV test.] Results for 9 drivers who received training (8-to-12-sessions) with the UFOV protocol showed improved UFOV scores, but only 2 drivers improved on-road performance.	On-going NIA project sponsored through Roybal Center for Mobility Enhancement in the Elderly. Principal Investigator - Tom Kalina

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	294 older drivers, ages 56-90 years at enrollment, drawn from the population of licensed drivers in Jefferson County over age 55. 33% had 0 crashes on record 49% had 1 to 3 crashes over the prior 5 year period 18% had 4 or more crashes over the prior 5 year period	Objective: To identify measures of visual processing associated with crash involvement by older drivers, in a prospective follow-up study. •Subjects received the following sensory tests: Letter Acuity - ETDRS chart Contrast Sensitivity - Pelli-Robson chart Stereoacuity - TNO Test Disability Glare - MCT-8000 (VisTech) Visual Field Sensitivity - Humphrey Field Analyzer 120-point program for central 60 degree radius field •Subjects received comprehensive eye exam resulting in a primary diagnosis (cataract, age-related maculopathy, glaucoma, diabetic retinopathy) •Mental status was assesses using the MOMSSE, with composite score ranging from 0-28. Lower scores = higher functioning. Scores greater than 9 = cognitive impairment. •Visual Attention was measured with the Vision Attention Analyzer: Subtest 1: Visual processing speed (score 0-30% reduction; impaired = >0) Subtest 2: Divided attention (score 0-30 % reduction; impaired = >14) Subtest 3: Selective Attention (score 0-30% reduction; impaired = >28) Overall UFOV composite score (0-90% reduction of the maximum 30 degree field size)--impaired UFOV =40% reduction or greater •"On the road" exposure was estimated using questionnaire data on number of days/week subjects drove and annual number of miles driven. Subjects were asked if anyone had ever suggested they limit or stop driving. Dependent variable: Motor vehicle crash occurrence during the 3 years following clinic assessment, obtained from Alabama Department of Public Safety. Person-years to first crash was calculated from enrollment date; Person-miles of travel was calculated by multiplying person-years times reported annual mileage.	University of Alabama, Birmingham Ophthal-mology clinic	•56 S's had at least 1 crash in the 3-year follow-up period, and 11 of these had 2 or more. •Estimated annual crash rate was 7.4 per 100 person-years of driving and 7.1 per million person-miles of travel. •Crash involvement in prior 5-year period was significantly associated with increased crash risk (Risk ratio = 2.0) •S's who reported that someone had suggested they limit or stop driving were no more likely to be involved in a crash. •Impaired UFOV was the only visual processing variable associated with increased crash risk. •Significant, independent associations with crash risk in 3-year follow-up were found only for: •UFOV reduction of ≥ 40%: RR=2.3; 95% CI = 1.27 - 4.29) •Driving < 7 days/week: 48% decreased crash risk (95% CI = 0.27 - 1.01). •Dx of diabetic retinopathy (5X greater risk, 95% CI = 1.13 - 21.8). •Dx of glaucoma: (RR=5.20, 95% CI = 1.19-22.72). Relationship for glaucoma and crashes stronger for males (RR=9.81) than females (RR=5.14). •Of UFOV component scores, speed of processing (subtest 1) and selective attention (subtest 3) were NOT associated with crash occurrence. Impairment in divided attention (subtest 2) was significantly associated with a 2.3 fold increased risk of crashing (95% CI = 1.24 - 4.38, p=0.01). •For every 10 points of UFOV reduction, S's had 16% increase in crash risk. •Estimates are that 24% of older driver crashes are due to UFOV reduction ≥40%.	Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	193 older drivers between age 55-87 (mean = 71 years), identified through Alabama Department of Public Safety Files. 78 drivers (cases) had at least 1 crash in the prior 5-year period that resulted in an injury to anyone in the involved vehicles. 115 drivers (controls) had no crashes in the same 5-year period. 53% male 47% female 83% White 17% African American	Objective: to identify visual risk factors for vehicle crashes by older drivers that result in injury. •Subjects received the following sensory tests: Letter Acuity - ETDRS chart (impairment = worse than 20/40) Contrast Sensitivity - Pelli-Robson chart (impairment = log CS of 1.5 or worse) Stereoacuity - TNO Test (impairment = 500 arcseconds or worse) Disability Glare - MCT-8000 (VisTech) (impairment = values > 0) Visual Field Sensitivity - Humphrey Field Analyzer 120-point program for central 60 degree radius field (impairment = loss of sensitivity > 1 log unit [10 dB]) •Subjects received comprehensive eye exam resulting in a primary diagnosis (cataract, age-related maculopathy, glaucoma, diabetic retinopathy) •Mental status was assesses using the MOMSSE, with composite score ranging from 0-28. Lower scores = higher functioning. Scores greater than 9 = cognitive impairment. •Visual Attention was measured with the Vision Attention Analyzer (composite scores from 0 - 90% reduction). •"on-the-road" driving exposure was estimated, using subjects' responses to a questionnaire that asked how many days per week and how many miles per year they drove. •Presence vs absence (self-reported) of common chronic medical conditions was determined through interview questions. Dependent measure: involvement in a crash in the previous 5-year period that resulted in an injury to anyone in the involved vehicles. **FINDINGS (Cont'd)** NOTE: although medication information was not collected in this study, Glynn et al. (1991) reported that the use of topical eye medications in elderly patients with glaucoma increased their risk of falling (an adverse mobility outcome).	University of Alabama, Birmingham	•No significant differences between cases and controls were found with respect to driving habits (exposure). •The odds ratio for a case driver having one or more chronic diseases was 2.2 (95% CI=1.1 to 4.5). •Case drivers were 2.1 times more likely to receive a score of greater than 9 on the MOMSSE as compared to control drivers. •Univariate analyses showed that older drivers involved in injurious crashes were more likely to have impairments in stereoacuity (OR=2.2); visual field sensitivity (OR=2.6 for central and 2.4 for peripheral); and UFOV reductions (OR =5.3 for 23 to 40% reduction; 16.3 for 41 to 60 % reduction; and 22.0 for greater than 60% reduction). • Univariate analyses for common eye diseases in the elderly showed that of the 4 conditions considered, only glaucoma and macular degeneration had significantly elevated point estimates. Case drivers were 3.6 times more likely to report a diagnosis of glaucoma compared to controls; case drivers were 3.3 times more likely to have macular degeneration. • Only 2 variables were independently associated with crash risk in the multivariate analyses: UFOV and glaucoma. • UFOV reductions of 22.5-40%, 41-60%, and >60% were associated with 5.2, 16.5, and 21.1-fold increased risk of an injurious crash, respectively compared to those with reductions of <22.5%. •Cases were 3.6 times more likely to report glaucoma than were controls.	Owsley, McGwin, Ball, K. (1998).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	239 older drivers, ages 56-90 years at enrollment, drawn from the population of licensed drivers in Jefferson County over age 55. Mean Age = 70.36 (sd = 8.95) 112 females 127 males 82% Caucasian 18% African American S's were recruited from the larger sample of drivers participating in the larger study (Ball et al., 1993); those with poor visual acuity were excluded (since those w/ acuity worse than 20/50 uniformly fail the first subtest of the UFOV).	Objective: to examine the utility of a set of commonly used neuropsychological tests in comparison to the UFOV in predicting state-recorded, at-fault crashes in the prior 5 year period in a group of older drivers. Measures included: • MOMSSE (total performance score) • Trail-Making Part A (time to complete) • Trail Making Part B (time to complete) • Wechsler Memory Scale - Visual Reproduction Subtest /WMS-VR (total raw score) •Rey-Osterrieth Complex Figures Test (accuracy scores for copy trial and immediate recall trial) •UFOV/Visual Attention Analyzer (composite % reduction; impaired/fail ≥ 40% vs unimpaired/pass < 40% Crash records were obtained from the Alabama Department of Public Safety; At-fault accidents were determined by 3 independent raters. Safe drivers = 0 at-fault crashes (n=115) Crashers = 1 or more at-fault crashes (n=124) **FINDINGS (Cont'd)** <u>Individual Analysis of Each Cognitive Variable for Predictiveness</u> •Each measure significantly associated with crash status; however, sensitivity & specificity less than that achieved with UFOV reduction score. <u>Measure</u> — <u>OR</u> — <u>Sensitivity</u> — <u>Specificity</u> MOMSSE 1.16 61.3 58.3 Trails A 1.02 57.3 62.6 Trails B 1.00 50.8 60.0 WMS-VR 0.90 66.1 52.2 Rey-O copy 0.95 50.0 61.7 Rey-O immed. 0.95 64.5 47.0 <u>Model using UFOV pass vs fail</u>: •Model statistically significant (p<.0001, OR = 33.92, 95% CI = 16.54, 69.50) •Classification success = 85.4%, with sensitivity of 86.3% and specificity of 84.3%. (same ad MODEL 3 continuous UFOV score)	University of Alabama, Birmingham	<u>MODEL 1- predictive ability of traditional neuropsychological tests</u> (MOMSSE, Trails A Time, Trails B Time, WMS-VR score, Rey-O copy score & immediate recall score) •Model statistically significant (p<.01) •MOMSSE score & Trails A time uniquely accounted for differences in outcome of crash status. •Classification success = 58.6% overall, correctly identifying 57.3% of crashers (sensitivity) and 60.0% of non crashers (specificity). <u>MODEL 2 - traditional tests & UFOV</u> •Model statistically significant (p<.001) •UFOV added unique info., accounting for crash status. •Classification success = 77.4% overall, with sensitivity of 76.6% and specificity of 78.3%. •Model 2 significantly better than Model 1 (p<.001) <u>MODEL 3 - UFOV alone</u> •Model statistically significant (p<.001). •Classification success = 85.4%, with sensitivity of 86.3% and specificity of 84.3%. •No significant difference between Model 3 and Model 2. •Estimated probability of crashing w/ UFOV score of 20 = 22%; for UFOV score of 60 = 81%.	Goode, Ball, Sloane, Roenker, Roth, Myers, and Owsley (1998).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	53 drivers ages 57-83 (mean age = 70), recruited from the Primary Care Clinic of the School of Optometry at the University of Alabama at Birmingham. Subjects had valid AL licenses and drove at least 1,000 mi/yr	A model 2000 Visual Attention Analyzer was used to measure the detection, localization and identification of suprathreshold targets in complex displays. The size of a person's UFOV is determined by manipulating three variables: target presentation duration, the competing attentional demands of the central and peripheral task, and the salience of the peripheral target. Three subtests provide a measure of the percentage reduction of a maximum 35 degree radius field. The dependent variables were the total number of state-recorded accidents in the previous 5-year period, total number of convictions for traffic violations in the past 5-year period. (This was because self-reported accidents and state-reported accidents had a very poor relationship, r=.11). The objective of the research was to determine whether incorporating eye health (ratings of the media, central vision, peripheral vision problems, diagnosis of cataract), visual function [acuity (Bailey-Lovie Chart), contrast sensitivity (Pelli-Robson), stereoacuity (Randot, TNO, Frisby), disability glare (Vistech MCT 8000), color discrimination (Farnsworth), visual field (Humphry Visual Field analyzer)], UFOV (Visual Attention Analyzer) , and mental status (MOMSSE test: information, abstraction, digit span, orientation, verbal memory, visual memory, speech, naming, comprehension, sentence repetition, writing, reading, drawing, block design, total score) could predict number of accidents in the sample. Subjects also completed Driving Habits Questionnaire to obtain measures of self-reported accident frequency and a composite measure of driving avoidance.	University Vision Laboratory	•UFOV was related to measures of peripheral vision (central and peripheral sensitivity loss) and to night acuity. •Only the mental status total score and UFOV were significantly related to state-reported accidents. Only the UFOV was related to traffic citations. •Eye health alone was not linked to accidents, and visual function alone was not significantly related to accidents. •There were significant zero-order correlations between UFOV and accident frequency ($r=.36$, $p<0.004$) and between mental status and accidents ($r=0.34$, $p<.02$). •S's who failed the UFOV had 4.2 times more accidents than those who passed. S's with high MOMSSE composite mental scores experienced 3.5 times more accidents than those with scores less than 10. Together these variables predicted accident frequency, accounting for 20% of the variance $R^2=0.20$, $f(2,49)=6.01$, $p<0.005$. •For intersection accidents, S's who failed the UFOV had 15.6 times more intersection accidents than S's who passed. S's with high MOMSSE scores had 6.3 times more intersection accidents. Together, these variables predicted 29% of the variance in intersection accidents, $R=.54$, $F(2,49)=9.8$, $p<0.001$. •For intersection accidents, MOMSSE: 25 correct rejections, 11 false alarms, 5 underpredictions (for no accident S's) and 9 misses and 3 hits for accident-involved S's. UFOV: 26 correct rejections, 14 false alarms, 1 miss, 11, hits.	Owsley, Ball, Sloane, Roenker, and Bruni (1991)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	294 drivers age 55-90 living in Jefferson County, AL, who were legally licensed to drive. 8 age categories = 55-59; 60-64; 65-69; 70-74; 75-79; 80-84; and 85+.	Visual Attention Analyzer. UFOV performance was summarized as a composite score ranging between 0-90, representing total percentage reduction of UFOV. Crash data (total at-fault crashes) for the 5-year period before testing were provided by AL Dept. Of Public Safety, and defined 3 categories of crash frequency for the previous 5-year period: 0, 1-3, 4+. The 294 drivers were involved in 364-at fault crashes. Test battery included tests described for Owsley, Ball, Sloane, Roenker, and Bruni (1991), plus the following cognitive tests assessing visuospatial abilities: Rey-Osterreith test; Trailmaking test; and the WAIS block design test. --- **FINDINGS (Cont'd)** As a predictor, UFOV resulted in 142 hits, 18 misses, 25 false-positives, and 109 correct rejections. Of the 25 false-positives, 19 were S's who reported avoiding driving in general, avoided driving alone, and/or avoided left turns, thus minimizing their driving exposure. Removing these people from the data set increases the correlation between UFOV and crash frequency from $r=0.52$ to $r=0.62$. UFOV had high sensitivity (89%) and high specificity (81%); mental status had sensitivity and specificity values of 61% and 62%, respectively.	University Vision Laboratory	The following correlations were found between crash frequency and: Eye health =.23 ($p<0.01$); Central vision* = -.24 ($p<0.01$); Peripheral vision = .26 ($p<0.01$); Mental status = .34 ($p<0.01$); UFOV = .52 ($p<0.01$). *neg correlation, because higher numbers for centrral vision = better performance; for other variables, lower numbers = better performance) •LISREL modeling program was used to evaluate IV in terms of whether they directly influence a DV, or operate indirectly through other IV's. Central vision, peripheral vision, and eye health were intercorrelated; they have indirect effects on crash frequency, but direct effects on UFOV. UFOV and mental status were the only variables that had a direct effect on crash frequency, accounting for 28% of the variance in crash frequency. •Central and peripheral vision accounted for 30% of the UFOV variance. Mental status had a significant direct effect on UFOV and crash frequency, but its effect on crash frequency was indirect, because removal of its direct effect from the model only sightly reduced the crash frequency accounted for (28% to 27%). If UFOV is entirely removed from the model, the remaining visual variables jointly account for 5% of the crash frequency. Adding the mental status to the eye status variables accounts for 16% of the variance in crash frequency. Inclusion of UFOV maximizes the prediction of crash frequency.	Ball, Owsley, Sloane, Roenker, and Bruni (1993)

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ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	3,669 randomly-selected Class C license renewal applicants, licensed in California for at least 12 years, and unable to renew by mail. Four driver age groups were studied: 26-39, 40-51, 52-69, and 70+.	A model 2000 Visual Attention Analyzer was used to measure the detection, localization and identification of suprathreshold targets in complex displays. Three subtests provide a measure of the percentage reduction of a maximum 35 degree radius field. The three measures were: total UFOV loss, perceptual-reaction time, and UFOV loss associated with divided attention. 5 experimental vision tests were employed: • Pelli-Robson Low-Contrast Acuity Test (measures loss in low contrast acuity; ability to see objects and borders) • Smith-Kettlewell Low-Luminance Card (measures high-contrast near-acuity loss and low-contrast near-acuity loss) • Berkeley Glare Tester (measures low-contrast near acuity loss, and low-contrast near-acuity loss in the presence of glare) • Modified Synemen Perimeter (measures standard visual field-integrity loss and attentional visual field-integrity loss • Visual Attention Analyzer (measures loss in UFOV, the area of the visual field in which useful information can be rapidly extracted from a complex visual display) The dependent measure was the crash frequency during the previous 3-year period, extracted from the DMV database. Drivers also completed a Driving Habits Survey measuring level of restriction (never, sometimes, often or always) for night driving, rain or fog, sunrise or sunset, driving alone, left turns, and heavy traffic. **FINDINGS (Cont'd)** •Of drivers age 52-69, less than 7% failed the UFOV test. •Approximately 7% of the variation in reported level of self-restriction was explained by total UFOV and divided attention test performance (or age), and 5% for PRT (or age)--the worse the visual performance or the older the driver, the more restriction. UFOV subtests were the only measure associated with the avoidance of heavy traffic. Also avoided by 70+ age S's with poor UFOV: total amount of driving, driving in rain and fog, avoiding parallel parking, driving alone, driving at sunrise or sunset, and making left turns.	California DMV Field Offices: Carmichael El Cerrito Roseville	•S's rated clarity of instructions high, but safety-relatedness and fairness of requirement to pass were rated lower than sensory tests. Regression analyses showed that S's who performed more poorly on attentional tests tended to rate them more negatively. •For all age groups combined, test score was not significantly associated with total prior 3-year crash involvement when considered in isolation. •S's aged 70+ showed high variability in visual divided attention ability and PRT. There was a very small percentage of drivers age 70+ with very good total UFOV. •Test scores had small but significant predictive value (2.9%) for S's age 70+. •After adjusting for gender, age, and exposure, total UFOV scores explained 0.9% of the variance in crash involvement, PRT explained 0.9% and divided attention explained 0.9%. •Association with crashes for S's in the 70+ age group was even stronger, with total UFOV accounting for 4.1% of the variation in crashes, PRT accounting for 4.1% of the crashes, and divided attention accounting for 4.3% of the crashes in the oldest age group. UFOV not predictive of crashes in the 3 younger age groups. •Of 285 S's age 70+, 84 (29%) scored poorly. 36 of the 285 S's had an accident, and of the 36, 13 (36%) scored poorly on the UFOV. Thus UFOV sensitivity = 36%, specificity=71%, positive predictive accuracy=15.5%. For citation occurrence, sensitivity=28%, specificity=70%, positive predictive accuracy=12%.	Hennessy (1995)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	1,475 ITT Hartford Insurance Co. policyholders for whom past driving histories were available through insurance records, divided into two groups based on the presence or absence of recent at-fault accidents. Driver age ranged between 50 and 80+ and was distributed as follows: • 26 percent of the sample were between 50-64, • 54 percent were between 65-74, • 20 percent were over 75. Participants were active drivers who had (generally) been pre-screened for risk in the insurance underwriting process. Also, participants who came in for testing appeared confident in their driving abilities.	The Visual Attention Analyzer was employed; the overall score from the three subtests--speed of information processing, divided attention, and a measure of distractibility--was used to describe useful field of view loss. Insurance and motor vehicle department records provided information about the following variables: at-fault accidents, non-fault accidents, non-accident claims, violations and convictions, miles driven, age, gender and marital status.	Testing rooms in hotels in 15 cities throughout Connecticut, Florida, and Illinois	Results showed that 42 percent of the sample had an at-fault accident between 1989-1991. Univariate correlations and multiple regression analyses were computed to determine the relationships between the variables and accidents. The correlation between performance on the UFOV test and at-fault accidents ($r=0.05$) was significant ($p<0.05$). The low correlation was explained by the possibility that because participants were recruited through their insurance company (as opposed to being recruited through an eye clinic and offered a detailed eye exam, as were the subjects in the Ball et al. [1991] study), drivers who were less confident in their driving skills may have elected not to participate for fear that their insurance rates could be affected.	Brown, Greaney, Mitchel, and Lee (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	101 licensed drivers (39 females and 62 males) age 72-90 (mean age = 78.3) who were members of a preexisting study cohort engaged in longitudinal studies of a community-dwelling cohort of older people (at Buck Center for Research in Aging)	Only Part 1 of this test was used in the study. Part 1 tests processing speed for stimuli in the fovea, rather than visual field. The subject must identify a silhouette rapidly flashed in the central part of the field as either a car or a truck. Stimulus duration ranges from 16 to 500 ms; the briefest stimulus duration at which a subject could make the identification correctly 75% of the time is his/her score. An on-road driving exam was given by the project driving instructor (owner/operator of a driving school in San Francisco) based on the California Driving Performance Evaluation (DPE), and using the same scoresheet as used for the MDPE given in San Jose by these researchers. (See On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium). A weighted error score was calculated as total # of unweighted errors, plus twice the sum of critical and hazardous errors. Concentration errors were also noted. Critical errors = errors which would in normal circumstances cause test termination (turning from improper lane, dangerous maneuver, examiner intervention needed). Hazardous errors = dangerous maneuver or examiner intervention. Concentration errors = subject unable to proceed to field office at end of test, or drove past the street on which the field office was located and did not recognize their error.	Novato, Marin County California; Buck Center for Research in Aging	The correlation between performance on Module 1 of the UFOV (here called "PRT") and road test performance was moderately high, but did not reach significance (r= 0.27). A multiple regression model using 98 subjects using age, average time per exercise on WayPoint 1, Perceptual Response Time (Part 1 of the UFOV), and average number of cognitive domains on the MMSE in which subjects made 1 error yielded a significant prediction of weighted error score on the drive test (Multiple R = .484, adjusted R^2 =0.202. Substituting channel capacity for WayPoint average time reduced the number of subjects to 92, and yielded a multiple R of .475 and adjusted R^2 of 0.190. Eliminating age and using Waypoint average time, MMSE error areas and PRT yielded a multiple R of .462, and adjusted R2 of 0.188. Substituting channel capacity for average WayPoint time yielded Multiple R of .451, adjusted R2 of 0.176. Using only WayPoint 1 average time and PRT as predictors of weighted error score on the road test yielded multiple R = .428; adjusted R^2=0.166. PRT was (after WayPoint) the best predictor of weighted error score, with a unique contribution of R^2 of 3%, after adjustment for age.	Janke and Hersch (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	Recruitment is focused on older drivers over the age of 80 in the attempt to identify a higher percentage of drivers who qualify for the training protocol.	**In Progress Study**: "UFOV Training Intervention." Subjects are screened on visual acuity, contrast sensitivity, and UFOV. Those who demonstrate impaired driving and reduced UFOV are assigned to training or no training group. Driving performance for trained group is compared to that of untrained participants.	Washington University	Preliminary results indicate that the average UFOV reduction for those who pass the driving evaluation is 26% while the average reduction for marginal drivers is 52%. Retraining has been complete on 1 older driver, however this individual remained marginal due to difficulty in following directions and general confusion. An additional 20 participants are scheduled to participate in 1996-1997.	Study Funded by NIH through Roybal Center Principal Investigator: Linda Hunt, O.T.
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	Older drivers in the Chicago area are recruited through GEICO insurance records, based on past driving record to ensure inclusion of individuals with a range of crash involvement.	**In Progress Study**: "UFOV Training Intervention." Data collection includes UFOV, visual acuity, contrast sensitivity, and visual sensitivity. Subjects are randomly assigned to the training or no training groups; crash involvement is tracked subsequent to training, along with mobility and continued driving histories.	Rehab Institute of Chicago	Recruitment underway, with approximately 700 Chicago drivers ages 55+ with points on their record relative to approximately 6,500 similar drivers with 0 points on their record. (Center update 1/9/96) Data collection continues through 1996-1997.	Study Funded by NIH through Roybal Center: Principal Investigator: Christie Rom, O.T.

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Attentional Visual Field: **Visual Attention Analyzer (UFOV)**	Active mature drivers age 48-94 (mean age = 69) who were residents of Warren county, KY and surrounding area. Recruited through letters, telephone conversations, and public addresses to community groups. Also, letters sent to drivers age 55+ who had been involved in at least 1 crash between 1988 and 1993 During the 1st 2 years of study (1993-1995) 456 older drivers were screened for attentional difficulties with UFOV. 129 s's with restriction of 35% or more in attentional field were identified, and 71 completed the training study. Individuals with < 30% UFOV reduction were recruited as control S's (n=25) Visual acuity and contrast sensitivity were assessed to ensure that poor visual attentional performance was not caused by poor visual function	S's were divided into 1 of 2 training groups: (1) <u>UFOV</u>: (n=49 subjects); four 1-hour blocks on UFOV, customized to needs of individual (processing speed, divided attention training, and/or selective attention training). Size of UFOV assessed; training continued until a mastery level of 75% correct performance was achieved (average training time = 4.5 hours). (2) <u>Doron Driving Simulator</u>. (n=22 subjects) : Two educational sessions of 2 hours each. Included 3 hours of instruction in driver safety + 1 hour on-the-road demonstration of these driving skills (e.g., safe following dist, use of turn signals). <u>Control group</u> (n=25): Individuals with < 30% UFOV reduction Participants were assessed on several visual, attentional, and driving tasks; then training proceeded, and S's were re-assessed on the same measures. These included: •UFOV •Simple RT to simulated brake lights (Doron L-225 Driving Simulator) •Complex RT to Doron simulator stimuli •15-mi open road driving evaluation (1-mile warm up, plus 2 loops of a 7-mile urban/suburban route) <u>Driving evaluation</u>: Two independent evaluators in the back seat rated each driver on a checklist of 455 driving skills. Behaviors rated on 3 point scale: 0=very unsafe or inappropriate; 1=somewhat unsafe; 2=safe or appropriate. Also a global rating of driving skill was indicated, ranging from 1 (drive aborted/very unsafe) to 6 (very competent driver). Eleven composite behaviors were formed from the 455 individual items: (1) acceleration; (2) gap selection; (3) position in traffic; (4) signals; (5) speed; (6) stop position; (7) deceleration; (8) tracking; (9) turning; (10) right of way; and (11) changing lanes. A visual search composite had to be dropped from analyses due to difficulty in assessing behavior. A dangerous maneuver composite was created from 17 high traffic roadways, consisting of 6 left unprotected turns, 9 entrances to high traffic road from stop sign, and 2 opportunities for inappropriate stopping in traffic to turn right.	Bowling Green, KY: Laboratory and on-road, in-traffic Evaluations	•UFOV scores significantly improved across testing sessions for only the UFOV-trained subjects (average = 24.44 point improvement). •No significant differences were found across testing sessions for Simple Reaction Time. •For Complex RT, only the UFOV-trained group significantly improved their scores (average improvement = 0.287 sec, or 23 feet) •On the on-road driving evaluation, both the Simulator and UFOV-trained group improved their global ratings across test sessions; there was no change in the control groups' global rating. •For turning (turning into the correct lane), stop position (positioning vehicle at stops in order to see clearly but not obstructing traffic flow) and signals (signaling 100-150 ft in advance of a turn) composites, only the simulator-trained group significantly improved from pre- to post-training test. •No group by pre/post interactions were found for the other composites, but general improvement was found for all groups from pre to post test. This reflects comfort and familiarity on second drive through the route. •For the dangerous maneuvers composite, only the UFOV-trained group demonstrated a significant reduction in the number of dangerous maneuvers from pre to post test. •Simulator training was effective in some areas of specific instruction and demonstration; UFOV training did not transfer to driving skills that reflect the mechanical operation of the vehicle, but improved items that measured critical search and judgment abilities in visually cluttered and cognitively demanding situations.	Roenker, Cissell, and Ball (Submitted)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Divided Attention: *Multi*CAD	82 "referred" subjects aged 60-91 (26 of which were identified as probably being cognitively impaired to some degree). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment.	This test used *MultiCAD* to measure drivers' ability to remain vigilant and respond in a timely and appropriate manner to events that occurred directly ahead, in the travel path, while detecting unexpected events of a safety-critical nature that occur in the areas of peripheral vision. After angular motion sensitivity data were obtained, the same driving video continued to use the lead vehicle target as a "foveal task" (i.e., located centrally along the driver's line of sight). At predetermined intervals in relation to a (lead vehicle) brake light stimulus, vehicles and pedestrians, offset at angles of 15 degrees and 30 degrees to the left and right sides, were introduced unexpectedly in the periphery of the driver's forward vision. The motion of these peripheral targets brought them into potential conflict with the driver within several seconds' travel time at current speeds. For threats intersecting from the periphery at approximately a 15-degree angle of eccentricity (2 trials), the measures of effectiveness were (1) mean reaction time for correct response to (a) a vehicle pulling out from behind a building on the right side of the scene and (b) a vehicle backing out of a parking space from behind a (blocking) U-Haul van on the left side of the scene; and (2) percent error for these two trials. For threats intersecting from the periphery at approximately a 30-degree angle of eccentricity (1 trial), the measures of effectiveness were (1) mean reaction time for correct response to a pedestrian stepping of the curb and entering the driver's path; and (2) percent error. Multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance on road tests (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium), and comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance on nondriving tests and driving tests.	California DMV Field Office	The proportion of errors on trials with a threat at 15 degrees was significantly correlated with weighted error score on the drive test ($r=.2430$, $p<.043$). Neither mean time (to 15 or 30 degree targets) nor proportion of errors to threats at 30 degrees were correlated significantly with weighted error score on the drive test. Although the cognitively impaired referrals had higher error proportions for threats at 15 and 30 degrees (did not brake in 34% of either trial type) than did cognitively unimpaired referrals (who did not brake in 16% and 30% of the trials), the differences were not significant. Response time to targets at 15 and 30 degrees did not discriminate between cognitively impaired referrals and cognitively unimpaired referrals.	Janke & Eberhard (1998). Staplin, Gish, Decina, Lococo, and McKnight (*in press*)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Driving Knowledge: **Rules of the Road**	105 drivers licensed in Nebraska, aged 65-88 (mean age = 71.4). 54 were females (mean age = 70.5 years); 51 were males (mean age = 72.2 years). All subjects were volunteers, and were paid $25.00 for participating. 36 had taken a driver education course in the past 10 years.	50-question, multiple choice test designed to determine the driving knowledge pertinent to the types of accidents in which older drivers in Nebraska were over-involved. Questions pinpointed contributing circumstances (failure to yield, disregard signal, improper turn signal, improper turn, following too close, and improper lane change) and accident type (right angle, rear end, side swipe, head on, left turn, other turn, right turn, and pedestrian). The percentage of the questions answered quickly was used as the measure of driving knowledge. The driving performance of the subjects was evaluated using the on-street driving performance measurement (DPM) technique developed by Vanosdall and Rudisill (1979). The subjects were evaluated by a driver education expert trained in the use of the DPM technique, while they drove in their own cars. The DPM route was a 19-km circuit designed to evaluate the subjects in the situations that are most often involved in the accidents of older drivers. Therefore, their performance was evaluated at 7 intersections where they were required to make left turns at 5 intersections and right turns at the other 2 intersections. Four of the left turns were made from left-turn lanes onto four-lane divided arterial streets in suburban areas, and one was made from a left turn lane onto a two-lane one-way street in an outlying business district.	Paper and pencil test: University laboratory. Driving measures: business district and residential street networks	The driving knowledge test score was significantly correlated with driving performance (correlation coefficient =0.27, p=0.0053). Better performance on the knowledge test was associated with better on-road driving performance. Of interest is the finding that whether or not a subject had taken a driver education course within the past 10 years had a very small correlation with on-road driving performance. Most of the subjects who had taken the course had taken it more than 5 years ago; therefore, the findings are not applicable to older drivers who have taken the course in the past 5 years.	Tarawneh, McCoy, Bishu, and Ballard (1993).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)40
ATTENTION/ PERCEPTION/ COGNITION Driving Knowledge: **Rules of the Road**	• 102 "referred" subjects aged 60-91 (34 of which were identified as probably being cognitively impaired to some degree). 47% of the noncognitively impaired referred drivers had visual impairment noted on their record, and 24% of the cognitively impaired had a visual disability noted). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment. • 33 paid "volunteers" aged 56-85, recruited through signs posted at study site or word of mouth.	12-item multiple-choice written test with 4 alternatives per item. Items selected from DMV's standard renewal knowledge test. Three tiers of analyses were conducted in this research: (1) logistic regressions to determine what combination of tests, observations, or survey variables, with what weightings, would best predict whether a subject was a volunteer or referral; (2) multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance on road tests; and (3) comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance on nondriving tests and driving tests. (See On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium).	California DMV Field Office	Referral drivers made significantly more errors than did the volunteer group. The correlation between knowledge error and group was not significant, however (r= .234) Average number of errors : referrals = 2.70 Volunteers = 1.58 The correlation between knowledge test errors and weighted errors on the road test was significant for the combined referral and volunteer group ($r=.3847$, $p<.000$) and for the referral group only ($r=.3316$, $p<.001$). A multiple linear regression model using knowledge test score, Auto Trails time, Doron Cue Recognition 2 score, MultiCAD Static Contrast Sensitivity time with the high contrast 20/80 target, and MultiCAD Static Acuity time for correct responses at 20/80 accounted for 56.4% of the variance in performance on the road test (weighted road test error score). Although the cognitively impaired group had more knowledge test errors (average = 3.76) than the cognitively unimpaired group (average = 2.14), the difference was not significant.	Janke & Eberhard (1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)4
ATTENTION/ PERCEPTION/ COGNITION Driving Knowledge: **Rules of the Road**	17 subjects (age 57-97; mean age = 75); 6 females and 11 males. 8 S's were referred from local mental disorder clinics or from local physicians because of possible dementia and associated driving problems. 9 S's were community residents who did not have suspected dementia or driving problems.	The road (driving) knowledge test was a multiple choice paper and pencil test consisting of 21 questions assessing knowledge of rules of the road. It additionally required subjects to identify and describe the meaning of 16 road signs (what the required driver action was); later, they were required to identify 6 of these signs by shape, when presented without wording, and in a black-and-white format. An on-road driving assessment was performed with the subject driving with a certified driving examiner in a dual-brake vehicle. Simple maneuvers were first performed in a parking lot, then subjects joined the flow of traffic and traveled over a prescribed route in moderate to heavy traffic. Subjects were scored on the basis of errors or omissions that correspond to points on the State of New York road test exam; higher scores indicate poorer performance. Therefore a total score was used as well as a determination of whether the subject met or exceeded state standards ("pass") or failed to meet standards ("fail"). In addition, a pass/fail rating was given for the subjects' performance in steering control, braking, acceleration, judgment in traffic, observation skills, and turning skills (particularly left turning).	Clinical tests: University Laboratory On-road driving evaluation: parking lot and in-traffic (moderate to heavy traffic situations)	The group that failed the road exam had significantly lower mean scores on the written (multiple choice) knowledge test and the road sign identification test. Of the 8 persons referred for possible dementia, 5 failed the road test, 2 passed the test, and 1 was unable to complete the evaluation.	Cushman (1992)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)44
ATTENTION/ PERCEPTION/ COGNITION Driving Knowledge: **Traffic Sign Recognition**	• 102 "referred" subjects aged 60-91 (34 of which were identified as probably being cognitively impaired to some degree). 47% of the noncognitively impaired referred drivers had visual impairment noted on their record, and 24% of the cognitively impaired had a visual disability noted). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment. • 33 paid "volunteers" aged 56-85, recruited through signs posted at study site or word of mouth.	Two-part written traffic-sign test. Part 1 presented pictures of traffic signs and asked whether it meant that the driver should perform a certain action (e.g., "watch for hazards"). Part 2 presented several traffic sign shapes embedded in complex abstract drawings, and subject were to indicate the number of sign shapes of a particular type hidden in the drawing. Three tiers of analyses were conducted in this research: (1) logistic regressions to determine what combination of tests, observations, or survey variables, with what weightings, would best predict whether a subject was a volunteer or referral; (2) multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance on road tests; and (3) comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance on nondriving tests and driving tests. (See On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium).	California DMV Field Office	The correlation between traffic sign errors and group (volunteer vs referral) was not significant. Although the referral group made more errors on the traffic sign test (average = 8.20) than did the volunteers (average = 6.90), the difference was not significant. Sign test errors correlated significantly with weighted errors on the road test ($r=.2026$, $p< .044$) for the combined referral and volunteer group, but not for the referral group only ($r=.1046$, $p<.396$) Traffic sign error score did not discriminate between cognitively impaired referral subjects (average error score = 8.67) and cognitively unimpaired referral subjects (average error score = 7.96)	Janke & Eberhard (1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)4
ATTENTION/ PERCEPTION/ COGNITION Driving Knowledge: **Traffic Sign Recognition**	• Healthy elderly controls (n=13); mean age = 73.5; CDR score =0 • Subjects with very mild dementia (n=12) ; mean age = 72.5; CDR score = 0.5 • Subjects with mild dementia (n=13); mean age = 73.4; CDR score = 1.0 Subjects came from the Washington University Longitudinal Studies population Dementia severity measured w/ Washington University's Clinical Dementia Rating	Traffic sign recognition required the identification of the following four standard symbols: traffic merging, no right turn, no left turn, and no U turn. These symbol signs were chosen because they are frequently encountered in everyday driving situations. Subjects were asked to explain the meaning of each symbol. Each item was scored individually to determine if one type of sign posed greater difficulty than the others. The in-vehicle, on-road driving ability of participants was scored independently by a driving instructor (blind to study design and dementia status of the subjects), and an unblinded occupational therapist (Principal Investigator). The vehicle was a standard model car w/ automatic transmission and equipped with dual brake pedals. Each subject drove for 1 hour on a pre-designed route using urban streets and highways, that included common driving situations (stop signs, traffic signals, left turns at intersections, entering and exiting an interstate highway, changing lanes, merging, diagonal and parallel parking). Subjects drove in low volume conditions. A gestalt "pass/fail" rating was given by each observer in the vehicle.	Washington University Alzheimer's Disease Research Center.	•Five subjects--all in the CDR 1 stage--"failed" the in-car on-road test. There was 100% agreement between the driving instructor and principal investigator in their pass/fail ratings for all 38 drivers. The ability to follow the driving instructor's directions, the demonstration of appropriate decision-making ('judgment') in traffic, and interpretation of traffic signs were highly correlated with overall driving performance. •Traffic sign interpretation during the road test was scored as "unsafe" when the subject required verbal cues or physical assistance to comply with the sign's intent. Three prohibitive signs (no right turn, no left turn, no u turn) were tested. Ability to interpret an "active" sign (merging traffic) correlated significantly ($p<0.01$) with three "prohibitive" signs as follows: no right turn = 0.553; no left turn = 0.402; no u turn = 0.621. •All 5 CDR 1 subjects who failed the road test performed poorly on the pre-driving traffic sign recognition test. •The correlation between the pass/fail outcome on the road test and performance on the Traffic Sign Recognition test was significant at the $p<.0002$ level. •The authors noted that visual form detection may be impaired in mild senile dementia of the Alzheimer type (SDAT), while visual acuity remains intact; this may contribute to the difficulty some subjects experienced with sign recognition, since the signs were symbols (form) rather than letters (acuity). There was no association between acuity and driving performance in this study.	Hunt, Morris, Edwards, and Wilson (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Driving Knowledge: **Traffic Sign Recognition**	3,238 drivers ages 65+, who applied for renewal of North Carolina driver's license	Test administered by license examiner, requiring the driver to identify and explain the meaning of 12 traffic signs based on their color and shape (e.g., yellow diamond with + would be identified as a warning sign for a crossroad ahead). The signs are displayed six at a time in the viewing equipment used for vision testing. The test is not normally timed for license renewal, however, for the research, examiners recorded how long (seconds) it took license applicants to complete test. Applicants were not told they were being timed; number of errors remained the only criteria for passing or failing test. Three or more errors automatically dismisses a license applicant. Dependent variable: involvement in a police-reported motor vehicle crash during the three-year period immediately preceding license renewal.	Eight NC driver's license offices, representing a mix of urban and rural locations in the western, central, and eastern portions of the State.	Performance declined significantly as a function of increasing age (time to complete test increased with increasing age). Correlational coefficient with number of crashes = 0.05 ($p<0.001$). Annual crash involvements increased with increasing (poorer) cognitive scores.	Stutts, Stewart, and Martell (1996)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Driving Knowledge: **Traffic Sign Recognition**	101 licensed drivers (39 females and 62 males) age 72-90 (mean age = 78.3) who were members of a preexisting study cohort engaged in longitudinal studies of a community-dwelling cohort of older people (at Buck Center for Research in Aging)	Paper-and-pencil test consisting of 12 factually oriented questions requiring a subject to check an alternative corresponding to the meaning of each pictured sign, and one judgmentally oriented question, where an intersection displays a "no left turn" and two "do not enter" signs on the through path, and the subject must check the alternative corresponding to what they could do (turn right). An on-road driving exam was given by the project driving instructor (owner/operator of a driving school in San Francisco) based on the California Driving Performance Evaluation (DPE), and using the same scoresheet as used for the MDPE given in San Jose by these researchers. (See On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium). A weighted error score was calculated as total # of unweighted errors, plus twice the sum of critical and hazardous errors. Concentration errors were also noted. Critical errors = errors which would in normal circumstances cause test termination (turning from improper lane, dangerous maneuver, examiner intervention needed). Hazardous errors = dangerous maneuver or examiner intervention. Concentration errors = subject unable to proceed to field office at end of test, or drove past the street on which the field office was located and did not recognize their error.	Novato, Marin County California; Buck Center for Research in Aging	The correlation between traffic sign errors and weighted error score on the drive test was not significant (r=0.07)	Janke and Hersch (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)402
ATTENTION/ PERCEPTION/ COGNITION Immediate/Delayed Recall: **Logical Memory Subscale of Wechsler Memory Scale**	• Healthy elderly controls (n=13); mean age = 73.5; CDR score =0 • Subjects with very mild dementia (n=12) ; mean age = 72.5; CDR score = 0.5 • Subjects with mild dementia (n=13); mean age = 73.4; CDR score = 1.0 Subjects came from the Washington University Longitudinal Studies population Dementia severity measured w/ Washington University's Clinical Dementia Rating	The Logical Memory subscale of Wechsler Memory Scale was given to participants prior to the on-road drive test. Logical memory assesses immediate or delayed recall of verbal ideas presented in two paragraphs, read aloud by the experimenter. The in-vehicle, on-road driving ability of participants was scored independently by a driving instructor (blind to study design and dementia status of the subjects), and an unblinded occupational therapist. The vehicle was a standard model car w/ automatic transmission and equipped with dual brake pedals. Each subject drove for 1 hour on a pre-designed route using urban streets and highways, that included common driving situations (stop signs, traffic signals, left turns at intersections, entering and exiting an interstate highway, changing lanes, merging, diagonal and parallel parking). Subjects drove in low volume conditions. A gestalt "pass/fail" rating was given by each observer in the vehicle.	Washington University Alzheimer's Disease Research Center.	Five subjects--all in the CDR 1 stage--"failed" the in-car on-road test. There was 100% agreement between the driving instructor and principal investigator in their pass/fail ratings for all 38 drivers. The ability to follow the driving instructor's directions, the demonstration of appropriate decision-making ('judgment') in traffic, and interpretation of traffic signs were highly correlated with overall driving performance. Other behaviors demonstrated by subjects who "failed" the in-car exam included coasting to a near stop in the midst of traffic, drifting into other lanes of traffic, stopping abruptly without cause, simultaneously pressing the brake and accelerator while driving, delay in changing lanes when an obstacle appeared, and failure to understand why other drivers signaled them in frustration or exaggeration. The correlation between the pass/fail outcome on the road test and performance on the Logical Memory test was significant at the $p < .0009$ level.	Hunt, Morris, Edwards, and Wilson (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)403
ATTENTION/ PERCEPTION/ COGNITION Language Abilities/Naming Behavior: **Boston Naming Test**	• Healthy elderly controls (n=13); mean age = 73.5; CDR score =0 • Subjects with very mild dementia (n=12) ; mean age = 72.5; CDR score = 0.5 • Subjects with mild dementia (n=13); mean age = 73.4; CDR score = 1.0 Subjects came from the Washington University Longitudinal Studies population Dementia severity measured w/ Washington University's Clinical Dementia Rating	The Boston Naming Test (Kaplan, Goodglass, and Weintraub, 1976) is a test of knowledge and language abilities (Janke, 1994). Sixty line drawings representing common to rare objects are presented individually to a subject, who must name the object. The subjects were also given a word fluency test (Thurston and Thurston, 1949) and an aphasia battery. The in-vehicle, on-road driving ability of participants was scored independently by a driving instructor (blind to study design and dementia status of the subjects), and an unblinded occupational therapist. The vehicle was a standard model car w/ automatic transmission and equipped with dual brake pedals. Each subject drove for 1 hour on a pre-designed route using urban streets and highways, that included common driving situations (stop signs, traffic signals, left turns at intersections, entering and exiting an interstate highway, changing lanes, merging, diagonal and parallel parking). Subjects drove in low volume conditions. A gestalt "pass/fail" rating was given by each observer in the vehicle.	Washington University Alzheimer's Disease Research Center.	Five subjects--all in the CDR 1 stage--"failed" the in-car on-road test. There was 100% agreement between the driving instructor and principal investigator in their pass/fail ratings for all 38 drivers. The ability to follow the driving instructor's directions, the demonstration of appropriate decision-making ('judgment') in traffic, and interpretation of traffic signs were highly correlated with overall driving performance. Other behaviors demonstrated by subjects who "failed" the in-car exam included coasting to a near stop in the midst of traffic, drifting into other lanes of traffic, stopping abruptly without cause, simultaneously pressing the brake and accelerator while driving, delay in changing lanes when an obstacle appeared, and failure to understand why other drivers signaled them in frustration or exaggeration. The correlation between the pass/fail outcome on the road test and performance on the Boston Naming Test was significant at the $p < .003$ level. The correlation between driving performance and word fluency was not significant. Performance on the aphasia battery correlated significantly with driving performance ($p < .0001$). The authors note that road test performance depended, in part, on the ability to follow verbal commands. Language impairment in SDAT may interfere w/ the ability to understand commands or advice from other passengers, rendering copilots ineffective in ensuring or extending driving competency in demented drivers.	Hunt, Morris, Edwards, and Wilson (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)404
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Mattis Organic Mental Status Syndrome Examination (MOMSSE)**	53 drivers ages 57-83 (mean age = 70), recruited from the Primary Care Clinic of the School of Optometry at the University of Alabama at Birmingham. Subjects had valid AL licenses and drove at least 1,000 mi/yr	A brief mental status examination (Mattis, 1976) consisting of items testing: • -General fund of information (e.g., How many weeks are in a year?) • Verbal Abstraction (e.g., How are a poem and statue alike?) • Attention (forward and backward digit span) • Memory (orientation, verbal memory, reproduction of design from memory) • Language (e.g., test for objects, body parts, double and triple commands, reading silently and aloud) • Construction (draw a clock, cube copying) It is comprised of a sample of several WAIS subtests, a Benton geometric figure, and some items from the Eisenson Test of Aphasia. It requires 15 to 20 mins. to administer. Each of the 14 subtests was scored from 0 (normal) to 2 (impaired), and an overall composite score was calculated by adding subtest scores. Composite scores ranged from 0 to 28 (0 = excellent mental status; 28 = severe dementia) Subjects were also assessed with several other measures to find predictors of accidents. Assessments included: 1. Eye health 2. Visual Function: • Static Acuity (Bailey-Lovie chart) • Contrast Sensitivity (Pelli-Robson) • Disability Glare (MCT 8000) • Stereopsis (Randot, TNQ, Frisby) • Color Discrimination (Farnsworth Dichotomous Test Panel) • Visual Field Sensitivity (Humphrey Visual Field Analyzer) • Useful Field of View- Visual Attention Analyzer 3. Driving Habits Questionnaire (Sloane et al., 1990) to measure self-imposed driving restrictions and self-reported accident frequency Accident information was obtained on all subjects from the Alabama Department of Public Safety. Data obtained for each subject included total number of accidents in the last five years and the total number of convictions for violations of traffic laws.	University of Alabama at Birmingham	Mental Status (Score on MOMSSE) found to be related to number of accidents (r=.36.) When accidents were categorized by type, most were found to be intersection problems. MOMSSE found to be better predictors of intersection accidents than accidents in genera (r=.41). MOMSSE and UFOV together predicted 29% of the variance in intersection accidents, and 20% of the variance in accidents in general. Individuals with high MOMSSE scores (n=8) experienced 3.8 times more accidents on average than those with MOMSSE scores $<$ 10 (n=45). For intersection accidents only, subjects with MOMSSE scores $>$ 10 (n=8) had a total of 9 intersection accidents, and those with scores $<$ 10 (n=39) had only 7 intersection accidents between them. On the basis of the number of subjects in each group, individuals with higher MOMSSE scores had 6.3 times more intersection accidents than those with lower scores. Eye health and measures of visual function were unrelated to accidents, in and of themselves, although they contributed to UFOV performance. MOMSSE as a predictor of intersection accidents: • 34 s's were predicted to have no accidents. 25 S's had no accidents on record, but 9 S's did • 19 S's were predicted to have 1 or more accidents. 11 had no accidents; of the 8 who had accidents, 5 had fewer than predicted by MOMSSE.	Owsley, Ball, Sloane, Roenker, and Bruni (1991)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)4
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Mattis Organic Mental Status Syndrome Examination (MOMSSE)**	294 subjects 56-90 yrs old mean age 71 yrs. 33% 0 crashes 49% 1-3 crashes 18% 4+ crashes Subjects evenly distributed within 7 age groups within each crash category Age Groups: 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85+	The objective of the study was to test a model designed to predict crash frequency in older drivers on the basis of visual and cognitive measures. Mental status was assessed by the Mattis Organic Mental Status Syndrome Examination. The tests described in Owsley et al (1991) were also administered to assess visual sensory function, UFOV, driving habits, and eye health. The dependent variable was the total number of at-fault crashes recorded by the state during the 5-year period prior to testing.	UAB Laboratory	Significant correlation between MOMSSE score and crash frequency ($r=.34$, $p<.01$) Significant correlation between UFOV and crash frequency ($r=.52$, $p<.01$) Significant correlation between eye health (central vision problems, peripheral vision problems, ocular media problems) and crash frequency Significant correlation between central vision and crash frequency ($r=-.24$, $p<.01$). Correlation is neg. Because central vision expressed in terms of log contrast sensitivity, where higher numbers represent better performance) Significant correlation between peripheral vision and crash frequency ($r=.26$, $p<.01$) Data tested with the LISREL VII structural modeling program to evaluate IV's in terms of whether they directly influence DV, or if they operate indirectly through other variables. UFOV and mental status were the only variables that had a direct effect on the crash-frequency variance. Mental status was found to have a small, but significant direct effect on crash frequency, and a larger indirect effect on crash frequency through UFOV. Together, UFOV and mental status (MOMSSE) account for 28% of the variance in crash frequency. Mental status had sensitivity (.61) and specificity (.62) values that were "markedly" less than those for UFOV (.89) and (.81), respectively.	Ball, Owsley, Sloane, Roenker, and Bruni (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Mini-Mental State Evaluation (MMSE)**	105 drivers licensed in Nebraska, aged 65-88 (mean age = 71.4). 54 were females (mean age = 70.5 years); 51 were males (mean age = 72.2 years). All subjects were volunteers, and were paid $25.00 for participating. 36 had taken a driver education course in the past 10 years.	Screening instrument for dementia (Folstein, Folstein, and McHugh, 1975) that contains tests of orientation, immediate and delayed recall, backward spelling, object naming, repetition of a phrase, following a three-stage command, sentence reading and comprehension, sentence writing, and design copying. Scores range from 0 to 30. The driving performance of the subjects was evaluated using the on-street driving performance measurement (DPM) technique developed by Vanosdall and Rudisill (1979). The subjects were evaluated by a driver education expert trained in the use of the DPM technique, while they drove in their own cars. The DPM route was a 19-km circuit designed to evaluate the subjects in the situations that are most often involved in the accidents of older drivers. Therefore, their performance was evaluated at 7 intersections where they were required to make left turns at 5 intersections and right turns at the other 2 intersections. Four of the left turns were made from left-turn lanes onto four-lane divided arterial streets in suburban areas, and one was made from a left turn lane onto a two-lane one-way street in an outlying business district.	Cognitive measures: University laboratory. Driving measures: business district and residential street networks	MMSE showed a significant correlation to performance on the driving task (correlation = 0.24, $p<0.01$).	Tarawneh, McCoy, Bishu, and Ballard (1993).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Mini-Mental State Evaluation (MMSE)** (brief form)	492 subjects age 60+ half were applicants (community group) to the state-home-based long-term care program; half were nursing home residents	An abbreviated test was constructed including the first 4 items of the MMSE in which a cut-off score of 14 provided good sensitivity and specificity, to economically identify cognitive impairment. {NOTE: this study did not address driving performance} The brief MMSE included: (1) orientation to time, (2) orientation to place, (3) memorizing and repeating three nonrelated items (house, bus, dog), and (4) spelling "world" backward.	Community-care setting	A score of 14 had a sensitivity of 98% (i.e., 2% of persons likely to be cognitively impaired would fail to have the full MMSE completed--false negatives) and a specificity of 87% (i.e., 13% of the applicants considered cognitively intact would have to complete the full MMSE--false positives). The 14-point cut-off, when applied to the nursing home population produced a sensitivity of 100% and a specificity of 82.4%.	Paveza, Cohen, Blaser, and Hagopian (1990)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Mini-Mental State Evaluation (MMSE)**	30 licensed drivers age 61-89 (mean = 72.2), recruited by word of mouth from studies of normal aging (n=17), medical and dementia clinics (n=9), and from the community (n=4) 26 males, 4 females 3 subjects had dementia of the Alzheimer's Type; 3 others had dementia of the Vascular Type	The MMSE was given prior to an on-road test. MMSE score of 30 is the best possible score. The road test was 10 miles long and took 45 minutes. An instructor sat in the front seat and two research raters sat in the back seat. Seven closed course tasks and 68 in-traffic scored tasks were rated by scoring 5 relevant behaviors for each task (scanning the environment, lateral position of the vehicle, anterior/posterior position of the vehicle (following too closely), speed, and use of turn signals. The test route began on residential streets in low traffic, and progressed to busy streets, congested city traffic, and freeway driving. The test focused on tasks known to be difficult to older drivers, such as left turns at busy intersections and merging into fast-moving traffic. Failing any behavior resulted in a failure of the task. Scores were calculated by averaging the two raters scores for each item, summing the averaged scores, and dividing by the number of tasks completed. This resulted in in-traffic scores that ranged from 0 to 1. Other cognitive tests included traffic sign recognition (not described in the report); Verbal and Visual memory subscales of the Wechsler Memory Scale; Trail-Making Part A; and computer-generated simple and complex reaction time tests developed by the Neurobehavioral Evaluation System.	Harvard Medical School, Boston, MA. Clinical evaluations; closed-course driving route; in-traffic road test	•In traffic scores ranged from 0.0 to 0.91 (mean = .67). Four subjects for whom the road test was aborted because of dangerous driving behavior received a score of 0. •MMSE scores ranged from, 4 to 30 (mean = 26.2). •MMSE scores for subjects with dementia ranged from 4 to 25 (mean = 14.8). •One subject w/ dementia had a MMSE score of 25. •Five of the 6 subjects who scored 24 or less on MMSE had diagnoses of dementia. •The correlation between MMSE score and in-traffic score was .72, and significant at the p<.01 level. Adjusting for age resulted in no change in the correlation. •Although there was a strong correlation between the MMSE and driving performance, the MMSE alone was deemed inadequate to predict driving performance. The MMSE scores of the four subjects who failed the road test were 4, 16, 21, and 24. Of the subjects who passed the road test, the lowest MMSE score was 14. •The correlations between the in-traffic scores and the other cognitive tests are as follows, with age-adjusted correlations in parentheses: Traffic Sign Recog. 0.65** (0.69**) Visual Memory 0.54** (0.50**) Verbal Memory 0.51** (0.37*) Trails A 0.52** (0.33*) Simple RT -.25 (-.12) Complex RT -0.70** (-0.58**) *p<.05 **p<.01	Odenheimer, Beaudet, Jette, Albert, Grande, and Minaker (1994)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Mini-Mental State Evaluation (MMSE)**	67 patients diagnosed with Alzheimers (met the NINCDS-ARDA criteria were met for diagnosis of probable Alzheimer's) recruited from the Alzheimer's Clinic of the University of Kansas Medical Center (mean age = 71.3, s.d.= 8.3); 100 elderly, non-spousal controls (mean age = 64.6, s.d. 9.4)	The study was conducted to determine if the impaired mental skills in Alzheimer's disease may adversely affect driving ability. A 40-question survey was administered that asked about whether the subject was still driving, and if not, why; car size; miles traveled per month and roadway types; whether the subject drove in inclement weather; usual time of day chosen for driving; usual speed in relation to speed limit; and number of accidents per year in the past 10 years. Family members corroborated AD patients' responses. The Mini-Mental State Exam was also administered. --- **FINDINGS (Cont'd)** The accident rate per million vehicle miles of travel was calculated for the 3 years prior to the study for the 19 AD subjects and 98 normal controls still driving. AD =262 Controls = 14 National Accident Rate All Drivers age 55+ = 5.7 All drivers in Kansas and Missouri = 3.7 and 3.2 The accident rate for AD patients was significantly different from each other group. There was no significant difference between the accident rate for the controls and state or national averages.	Alzheimer's Clinic of the University of Kansas	46 of the AD subjects had stopped driving due to self or other's safety concerns, 1 stopped for failing a driver's test, and 1 stopped for other reasons. Only 2 control subjects had stopped driving (own safety concern and broken hip). The mean MMSE score for all AD patients was 17.3 (s.d.= 7.1) and for controls 29.4 (s.d.=0.79). This difference was significant. The mean MMSE score for the 19 AD patients still driving was 22.3 (s.d. = 2.8) and for AD patients who stopped driving 15.3 (s.d. = 7.4).This difference was significant. The mean number of accidents/person/year for the entire AD group was 0.106 +/- 0.351 after disease onset, and 0.053 +/- 0.224 for the years prior to the disease. The control group had 0.055 +/- 0.241 accidents/person/year for the 10 years of the study.	Dubinsky, Williamson, Gray, and Glatt (1992).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Mini-Mental State Evaluation (MMSE)**	101 licensed drivers (39 females and 62 males) age 72-90 (mean age = 78.3) who were members of a preexisting study cohort engaged in longitudinal studies of a community-dwelling cohort of older people (at Buck Center for Research in Aging)	The 11-item (30 point) MMSE was given in Novato as part of the Buck Center for Research in Aging. Possible errors can occur in the 6 general cognitive domains of orientation (items 1 and 2); registration (item 3), attention/calculation (item 4), recall (item 5), language (items 6-10), and visuospatial perception/praxis (item 11-copying a figure of 2 intersecting pentagons). An on-road driving exam was given by the project driving instructor (owner/operator of a driving school in San Francisco) based on the California Driving Performance Evaluation (DPE), and using the same scoresheet as used for the MDPE given in San Jose by these researchers. (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium). A weighted error score was calculated as total # of unweighted errors, plus twice the sum of critical and hazardous errors. Concentration errors were also noted. Critical errors = errors which would in normal circumstances cause test termination (turning from improper lane, dangerous maneuver, examiner intervention needed). Hazardous errors = dangerous maneuver or examiner intervention. Concentration errors = subject unable to proceed to field office at end of test, or drove past the street on which the field office was located and did not recognize their error.	Novato, Marin County California; Buck Center for Research in Aging	MMSE correct responses were not significantly correlated with road test weighted errors, but MMSE correct responses did significantly correlate with concentration errors on the road test (r=0.09, p=0.359). MMSE "error areas," the number of cognitive domains represented on the MMSE on which at least one error was made correlated 0.27 (p=0.006) with road test weighted errors and 0.29 (p=0.003) with concentration errors. The binary "pass/fail" score on the pentagon item did not relate to road test weighted errors (r=0.0007, p=0.994).	Janke and Hersch (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Mini-Mental State Evaluation (MMSE)**	Matched pair case-control study, with close (1 year) age matching conducted in Sweden • 37 drivers age 65+ (mean age 75.5) with temporarily-suspended licenses due to crashes (23 drivers) or other moving violations (14 drivers). Moving violations were: speeding (2), running stop sign (4), running red light (4) run off the road (4). Mean distance driven/yr = 12000 km; # males = 30, # females = 7 • 37 matched controls age 65+ (mean age 74.8) with no license suspensions within the past 5 yrs; mean # miles driven = 9200 km; # males = 30, # females = 7	The MMSE Score was obtained as a global index of cognitive functioning. Other tests included: **Immediate memory** was tested by a 5-item recall test, where the subject was required to name and recall 5 objects viewed on a desk after a 10-minute period (the items were not listed in this review). The delayed recall score was 1 point per correct item. If the subject failed, the procedure was repeated for up to 3 times. **Visuoconstruction abilities** were assessed by having the subjects copy a cube without time limit. Scoring: 2 points for correct or minor errors only, with 3-dimensional view correct; 1 point for presence of 3-dimensional view but with errors; 0 points if no 3-d view present. The severity of cognitive and functional impairment was judged using the **Clinical Dementia Rating Scale** (CDR). **Static Visual Acuity** was measured using a standard letter chart at 4 m. Subjects underwent blood tests, MRI, and EEG testing --- **FINDINGS (Cont'd)** • Cardiovascular disease was 2.7 times more frequent among s's with crashes than s's with other moving violations. • High diastolic blood pressure occurred more often in crash group compared to controls.	Hospital clinic (Unit of Traffic Medicine, Section of Geriatric Medicine, Department of Clinical Neuroscience & Family Medicine, Karolinska Institutet, Stockholm, Sweden)	• Questionable (CDR=0.5) and mild (CDR = 1) dementia were found significantly more often in the case group than in the matched control group (49% vs 11%, p=.003). • Subjects in case group (suspensions + crashes) had significantly lower MMSE score (p=.019), lower immediate memory task performance (p=.010) and poorer performance on the cube copying task (p=.010) compared to matched controls. • There were no significant differences between cases and controls on visual acuity measure (nor on EEG abnormalities, brain infarctions, neurological signs, white matter hyperintensities, number of prescribed drugs, blood pressure, physician reported cardiovascular disease, or blood tests--sedimentation rate, hemoglobin, leukocytes, platelets, thyroid-stimulating hormone, vitamin B12, folic acid, creatinine, glutamyl transferase, glucose, cholesterol, and triglyceride level.) • Comparison of the 23 case subjects with crashes and the 29 control subjects with no crashes in the past 5 years showed that the crashed drivers had more incidence of dementia/CDR>0 (p<.001), worse cube copying (p<.015), poorer 5-item recall (p<.003), lower MMSE (p<.019), and more EEG abnormalities. • Mean MMSE of case S's with crashes = 27.5; but 78% of drivers with crashes had MMSE greater than 25. Thus, MMSE score of 23-25 has low sensitivity in crash prediction.	Johansson, Bronge, Lundberg, Persson, Seideman, and Viitanen (1996) Johansson (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Mini-Mental State Evaluation (MMSE)**	283 community-dwelling individuals age 72 to 92 (mean age = 77.8) from the Project Safety cohort living in New Haven, CT who drove between 1990 and 1991. 57% were males.	The MMSE was given as part of a battery of tests. The outcome variable was self-reported involvement in automobile crashes, moving violations, or being stopped by police in the year following administration of the test battery.	New Haven, CT. Subjects were interviewed and given the assessments in their homes by a trained research nurse.	Persons with borderline cognitive impairment (MMSE score of 23-25) were more likely to have adverse events (traffic accident, violation, or stopped by police) in the year following examination than those with higher or lower scores (relative risk 2.0, 95% CI, 1.1-3.7). The authors examined the components of the MMSE individually and by cognitive domain (orientation, memory, attention, language, and visuospatial ability), and found that the item most closely associated with adverse events was impaired design copying (24% of persons who could not correctly copy the intersecting pentagons had events compared with 8% of those who could {relative risk 3.0, CI, 1.6-5.6}). A multivariate analysis adjusting for driving frequency and housing type found the following factors to be associated with the occurrence of adverse events: poor design copying on the MMSE (relative risk 2.3, 95% CI, 1.5 to 5.0), fewer blocks walked--0 versus $\geq$ 1 (relative risk 2.3, 95% CI 1.3 to 4.0) and more foot abnormalities--3 to 8 versus 0 to 2 (relative risk 1.9, 95% CI, 1.1 to 3.3). Combining these 3 factors to assess their ability to predict adverse driving events showed that if no factors were present, 6% of drivers had adverse events; if 1 factor was present, 12% had events; if 2 factors were present, 26% had events; and if all 3 factors were present, 47% had events.	Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Mini-Mental State Evaluation (MMSE)**	N/A	A consensus statement was generated by 22 researchers meeting in Borlange Sweden, aimed at providing advice to primary care physicians concerning the assessment of cognitive status in relation to driving. Although consensus could not be reached concerning the issue of a cutoff score on the MMSE, it was determined by the majority (with some reservation) that some cut-off levels can be cautiously proposed in the context of decisions concerning future driving.	Meeting in Borlange Sweeden	•Cutoff scores must be considered as being relative, forming a small part of the basis of making decisions about driving, and secondary to a clinical evaluation. •MMSE score ≤10, accompanied by a diagnosis of dementia, indicates a suficiently low level of cognitive functioning to justify recommending immediate cessation of driving. •MMSE score of 11-17, accompanied by a diagnosis of dementia, suggests severe cognitive impairment; the patient should be referred for specialized assessment unless the clinician feels that it is unnecessary. •MMSE score of 18-23 indicates mild impairment; decisions concerning possible assessment should be based on the functional level of the patient. If the functional level is stable, then a periodic follow up is recommended. If functional deterioration is present, then specialized assessment is recommended •For patients without diagnosis of dementia, score of 17 or less and scores of 18-23 with accompanying signs of functional deterioration should be indications for specialized assessment. •Some participants could not accept this suggested use because: •Risk of designating false positives; low scores are related to illiteracy, aphasia, depression, and resistive behavior; may not correctly assess mental status of patient. •MMSE does not assess poor judgment and impulse control; persons with scores above the cutoff may be inappropriately viewed as safe drivers. •Use may be wasteful adding nothing more to eval. of competence than clinical observation of general functioning.	Lundberg, Johansson, Ball, Bjerre, Blomqvist, Braekhus, Brouwer, Blysma, Carr, Englund, Friedland, Hakamies-Blomqvist, Klemetz, O'Neill, Odenheimer, Rizzo, Schelin, Seideman, Tallman, Viitanen, Waller, and Winblad (1997).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Short Blessed Cognitive Screen**	3,238 drivers ages 65+, who applied for renewal of North Carolina driver's license	Originally a 26-item test (Orientation-Memory-Concentration) test of cognitive impairment, it was shortened to a 6-item test, and has been shown to reliably discriminate among mild, moderate, and severe cognitive deficits. This test requires identification of current year and month, identifying time within one hour, counting backwards from 20 to 1, saying months in reverse order, and repeating a name and address that the test administrator has told the subject just before asking current time. Weighted scores on the test range from 0 (no errors) to 28 (maximum errors). Scores of 0-8 indicate normal or minimal cognitive impairment; 9-19 moderate impairment; and 20 and above severe impairment. Dependent variable: involvement in a police-reported motor vehicle crash during the three-year period immediately preceding license renewal	Eight NC driver's license offices, representing a mix of urban and rural locations in the western, central, and eastern portions of the State.	Performance declined significantly as a function of increasing age (number of errors increased with increasing age). 90% of the sample scored normal or minimally impaired, 9.3% scored moderately impaired, 0.7% scored severely impaired. Prevalence of impairment increased with increasing age. Results of single variable models for the association of each cognitive test measure with recent prior crash involvement using continuous test scores (Chi Square Tests) showed that the Short blessed test was not significant. Multivariate Poisson Regression Models were employed to control for effects of age, race, driving exposure, etc, and included Trails A, Trails B and Short Blessed. All three models fit the data adequately, although the Short Blessed was the least significant of the variables with an associated p-value of 0.48 (odds ratio 1.10, 95% confidence interval 1.01-1.19 for association of cognitive test with recent prior crash involvement). The Short Blessed test was less sensitive to reduced cognitive function than the two Trails tests employed in this research, even though it is supposed to be relatively sensitive to milder levels of impairment. The short answer format may make it less appropriate for driver's license settings, compared to the more performance-based Trail Making and AARP Reaction Time Tests.	Stutts, Stewart, and Martell (1996, 1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Mental Status: **Short Blessed Cognitive Screen**	• Healthy elderly controls (n=13); mean age = 73.5; CDR score =0 • Subjects with very mild dementia (n=12) ; mean age = 72.5; CDR score = 0.5 • Subjects with mild dementia (n=13); mean age = 73.4; CDR score = 1.0 Subjects came from the Washington University Longitudinal Studies population Dementia severity measured w/ Washington University's Clinical Dementia Rating	The Short Blessed Cognitive Test was given prior to the on-road driving exam. This test is scored from 0 (no cognitive impairment) to 28 (maximum impairment). The in-vehicle, on-road driving ability of participants was scored independently by a driving instructor (blind to study design and dementia status of the subjects), and an unblinded occupational therapist (Principal Investigator). The vehicle was a standard model car w/ automatic transmission and equipped with dual brake pedals. Each subject drove for 1 hour on a pre-designed route using urban streets and highways, that included common driving situations (stop signs, traffic signals, left turns at intersections, entering and exiting an interstate highway, changing lanes, merging, diagonal and parallel parking). Subjects drove in low volume conditions. A gestalt "pass/fail" rating was given by each observer in the vehicle.	Washington University Alzheimer's Disease Research Center.	The mean Short Blessed Test scores were: Control group (CDR=0): 0.3 +/- 0.8 Very mild (CDR=0.5): 2.1 +/- 1.9 Mild (CDR = 1.0): 12.4 +/- 7.9 Five subjects--all in the CDR 1 stage--"failed" the in-car on-road test. There was 100% agreement between the driving instructor and principal investigator in their pass/fail ratings for all 38 drivers. The ability to follow the driving instructor's directions, the demonstration of appropriate decision-making ('judgment') in traffic, and interpretation of traffic signs were highly correlated with overall driving performance. Other behaviors demonstrated by subjects who "failed" the in-car exam included coasting to a near stop in the midst of traffic, drifting into other lanes of traffic, stopping abruptly without cause, simultaneously pressing the brake and accelerator while driving, delay in changing lanes when an obstacle appeared, and failure to understand why other drivers signaled them in frustration or exaggeration. The correlation between the pass/fail outcome on the road test and performance on the Short Blessed Test was significant at the $p < .001$ level.	Hunt, Morris, Edwards, and Wilson (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Perceptual Speed: **Cue Recognition (DORON Driver Analyzer)**	• 102 "referred" subjects aged 60-91 (34 of which were identified as probably being cognitively impaired to some degree). 47% of the noncognitively impaired referred drivers had visual impairment noted on their record, and 24% of the cognitively impaired had a visual disability noted). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment. • 33 paid "volunteers" aged 56-85, recruited through signs posted at study site or word of mouth.	Three-part test administered via noninteractive driver simulator system (Doron Precision Systems' L-300 Series Driver Analyzer). A familiarization session allowed for RT testing (press brake to lights flashing in a certain configuration on console). Cue Recognition presents car icons generally facing away from the subject and rapidly and suddenly changing their positions on a wide projection screen. When "action cue" occurs (icon faces forward to the side) the subject is to release the accelerator, and within 5 s, brake or turn wheel in appropriate direction. For Cue 1: action cue is car facing toward subject; subject must brake. For Cue 2: action cue is car faces to left or right and subject must turn wheel in that direction. Cue 3 is a mix of trials from Cue 1 and Cue 2. Release of accelerator from stimulus initiation is timed, and score is output in distance traveled at 55 mi/h from stimulus presentation to accelerator release. Speed of braking or wheel turn is irrelevant. Three tiers of analyses were conducted in this research: (1) logistic regressions to determine what combination of tests, observations, or survey variables, with what weightings, would best predict whether a subject was a volunteer or referral; (2) multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance on road tests; and (3) comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance on nondriving tests and driving tests. (See On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium).	California DMV Field Office	Referral group performed significantly worse than the volunteer group (correlations: Cue 1 and group = .363; Cue 2 and group = .415; Cue 3 and group = .541; total errors and group = .410). Note: These variables were also significantly correlated with age (Correlations: Cue 1 and age = .313; Cue 2 and age = .416; Cue 3 and age = .508; total errors and age = .379) Cue 1, Cue 2, and Cue 3 average distances, total errors, and average RT (Doron orientation exercise) correlated significantly with weighted error score on the road test as follows: Total Errors: $r = .4382$, $p < .000$ Average RT: $r = .3297$, $p < .005$ Cue 1 dist: $r = .4777$, $p < .000$ Cue 2 dist: $r = .4656$, $p < .000$ Cue 3 dist: $r = .3584$, $p < .002$ A multiple linear regression model using knowledge test score, Auto Trails time, Doron Cue Recognition 2 score, MultiCAD Static Contrast Sensitivity time with the high contrast 20/80 target, and MultiCAD Static Acuity time for correct responses at 20/80 accounted for 56.4% of the variance in performance on the road test (weighted road test error score). The cognitively impaired group performed significantly more poorly on Cue 2 , Cue 3 , reaction time, and total errors than the cognitively nonimpaired referrals.	Janke & Eberhard (1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Perceptual Speed: **Cue Recognition (DORON Driver Analyzer)**	101 licensed drivers (39 females and 62 males) age 72-90 (mean age = 78.3) who were members of a preexisting study cohort engaged in longitudinal studies of a community-dwelling cohort of older people (at Buck Center for Research in Aging)	Three-part test administered via noninteractive driver simulator system (Doron Precision Systems' L-300 Series Driver Analyzer). A familiarization session allowed for RT testing (press brake to lights flashing in a certain configuration on console). Cue Recognition presents car icons generally facing away from the subject and rapidly and suddenly changing their positions on a wide projection screen. When "action cue" occurs (icon faces forward to the side) the subject is to release the accelerator, and within 5 s, brake or turn wheel in appropriate direction. For Cue 1: action cue is car facing toward subject; subject must brake. For Cue 2: action cue is car faces to left or right and subject must turn wheel in that direction. Cue 3 is a mix of trials from Cue 1 and Cue 2. Release of accelerator from stimulus initiation is timed, and score is output in terms of time--rather than distance traveled at 55 mi/h, as described for San Jose testing-- from stimulus presentation to accelerator release. Recognition time was available only if the correct (steering or braking) response followed accelerator release. Speed of braking or wheel turn is irrelevant. An on-road driving exam was given by the project driving instructor (owner/operator of a driving school in San Francisco) based on the California Driving Performance Evaluation (DPE), and using the same scoresheet as used for the MDPE given in San Jose by these researchers. (See On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium). A weighted error score was calculated as total # of unweighted errors, plus twice the sum of critical and hazardous errors. Concentration errors were also noted. Critical errors = errors which would in normal circumstances cause test termination (turning from improper lane, dangerous maneuver, examiner intervention needed). Hazardous errors = dangerous maneuver or examiner intervention. Concentration errors = subject unable to proceed to field office at end of test, or drove past the street on which the field office was located and did not recognize their error.	Novato, Marin County California; Buck Center for Research in Aging	The correlations between response time for each Cue Recognition test and weighted road test score were not significant (r=.00 for Cue 1, f=0.20 for Cue 2, and r=0.22 for Cue 3). It should be noted that there were hardware problems at this test site, resulting in many missing data occurrences; and many subjects anticipated critical stimuli and responded before a response window was available in the software, resulting in response time readouts of "zero".	Janke and Hersch (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Selective Attention: **Auditory Selective Attention Test**	72 drivers (58 males and 14 females) ages 28-59, divided into 2 accident groups: • no accidents in the previous 10 years • 1 or more accidents in the past 10 years Subjects were volunteers from a large northeastern utility firm, who had been drivers for the firm during the previous 10 years.	**Auditory Selective Attention Test**: presented 24 dichotic messages simultaneously to the S's ears. A tone presented at the beginning of each trial indicated which ear (right or left) would be presented with the relevant information. Sixteen pairs of letters and numbers were then presented, followed by another tone, and then three pairs of numbers. The S was required to report aloud the digits appearing in the channel that was indicated as being relevant. Scores on the test were the total number of errors made on the test including failure to report a number or letter (omission) on the relevant channel, report of an incorrect competing message number or letter (intrusion error) on the irrelevant channel, and errors on trials following a cue to switch channel attention (switching error). **Visual Selective Attention Test**: constructed for this study to approximate a visual counterpart of the Auditory Test, and was presented to s's via CRT microcomputer. **Group Embedded Figures Test**: a measure of perceptual style ability (field dependence vs field independence) was obtained, in which a S must perceptually extract a target geometric figure embedded within an irrelevant stimulus context. It was predicted that poorer performance on measures of selective attention would be significantly related correlated with higher motor vehicle accident frequency, and that performance on the auditory and visual selective attention tests would be positively correlated. It was also hypothesized that drivers who were found to be field dependent would show a higher motor vehicle accident rate. Also, it was predicted that the measures of selective attention would be positively correlated with the measure of perceptual style.	University laboratory: all S's were tested individually in small experimental rooms that were quiet, comfortable, and well-lighted.	• None of the following variables were significantly correlated with crash frequency: gender, age, number of miles driven daily, or tenure with utility company. • For both measures of selective attention, the accident group showed significantly poorer performance, as evidenced by their higher error frequency. For both selective attention tests, omission errors (failure to report a presented number or letter) and switching errors (errors on trials following a cue to switch channel attention) were significantly correlated with accident frequency. Intrusion errors (report of an incorrect competing message number or letter) on the auditory selective attention test were also positively correlated with accident involvement. • The total number of figures correctly identified with the Group Embedded Figures Test was higher for the no-accident group, but performance on this test was only marginally related to accident involvement ($p<0.10$). • Switching errors on both measures of selective attention were found to have the highest correlation with accident involvement of all the measures in the predictor battery. Correlations: Visual attention switching errors and total number of accidents = 0.40 ($p<0.0001$); auditory selective attention and total number of accidents = 0.43 ($p<0.0001$).	Avolio, Kroeck, and Panek (1985)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Selective Attention: **Auditory Selective Attention Test**	1,475 ITT Hartford Insurance Co. policyholders for whom past driving histories were available through insurance records, divided into two groups based on the presence or absence of recent at-fault accidents. Driver age ranged between 50 and 80+ and was distributed as follows: • 26 percent of the sample were between 50-64, • 54 percent were between 65-74, • 20 percent were over 75. Participants were active drivers who had (generally) been pre-screened for risk in the insurance underwriting process. Also, participants who came in for testing appeared confident in their driving abilities.	A measure of auditory selective attention was obtained using the *Auditory Selective Attention Test* (ASAT), which includes a series of dichotic messages heard through a stereo headset (Arthur, 1991). In this test, each message is presented in two parts and consists of a series of pairs of numbers and letters. A modification from its usual format required subjects to manually record responses on an answer sheet, instead of giving them orally to the experimenter. Insurance and motor vehicle department records provided information about the following variables: at-fault accidents, non-fault accidents, non-accident claims, violations and convictions, miles driven, age, gender and marital status.	Testing rooms in hotels in 15 cities throughout Connecticut, Florida, and Illinois	The Auditory Selective Attention Test did not correlate significantly with at-fault accidents. ASAT data from only Connecticut (initial testing) correlated significantly ($r=0.24$) with at-fault accidents with a simple accident/no accident criterion. Testing conducted in Florida and Illinois did not show the same relationship. The authors note that the ASAT is an auditory test that requires a quiet test environment, which may not have been true of the hotel room test sites in these two states. Testing rooms at times became crowded and noisy, and administration proved to be difficult at times, and there was missing data as site staff tended to eliminate this test on heavily scheduled days.	Brown, Greaney, Mitchel, and Lee (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Selective Attention: **Auditory Selective Attention Test**	Student volunteers from Texas A&M University. Postdictive (1988) sample contained 214 S's, mean age = 19.19 years, 70% females, 30% males Predictive sample (1990) contained 142 s's, mean age = 19.18 years, 68% females, 32% males.	Locus of control-- a measure of personality --measured by the Montag Driving Internality and Driving Externality scales (Montag and Comrey, 1987),and auditory selective attention, a measure of information processing, measured using the Auditory Selective Attention Test were used to predict driving accidents. The ASAT is a dichotic listening task, where 24 dichotic messages are presented simultaneously to subjects via stereo headphones (Gopher and Kahneman, 1971). Each message consists of a pair of single English letters or digits ranging from 0 to 9. The ASAT was scored as the total number of errors. The MDIE was scored as a single scale, with a higher score reflecting a more internal locus of control. The number of accidents was self-reported in 1988 to date; in 1990, number of accidents between 1988-1990 was self-reported.	University Laboratory	ASAT was significantly correlated with 1988/90 total ($r=0.24$, $p<0.01$), at-fault ($r=0.20$, $p<0.01$), and not-at-fault ($r=.15$, $p<0.05$) accidents. It was also significantly related to 1988 total ($r=0.19$, $p<0.01$) and at-fault ($r=0.23$, $p<0.001$) accidents. ASAT was also significantly correlated with 1990 not-at-fault accidents ($r=0.20$, $p<0.01$). The only significant correlation for the Montag Driving Internality and Driving Externality (MDIE) scale was for 1990 not-at-fault accidents ($r=-0.15$, $p<0.05$). The relationship was in the "wrong" direction: an internal locus of control was associated with elevated accident rates. The MDIE was not associated with accident involvement in either the postdictive or predictive design. Selective attention was not related to locus of control. The correlation between these 2 measures was 0.05 ($p>0.05$).	Arthur and Doverspike (1992).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Selective Attention: **Auditory Selective Attention Test**	Meta Analysis: 149 usable data points from 32 articles. The number of data points per predictors was: <u>Predictor</u> <u># of r's</u> Selective attention 13 Perceptual style 12 Choice & complex RT 5 Cognitive ability 10 Age 8 Education 7 General activity level 40 Regard for authority 13 Level of distress 13 Locust of control 13	Selective attention was operationalized as scores on the Auditory Selective Attention Test (Arthur, Barrett, & Doverspike, 1990) or the Dichotic Listening Test (Mckenna et al. 1986). Data points for selective attention comprised omission, intrusion, and switching errors. The 13 studies contained 1,101 drivers. These studies used a professional driver sample and archival criterion data.	Meta-Analysis	Results showed a significant correlation between selective attention and automobile accidents (mean $r=0.257$, $p<0.05$). The 95% confidence interval ranged from a lower limit of $r=0.205$ to an upper limit of $r=0.317$. The results indicated that although a significant amount of unexplained variance remained (43%), the 57% of total variance accounted for was relatively high. Better selective attention was associated with lower levels of accident involvement. In addition, marginally favorable results were obtained for higher regard for authority ($r=0.155$), an internal locus of control ($r=0.196$), and higher cognitive ability ($r=0.117$). The better the performance on these tests, the lower the levels of accident involvement.	Arthur, Barrett, and Alexander (1991)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Selective Attention: **Auditory Selective Attention Test**	39 repeat-accident professional bus drivers ages 22-32, with at least 2 moderately severe accidents 78 control professional bus drivers in the same age range; half with a zero-accident history; half with a low accident rating	The test used Gopher and Kahneman's test. Messages were presented by earphones, and subjects were required to repeat all relevant digits as soon as they heard them. The test lasted 25 minutes. In addition, subjects completed a brief form of Raven's (1956) Progressive Matrices Test (a short intelligence test). The test was completed in 1969. Accident records for the sample were obtained for the period of two years prior to the completion of the Auditory Selective Attention Test (1967-1969), and were used to assess the reliability of the test as a predictor of accidents in professional bus drivers. --- **FINDINGS (cont'd)** •The effects of a selection cutoff at a score of 16 errors in Part 2 were evaluated as an aid to the rejection of a group of applicants who were most likely to be accident prone. The effects of the rules (including the elimination of stereotyped error individuals) were estimated for the entire driving population, by extrapolation from the study results. The results are as follows: <u>sample</u> <u>accept</u> <u>reject</u> <u>invalid</u> <u>total</u> Acc. free 486 14 27 527 Intermed. 386 12 88 482 Acc. Prone 45 26 7 78 Total 913 52 122 1087 Although caution was extended because the study was posdictive rather than predictive, and the cutoff was chosen to fit the present data, the estimates suggest that the use of the ASAT as an aid in decisions about hiring could lead to a 15-25% reduction in the number of accident-prone drivers accepted, at a relatively negligible cost in the rejection of potentially safe drivers.	Testing was conducted during work hours at the local bus station (using employees of the Egged Bus Company, Israel), where they provide interurban and urban bus service.	•The association between accident scores for 2 successive years and performance of the ASAT was significant . Correlations between components of the ASAT (errors of omission in Part 1, errors of intrusion in Part 1, and errors in incorrect reports in Part 2) and the accident criterion were all significant. •Part 2 of the test measures the speed and effectiveness with which attention is redirected to a relevant channel after an orientation cue. When 24 subjects who had an extremely high frequency of all three types of errors (stereotyped patterns of errors where they ignored reorientation tone between Part 1 and 2) were eliminated form the analysis, the validity of the correlation with Part 2 performance and accident performance was improved (r=.46 for errors in Part 2). When the 2 categories of relatively safe drivers were combined and compared to the unsafe group, the point-biserial correlation between accident frequency and the number of errors in Part 2 was 0.51. •The intelligence test did not discriminate significantly between the accident groups, and had a low correlation with the attention test (.33 with Part 2 errors).	Kahneman, D and Ben-Ishai, R. (1973).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Sustained Attention: **Continuous Performance Task -X** **Continuous Performance Task-AX**	17 subjects (age 57-97; mean age = 75) 6 females and 11 males. 8 S's were referred from local mental disorder clinics or from local physicians because of possible dementia and associated driving problems. 9 S's were community residents who did not have suspected dementia or driving problems.	Both tests were administered via personal computer. The **continuous performance task-X** is a measure of sustained attention and assesses subjects' vigilance. Subjects were required to respond with a bar press every time the letter "X" was visualized in a sequence of letters continuously presented over a 5-minute period, where each letter had a 2-second duration. Scores included the number of correct responses, errors of omission, errors of commission, and average reaction time. The **continuous performance task-AX** was identical to the task-x test described above, except the subject was required to respond to an "X" only if it was preceded by an "A". An on-road driving assessment was performed with the subject driving with a certified driving examiner in a dual-brake vehicle. Simple maneuvers were first performed in a parking lot, then subjects joined the flow of traffic and traveled over a prescribed route in moderate to heavy traffic. Subjects were scored on the basis of errors or omissions that correspond to points on the State of New York road test exam; higher scores indicate poorer performance. Therefore a total score was used as well as a determination of whether the subject met or exceeded state standards ("pass") or failed to meet standards ("fail"). In addition, a pass/fail rating was given for the subjects' performance in steering control, braking, acceleration, judgment in traffic, observation skills, and turning skills (particularly left turning).	Clinical tests: University Laboratory On-road driving evaluation: parking lot and in-traffic (moderate to heavy traffic situations)	•Results of the driving exam indicated that eight subjects passed, eight failed (scored 19 or more errors on the on-road exam), and one could not complete the exam because of poor vision. The analyses conducted in this study compared the subjects who met the driving exam standards with the eight who did not. There was no significant difference in average age of subjects who passed the exam compared to those who failed. Drivers who failed drove significantly fewer miles, however. The group that failed the on-road exam made significantly more errors of omission on the continuous performance-AX test (mean errors = 5.86), than those who passed the on-road exam (mean errors = 0.86). They also made more omission errors on the continuous performance-X tasks (8.0 mean errors compared to 0.83). These differences failed to reach significance due to the large variability in this small sample. •A regression analysis to determine which variables predict driving status was not possible, because some subjects did not complete all measures and because the sample size was relatively small. An exploratory analysis using total score on the road test as the criterion measure and using five preselected variables determined that age, total time on Trail Making Test, and the number of omission errors on the continuous performance AX test were possible predictors, and when average reaction time is added, account for 93% of the variance in the road test scores. •Of the 8 persons referred for possible dementia, 5 failed the road test, 2 passed the test, and 1 was unable to complete the evaluation.	Cushman (1992)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Visual Perception: **Benton Visual Retention Test (Copy Test)**	• Healthy elderly controls (n=13); mean age = 73.5; CDR score =0 • Subjects with very mild dementia (*n*=12) ; mean age = 72.5; CDR score = 0.5 • Subjects with mild dementia (n=13); mean age = 73.4; CDR score = 1.0 Subjects came from the Washington University Longitudinal Studies population Dementia severity measured w/ Washington University's Clinical Dementia Rating	The Benton Copy Test (form D) was administered prior to the on-road driving exam. This test measures visuoperceptual function (Benton, 1963). The test involves a ten-card series with each card containing several (usually 3) line drawings in the horizontal plane. The cards are shown for 10 seconds, after which the subject must draw figures from memory. An examiner may also require simple copying of the figures, to assess the accuracy of the subject's drawings, when memory is not involved. The test was scored on the basis of the number of correct drawings. The in-vehicle, on-road driving ability of participants was scored independently by a driving instructor (blind to study design and dementia status of the subjects), and an unblinded occupational therapist (Principal Investigator). The vehicle was a standard model car w/ automatic transmission and equipped with dual brake pedals. Each subject drove for 1 hour on a pre-designed route using urban streets and highways, that included common driving situations (stop signs, traffic signals, left turns at intersections, entering and exiting an interstate highway, changing lanes, merging, diagonal and parallel parking). Subjects drove in low volume conditions. A gestalt "pass/fail" rating was given by each observer in the vehicle.	Washington University Alzheimer's Disease Research Center.	Five subjects--all in the CDR 1 stage--"failed" the in-car on-road test. There was 100% agreement between the driving instructor and principal investigator in their pass/fail ratings for all 38 drivers. The ability to follow the driving instructor's directions, the demonstration of appropriate decision-making ('judgment') in traffic, and interpretation of traffic signs were highly correlated with overall driving performance. Other behaviors demonstrated by subjects who "failed" the in-car exam included coasting to a near stop in the midst of traffic, drifting into other lanes of traffic, stopping abruptly without cause, simultaneously pressing the brake and accelerator while driving, delay in changing lanes when an obstacle appeared, and failure to understand why other drivers signaled them in frustration or exaggeration. The correlation between the pass/fail outcome on the road test and performance on the Benton Copy Test was significant at the $p < .008$ level.	Hunt, Morris, Edwards, and Wilson (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Visual Perception: **Motor-Free Visual Perception Test**	105 drivers licensed in Nebraska, aged 65-88 (mean age = 71.4). 54 were females (mean age = 70.5 years); 51 were males (mean age = 72.2 years). All subjects were volunteers, and were paid $25.00 for participating. 36 had taken a driver education course in the past 10 years.	Visual perception was assessed using the motor-free visual perception test (MVPT) designed by Colarusso and Hammil (1972). This test is composed of 36 questions, divided into five groups, that assess the following aspects of visual perception: spatial relationship; visual discrimination; figure ground; visual closure; and visual memory. Two scores were obtained for each subject for each of the five visual-perception measures; the *response-time* score was the mean time required for the subjects to answer questions pertaining to the given measure, and the *error score* was the number of questions answered correctly. Overall response-time and error scores were also computed. The driving performance of the subjects was evaluated using the on-street driving performance measurement (DPM) technique developed by Vanosdall and Rudisill (1979). The subjects were evaluated by a driver education expert trained in the use of the DPM technique, while they drove in their own cars. The DPM route was a 19-km circuit designed to evaluate the subjects in the situations that are most often involved in the accidents of older drivers. Therefore, their performance was evaluated at 7 intersections where they were required to make left turns at 5 intersections and right turns at the other 2 intersections. Four of the left turns were made from left-turn lanes onto four-lane divided arterial streets in suburban areas, and one was made from a left turn lane onto a two-lane one-way street in an outlying business district.	Cognitive measures: University laboratory. Driving measures: business district and residential street networks	Among the visual perception factors, the following scores correlated significantly with the driving performance measure (correlation coefficient in parentheses): spatial relationships error score (.21), visual discrimination error score (.26), visual discrimination response-time score (-0.22), figure-ground response-time score (-0.28), visual closure response-time score (-0.38), overall error score (.26), and overall response-time score (-0.32). As percent of correct responses increased on the visual perception tests, performance on the driving test increased; as the reaction time scores increased, performance on the driving test decreased. Definitions: <u>Spatial relationships</u>: the ability to orient one's body in space and perceive the positions of objects in relation to oneself and other objects. <u>Visual discrimination</u>: the ability to discriminate dominant features in different objects. <u>Figure-ground</u>: ability to distinguish an object from its background. <u>Visual closure</u>: ability to identify incomplete figures when only fragments are presented. <u>Visual memory</u>: ability to recall dominant features of one stimulus item or to remember the sequence of several items.	Tarawneh, McCoy, Bishu, and Ballard (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Visual Perception: **Motor-Free Visual Perception Test**	42 patients with Alzheimer's Disease (mean age = 72.2 years); 81 normal elderly controls (mean age = 69.1 years) Dementia S's were recruited from the Dementia Research Clinic (DRC) or the Alzheimer's Disease Research Center (ADRC) of the Johns Hopkins University School of Medicine; or from referring physicians and local chapters of the Alzheimer's Assoc. Non-demented S's were recruited from among friends of Drc or ADRC patients and from the community. Control S's were screened for psychiatric illness.	<u>Cognitive tests included</u>: Mini-Mental State Examination [(MMSE), Folstein, Folstein, and McHugh, 1975], Logical Memory and Visual Reproduction subtests (immediate) from the Wechsler Memory Scale-Revised; Category Fluency test (Issacs & Kennie, 1973); Standardized Road Map Test of Directional Sense (Money, 1976); Trail Making A and B (Reitan, 1958); Hopkins Verbal Learning Test (Brandt, 1991); Spatial recognition Span Test (Moss, Albert, Butters, & Payne, 1986); Motor-Free Visual Perception Test (Colarusso & Hammill, 1972); and simple, two-choice, and four-choice reaction time tests. •Driving performance was evaluated using the Doron L225 DrivoTrainer and Driver Analyzer system. Two 15 min "driver-point-of-view" films (Cue recognition task and "Drive to the City"). Drivers were required to brake, steer left or steer right to specific action cues in Cue recognition. In Drive to the City, appropriate performance is recorded under 5 categories: maintaining appropriate speed, use of turn signal, force applied to brake, use of accelerator, and position of steering wheel. •The number of actual crashes, violations, and near misses was obtained for the previous 2 years from control subjects, and from a family member of AD patients. **FINDINGS (Cont'd)** •With "Cue Recognition" as the dependent variable for the larger number of control subjects, age alone explained 26% of the variance. Visual Memory-immediate, # errors on Road Map test, Category Fluency, and visual closure subscore on Motor-Free Visual Perception test jointly accounted for 45% of the variance. Adding age increased the R^2 by 1%. •Considering miles driver/yr and # of crashes and near misses reported on questionnaire, AD patients in the highest mileage category (5,000-7,500) had considerably lower rates (< half) of both crashes and near misses than AD patients who drive <2,000 mi and those who drove 2,000-4,000 mi/yr. However, this group also performed worse in the simulator than the higher mileage AD drivers. This was interpreted that AD patients make an effort to compensate for deteriorating driving skills by driving less, but this is not an adequate strategy. For controls, # of reported crashes was equal for each mileage category.	Johns Hopkins University School of Medicine	•Driver simulator performance measures correlated strongly with Visual Memory immediate scores, & Visual Closure subscore of the Motor-Free Visual Perception Test for both AD and control subjects. •Errors on the standardized Road-Map Test of Directional Sense, completion time on Trails B, and Spatial Recognition span correlated with simulator driving performance only for control subjects. •Multiple regression results for AD patients using "Drive to the City" performance as the dependent variable (DV) showed that MMSE alone accounted for 22% of the variance. Logical Memory-immediate, Trails A time, and the visual closure subscore of the MVPT jointly accounted for 54% of the variance. Adding the MMSE to this set of variables did not account for any additional variance. When "Cue Recognition" was the DV, MMSE alone accounted for 21% of the variance; four-choice RT alone accounted for 33% of the variance, and jointly they accounted for 34% of the variance. •For the control S's with "Drive to the City" as the DV, 2 sets of variables explained the variance (due to a smaller set of S's completing the Spatial Recognition Span Test): For the group N=78, age alone accounted for 23% of the variance, and Visual Memory-immediate, # of errors on Road-Map test, and Trails A accounted for 33%. With age, these variables explained 41% of the variance. For the control S's N=59, age explained 26%; and Visual memory immediate, # errors on Road Map Test, Spatial Recognition span, and Category Fluency jointly accounted for 38% of the variance. Together with age, these variables	Keyl, Rebok, Bylsma, Tune, Brandt, Teret, Chase, and Sterns (manuscript under review)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Visual Perception: **Motor-Free Visual Perception Test**	7 Spinal Cord Injured (and rehabilitated) subjects with a mean age of 27; 10 Traumatic Brain Injured (and rehabilitated) subjects with a mean age of 29 years; The SCI and TBI subjects were representative of disabled clients referred by rehabilitation agencies to driving evaluators as driving candidates The control (able-bodied) group consisted of 8 Introductory Psychology class students, with a mean age of 19 years.	The psychometric predictors included: - Motor WAIS (WAIS Picture Arrangement, Block Design, and Digit Symbol subtests) - Non Motor WAIS (WAIS Arithmetic and Picture Completion subtests) - Motor-Free Visual Perception Test - Baylor Adult Visual Perception Test - Trail making A and B - Symbol Digit Modalities Test - Driver Performance Test (knowledge and judgment test using videotaped scenes of potentially dangerous driving situations) The criterion measure involved expert ratings of performance driving in a full-size vehicle on a closed course.	Rehabilitation Center	The able-bodied subjects drove better than the spinal-cord injured subjects, who drove better than the head-injured subjects. All of the psychometric measures **except the MVPT** correlated significantly with driving performance. The correlation between the MVPT and driving performance was -.382.	Schweitzer, Gouvier, and Horton (1987)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Visual Perception: **WAIS-R Picture Completion Test**	121 licensed drivers forming groups composed of : • 47 normal/nondemented elderly (mean age 72.9) • 29 middle-aged/nondemented controls (mean age 40.6) • 45 cognitively impaired drivers (mean age 73.3) • 28 with mild dementia • 8 with moderate dementia • 9 with cognitive impaired but not meeting the criteria for dementia	Test consists of 20 cards printed with pictures and bound in a booklet. The experimenter tells the subject," I am going to show you some pictures in which there is some important part missing. Look at each picture and tell me/show me what is missing." A maximum exposure of 20 s is allowed for each card. If the subject does not indicate the missing part, item is scored as a failure and the next card is presented. If the subject responds incorrectly, the next card is presented, even if the full 20 s has not elapsed. [6 other psychometric tests were included in this study: letter cancellation, stroop, choice reaction time, Trail Making Part B, WAIS-R comprehension subtest, and Direct Assessment of Functional Status] Two operational level dependent measures were collected using the Computerized Driving Assessment Module (CDAM): simulator brake reaction time and simulator steering accuracy. The brake RT measure comprised the average of three trials, where the subject was instructed to maintain a "speed" of 50 kph while monitoring a screen for the appearance of a STOP sign. RT corresponded to the interval between the appearance of the word STOP and the time the brake pedal was fully depressed. Steering accuracy was computed by summing the areas of deviation between the curve describing the position of computer generated lights and the curve generated by the steering actions of the driver. Maneuvering level measures were assessed on the Motor Vehicle Branch (MVB) Road Test and on a measure of stopping distance in response to a moving hazard. Strategical level measures were related to the accuracy of subjects' self appraisals and comprised the Cone Avoidance Task and a comparison between self-ratings and collateral ratings of driving problems. The cone avoidance task required a subject to maneuver a test vehicle through a course of traffic cones, hitting as few as possible.	Cognitive battery given at Clinic for Alzheimer's Disease and Related Disorders (University Hospital, Vancouver B.C.), CDAM testing performed at a local Rehab Center, MVB Road test conducted by license examiners on a class 5 course. Cone Avoidance test conducted on off-road course.	Performance on the Picture Completion Test was only significantly correlated with Brake Time performance in the simulator (correlation = -.41, $p<.05$). On the simulator brake RT test, the demented had a significantly longer mean reaction time than either of the control groups, while the normal elderly and mid-age controls did not show significantly different performance on this task. The only other psychometric measure significantly related to driving performance was Trail Making, which was only correlated with steering deviation on the driving simulator. In both cases, the psychometric tests accounted for less than 25% of the variance in driving behavior. A note of interest: Although the demented had on average, 10 more demerit points than the normal elderly on the MVB road test, 75% of the demented drivers passed the road test. There was no significant correlation between these two tests and performance on the motor vehicle branch test, or on stopping distance or cone avoidance.	Tallman, Tuokko, and Beattie (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Visual Perception: **WAIS-R Picture Completion Test**	7 Spinal Cord Injured and rehabilitated subjects (SCI) with a mean age of 27; 10 Traumatic Brain Injured and rehabilitated subjects (TBI) with a mean age of 29 years; The SCI and TBI subjects were representative of disabled clients referred by rehabilitation agencies to driving evaluators as driving candidates The control (able-bodied) group consisted of 8 Introductory Psychology class students, with a mean age of 19 years.	The psychometric predictors included: - Motor WAIS (WAIS Picture Arrangement, Block Design, and Digit Symbol subtests) **- Non Motor WAIS (WAIS Arithmetic and Picture Completion subtests)** - Motor-Free Visual Perception Test - Baylor Adult Visual Perception Test - Trail making A and B - Symbol Digit Modalities Test (Smith, 1968) - Driver Performance Test (Weaver, 1984) The DPT is a knowledge and judgment test using videotaped scenes of potentially dangerous driving situations. Separate scales assess capacity for search, identification, prediction, decision making, and execution of correct maneuver. The test measures capacity for polysensory information processing, integration, and motoric output. The criterion measure involved expert ratings of performance driving in a full-size vehicle on a closed course.	Rehabilitation Center	The able-bodied subjects drove better than the spinal-cord injured subjects, who drove better than the head-injured subjects. Correlations between each measure and the criterion were: Motor WAIS = 0.807 Digit-Symbol (WAIS) = 0.782 Trails = 0.668 Baylor = 0.632 **Non motor WAIS = 0.706** Symbol-Digit = 0.839 Motor-Free Visual Perception = -0.382 DPT = 0.847 All of the psychometric measures except the MFVPT correlated significantly with driving, and the correlations exceeded the a=0.005 level of probability. Multiple regression analyses using only 2 predictors, the DPT and Non Motor WAIS (Picture Completion and Arithmetic) variables yielded an R^2 of .81 (accounting for 81% of the variance in driving performance)	Schweitzer, Gouvier, and Horton (1987)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Cognitive Behavioral Driver's Inventory (CBDI)**	92 brain or spinal-cord injured patients from the Center for Outpatient Rehabilitation in Knoxville, TN 61% stroke 21% traumatic brain injury 6% spinal cord injury	Battery includes computerized and standardized psychometric tests. Standardized, nonautomated tests included: • WAIS-R Picture Completion Test • WAIS-R Digit Symbol Test • Trail-Making Test Parts A & B Computerized items were presented on an Atari 800 computer. Test software was adapted from Bracy's (1982, 1985) Cognitive Rehabilitation Programs (BCRP) for brain-injured and stroke patients, marketed through Psychological Software Service, Inc. (PSS). Computerized tests included: •<u>Visual Reaction Differential Response</u> - Computer screen is bisected by vertical line; a small dark square appears in random locations with random inter-trial interval. S pushes joystick toward side of screen on which square appears. DV=response time, variance, errors, and latencies in each visual quadrant. Measures attention, concentration, reaction time. •<u>Visual Reaction Differential Response Reversed</u> - Same as above, but S must push joystick in opposite direction. Measures attention, concentration, reaction time, dynamic cognitive processing, simple decision making. Radio in backroom provides auditory distractors. •<u>Visual Discrimination Differential Response II</u> - Three squares are presented on screen. S fixates on center square and moves joystick toward square that turns same color as center square. Measures rapid decision-making & stimulus discrimination/response differentiation. •<u>Visual Scanning III</u> - Two columns of alpha characters are shown, one on each side of screen. Starting in left column, a character group is highlighted, and S must find matching character group in right column and move cursor to it. Procedure repeats for 20 trials using alternative sides for initial stimulus. Measures ability to shift attention from one stimulus set to another and back. Other tests included: •<u>Keystone Driver Vision Tester</u> - far visual acuity, color vision • <u>Keystone Perimeter Field of Vision</u> - measures up to 90 degrees on each side of fixation point. A road test is given to assess basic vehicle control, attitute, reactions under pressure/stress, direction-following, safety awareness, destination finding, problem solving.	Lakeshore Systems Services, Center for Outpatient Rehabilitation. Knoxville, TN	The 10 tasks yield 27 response measures. A score termed "General Driving Index "GDI27" was defined as the mean standard score of all 27 items. • Internal consistency reliability of the CBDI was 0.95 (Cronbach's alpha) • Correlation between performance on CBDI (GDI27) and road test performance was significant (χ^2=86, Cramer's V=0.97, p<.0001). • Of the 44 patients who passed the CBDI, 42 passed the road test (95.5%). • Of the 48 patients who failed the CBDI, only 6 were allowed to take the road test. All 6 patients "convincingly" failed the road test.	Engum, Pendergrass, Cron, Lambert, and Hulse (1988)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Cognitive Behavioral Driver's Inventory (CBDI)**	121 brain-injured patients at Fort Sanders Regional Medical Center in Knoxville, TN (Cerebral vascular accident and traumatic head injury victims)	See: Engum, Pendergrass, Cron, Lambert, and Hulse (1988). Ten assessment tasks yield 27 response measures dealing with such cognitive/behavioral skills as attention, concentration, rapid decision-making, stimulus discrimination/response differentiation, visual scanning and acuity, and attention shifting. Two scores were calculated for each patient: (1) the overall General Driver's Index (GDI27) defined as the mean standard score of all 27 variables; and (2) the short form Abbreviated Driver's Index (ADI10), defined as the mean standard score of those 10 items with the highest corrected part-whole correlations. The 10 best items with corrected part-whole correlations (which measure how closely a given item correlates with all other items excluding itself) were: • Trails B Time • WAIS Digit Symbol (N correct) • Visual Reaction Differential Response: joy Stick to square (ave. time) • Visual Reaction Differential Response: joy stick to square (Q1 time) • Visual Reaction Differential Response: joy stick to square (Q3 time) • Visual Reaction Differential Response Reverse: joy stick away (ave time) • Visual Reaction Differential Response Reverse: joy stick away (Q1 time) • Visual Reaction Differential Response Reverse: joy stick away (Q3 time) • Visual Reaction Differential Response Reverse: joy stick away (Q4 time) • Left Visual Scanning III (time) Both the GDI27 and ADI10 have a mean of 50 and a standard deviation of 10, with scores above 50 indicating greater levels of disability. Patients were given the CBDI and then an on-road driving test.	Fort Sanders Regional Medical Center in Knoxville, TN	•Short form ADI10 scores and long form GDI27 scores were very closely related [r(GDI27, ADI10)=0.97 ($p<.001$)] •Above average scores on the CBDI (>50 indicates more deficit) were more likely to occur in patients who failed the road test, while below average scores (< 50 indicates less deficit) were more likely to occur in patients who passed the road test. •63 of 121 patients passed the on-road exam. Patients who passed had average GDI27 and ADI10 standard scores of 45. •Patients who failed the on-road exam had average standard scores of 55 •An indeterminate region with standard scores ranging from 47-52 has an overlap of passing and failing distributions. A patient with a standard score in this "zone of uncertainty" is almost equally likely to have passed or failed in the examiner's opinion. •Patients who obtained a standard GDI27 score of 47 or below passed the on-road test 100% of the time. •Patients who obtained a standard GDI27 score of 53 or above failed the on-road test 100% of the time. •The following decision-making criteria are suggested: standard scores of 46 or less are clearly passing; standard scores of 47-52 are borderline; and standard scores of 53 or greater are clearly failing. Borderline test scores on the CBDI are not definitive and an examiner should judge these cases with information independent of the CBDI, such as a road test, behavioral observations, or other neuropsychological tests.	Engum, Lambert, Womac, and Pendergrass (1988).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Cognitive Behavioral Driver's Inventory (CBDI)**	Double-blind validity study using 175 brain-injured patients	See: Engum, Pendergrass, Cron, Lambert, and Hulse (1988). Ten assessment tasks yield 27 response measures dealing with such cognitive/behavioral skills as attention, concentration, rapid decision-making, stimulus discrimination/response differentiation, visual scanning and acuity, and attention shifting. Subjects undergo examination on the CBDI and then are assessed on the road.	Fort Sanders Regional Medical Center in Knoxville, TN	The relationship between CBDI performance (pass, borderline, fail) and the on-road evaluation outcome (pass, fail) was significant ($r=0.81$, $p<.0001$). Of the 42 patients who received a favorable "pass" decision based on CBDI performance, 40 passed the on-road exam. Only 7 of the 39 patients who received an unfavorable "fail" rating on the CBDI passed the on-road test. Patients who passed the road test passed significantly more CBDI items (mean = 17.1) than those who failed the road test (mean = 6.3). Patients who failed the road test failed significantly more CBDI items (mean = 11.7) than those who passed the road test (mean = 1.7) Patients who passed the road test produced a CBDI protocol with much less scatter or within-subject variability (mean = 16.76) than those who failed the road test (mean = 82.33)	Engum, Lambert, Scott, Pendergrass, and Womac (1989).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Cognitive Behavioral Driver's Inventory (CBDI)**	232 patients from rehab centers: (121 members of the original normative sample, plus 111 added to constitute the restandardization sample) 61 patients with left cerebral vascular accidents 60 patients with right cerebral vascular accidents 71 patients with traumatic head injuries 9 patients with spinal cord injuries 31 patients with other disabling and debilitating neurological disorders (multiple sclerosis, Gullian-Barre syndrome, Alzheimer's disease, myasthenia gravis, intrinsic & extrinsic tumors of the brain, Parkinson's disease, toxic encephalopathy)	See: Engum, Pendergrass, Cron, Lambert, and Hulse (1988). Ten assessment tasks yield 27 response measures dealing with such cognitive/behavioral skills as attention, concentration, rapid decision-making, stimulus discrimination/response differentiation, visual scanning and acuity, and attention shifting. Restandardized normative tables support a new General Driver's Index (GDI28), a composite summary of the original 27 CBDI items, plus a measure of within-subject variability. Norms also support the Abbreviated Driver's Index (ADI10), a validity check on GDI28, which is based on the 10 most valid CBDI items in relation to road test performance. (Although there is a strong relationship between ADI10 and GDI28 scores, it is recommended that the ADI10 alone not be used for decision making). New norms also narrow the zone of uncertainty. Subjects undergo examination on the CBDI and then are assessed on the road.	Center for Outpatient Rehabilitation in Knoxville, TN; Fort Sanders Regional Medical Center in Knoxville, TN; and North Alabama Rehabilitation Hospital in Huntsville, AL	•CBDI norms are based on 232 patients; however, only 180 completed road test. 52 patients were not allowed to take the road test due to extreme levels of disability. •Of the 180 patients who completed the road test, 119 passed and 61 failed. •GDI28 scores of 47 and below are clearly passing (accounting for 95 of 119 patients who passed road test and 4 of 61 who failed road test); •GDI28 scores of 48-51 are borderline (accounting for 24 of 119 patients who passed road test and 23 of 61 who failed road test); •GDI28 scores of 52 and above are clearly failing (accounting for none of the drivers who passed the road test and 34 of 61 patients who failed •The probability of a patient with GDI28 scores of 51 and above passing the road test is below 23% •42 nonpatients passed an average of 25.3 items, compared to 20.85 items for patients who passed the road test, 8.8 for patients who failed the road test, and 9.2 for patients for whom no road test was allowed. •The 10 CBDI items most closely related to road test score are: •WAIS-R Digit Symbol, n correct •Trails A, time •Trails B, time •Visual Reaction Differential Response Reversed (VRDRR), average time •VRDRR, Q2 time •VRDRR, Q4 time •Visual Reaction Differential Response II, % correct •Visual Scanning III, match cols left, time •Visual Scanning III, match cols right, time •Individual's variance across items	Engum and Lambert (1990)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Cognitive Behavioral Driver's Inventory (CBDI)**	<u>215 rehabilitation patients</u> (mean age = 47.8 years) 59 patients with left cerebral vascular accidents 58 patients with right cerebral vascular accidents 63 patients with traumatic head injuries 9 patients with spinal cord injuries 26 patients with other disabling and debilitating neurological disorders (multiple sclerosis, Gullian-Barre syndrome, Alzheimer's disease, myasthenia gravis, intrinsic & extrinsic tumors of the brain, Parkinson's disease, toxic encephalopathy) <u>41 control subjects</u> (mean age = 31.15 years) Licensed drivers without any reported history of brain injury or other neurological disorder. Also, no license suspensions or revocations, and no restrictions on driving privileges.	See: Engum, Pendergrass, Cron, Lambert, and Hulse (1988). Ten assessment tasks yield 27 response measures dealing with such cognitive/behavioral skills as attention, concentration, rapid decision-making, stimulus discrimination/response differentiation, visual scanning and acuity, and attention shifting. Study objectives were to determine whether the CBDI would discriminate between 3 discrete groups: (1) those brain-injured persons whose residual cognitive impairments preclude them from driving; (2) those brain-injured individuals who have recovered sufficient cognitive function that they should be allowed to resume driving; and (3) normal control subjects without brain damage. Subjects undergo examination on the CBDI and then are assessed on the road. 5 summary scores were calculated from the CBDI: •GDI27 - the average of the patient's 27 CBDI item scores •within subject variance •number of items passed •number of items borderline •number of items failed **FINDINGS (Cont'd)** •22 of the 27 item scores and all summary scores correlated significantly with age; older patients produced larger (poorer) scores •After removing the confounding effects of age, 20 of 27 item scores and 4 of 5 summary scores continued to differentiate patients from controls. Five of the 7 that failed to differentiate pertained to number of errors (various Visual Reaction and Scanning tests) •Average GDI27 performance for controls (42.09) was superior to that of patients passing road test (45.75), which was, in turn, superior to patients who failed road test (54.23) •Controls failed less than 2 of 27 CBDI items. Patients failed from 0 to 27 items. 40.5% of patients failed 8 or more items; 40.9 % of patients failed less than 2 items. •Controls passed 18 to 27 items. 31.6% of patients passed 18 or more items (judged fit to drive). 32.1% of patients passed less than 8 items (judged cognitively impaired and unfit to drive)	Center for Outpatient Rehabilitation in Knoxville, TN; Fort Sanders Regional Medical Center in Knoxville, TN; and North Alabama Rehabilitation Hospital in Huntsville, AL.	•Based on CBDI performance, 118 patients were judged safe to drive and 97 were judged to be unsafe. Only 45 of the 97 patients judged unsafe were allowed to take the road test. •Of the 163 patients who took the road test (118 + 45), 109 passed and 54 failed. •All 5 summary scores, plus 25 of the 27 item scores significantly discriminated the 215 brain-injured patients from the 41 normal controls ($p < .05$) •The 109 patients who passed the road test performed significantly better on all 27 items of the CBDI, and 4 of the 5 summary scores than the 54 patients who failed the road test ($p < .01$). The sole exception was for the number of borderline items, which was unrelated to road test performance. •The control group performed significantly better on the CBDI (on 21 of the 27 items and all 5 summary scores) than the patient group who passed the road test (109 patients){$p < .05$] •The control group performed significantly better on the CBDI (on 19 of the 27 items and all 5 summary scores) than the patient group who "passed" the CBDI/ judged safe to drive (118 patients). [$p < .05$] •The control group performed significantly better on the CBDI (on 21 of the 27 items and all 5 summary scores) than the patient group who "passed" the CBDI and passed the road test [$p < .05$] •5 of the 7 items that failed to discriminate controls from passing patients on the CBDI pertained to the number of errors on a task rather than upon the speed and fluidity with which tasks were performed	Engum, Lambert, and Scott (1990)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Cognitive Behavioral Driver's Inventory (CBDI)**	232 rehabilitation patients (from the restandardization sample) and 42 control subjects in 4 age categories: youth (age 26 or less) adult (27-45) middle aged (46-62) elderly (age 63 and older) Diagnoses: 61 patients with left cerebral vascular accidents 60 patients with right cerebral vascular accidents 71 patients with traumatic head injuries 9 patients with spinal cord injuries 31 patients with other disabling and debilitating neurological disorders (multiple sclerosis, Gullian-Barre syndrome, Alzheimer's disease, myasthenia gravis, intrinsic & extrinsic tumors of the brain, Parkinson's disease, toxic encephalopathy)	See: Engum, Pendergrass, Cron, Lambert, and Hulse (1988). Ten assessment tasks yield 27 response measures dealing with such cognitive/behavioral skills as attention, concentration, rapid decision-making, stimulus discrimination/response differentiation, visual scanning and acuity, and attention shifting. Analysis Objective: to determine the differential effects of age and diagnosis upon cognitive status as related to driving safety. Variables: age group Diagnosis (LCVA, RCVA, head trauma, other neurological condition, spinal cord injury) CBDI performance (pass, fail, borderline) Road test status (pass, fail, deferred) Neuropsychologist's decision (pass, fail) Subject status (patient, control) Subjects undergo examination on the CBDI and then are assessed on the road. **FINDINGS (Cont'd)** •CBDI performance was the most sensitive to organicity or neuropsychological impairment of all patient variables. Older patients suffering left and right CVA or w/ other degenerative neuropsychological conditions who fail the CBDI and/or the road test, have a high morbidity index and a pessimistic prognosis for driving. But traumatically brain injured, spinal cord injured, and young patients who fail the CBDI are unstable neuropsychologically, and may be capable of making rapid gains due to rehab and spontaneous recovery (and many may resume driving after rehab). Middle-aged stroke patients are average on the stability index, and although may experience improvement in cognitive function, the age-limited recovery tends to restrict some of the gains.	Center for Outpatient Rehabilitation in Knoxville, TN; Fort Sanders Regional Medical Center in Knoxville, TN; and North Alabama Rehabilitation Hospital in Huntsville, AL	•Left CVA patients are less likely to pass the road test than the average patient, and more likely to obtain borderline CBDI scores. •Traumatically brain-injured patients are more likely to pass the road test than the average patient, and less likely to obtain borderline or failing CBDI scores. Also more likely to receive a passing recommendation from neuropsychologist. •Right CVA patients are more likely to fail the CBDI than the average patient, and more likely to receive a failing recommendation from the neuropsychologist. •Equations with weighted coordinates were derived to calculate (1) an organicity index (cognitive status; measure of operational skills required for safe operation of motor vehicle), (2) a stability index (to determine if a presently unqualified individual may be able to drive at some point in the future; the reduced probability of long term cognitive change in rehabilitation), and (3) a morbidity index (a global summary of all patient characteristics inc. CBDI performance, age, diagnosis, neuorpsych judgment, road test performance; the weighted sums of organicity and stability). Higher scores are pathological while lower scores are benign. Future versions of the CBDI software will calculate organicity, stability, and morbidity indices.	Lambert and Engum (1992)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Cognitive Screen ("DrivAble Testing, Ltd.")**	Test development research: 279 drivers across three groups: 176 patients referred to a clinic with suspected decline in mental abilities (majority were diagnosed with Alzheimer's) with mean age = 72; 70 mature healthy drivers volunteered for the research (mean age = 69); 33 young (age range 30-40; mean age = 36) healthy controls also volunteered. Validation research: 431 drivers (no other descriptive info provided about this sample)	The (cognitive) competence screen is presented on a touch screen computer, & takes 20-30 min to administer. Tasks require multiple mental abilities and integration and shifting among these abilities. Tests include: a selective attention task; an assessment of judgment/decision making using a Gap Task (designed by research team); visual attention (using a version of UFOV (Ball et al., 1994); a spatial working memory task; a simple and choice reaction time test; and Weaver's Driving Video (selected & revised driving scenarios). Two competence scores are generated: The high cutoff score identifies the performance level necessary to accurately predict that the driver would pass the road test; the low cut-off score identifies the performance level below which accurate predictions of failing road-test performance can be achieved. The road test would only need to be administered to those who score in the mid range on the competence screen (and, depending on the jurisdiction, for those who fail the competence screen but want a road test as due process) A road test was administered by 2 experienced driving instructors from the Canadian Automobile Association. Testing was conducted in a mid-sized American car equipped with dual brakes. Definition and scoring of errors was as follows: •<u>Hazardous or potentially catastrophic driving errors</u>: errors committed by drivers who are no longer competent to drive (e.g., wrong-way on a freeway, stop at green light), and would result in a crash if examiner did not intervene or traffic did not adjust •<u>Discriminating driving errors</u>: potentially dangerous errors that signal declining driving skill (e.g., poor positioning on turns and straight aways, observational errors) •<u>Non-Discriminating driving errors</u>: errors made equally often by good and bad drivers, reflecting bad habits as opposed to declining ability (e.g., rolled stops and speed errors). Drivers are not penalized for non-discriminating errors. Discriminating errors are documented and scored in terms of their severity (5, 10, or 51 points). Hazardous errors were renamed as Criterion errors and the commission results in an automatic fail. A combined criterion of one or more criterion errors and/or discriminating point total exceeding criterion, results in a failure on the road test.	Neuropsych. and Rehab. Med. Dept, Northern Alberta Regional Geriatric Program	Subjects in the development research were used to develop road test procedures and scoring. The majority of the drivers who failed the road test received low scores on the cognitive screen; the majority of the drivers who passed the road test received high scores on the cognitive screen. Validation Research: The cut-off scores identified in the original research for the competence screen were 94% accurate in predicting actual pass/fail performance on the road test. Only 33% of those tested had Competence Screen scores falling below the high and low cut-off scores. Analysis of the road test errors revealed the same categories of errors and verified the effectiveness of the road test for revealing the errors among unsafe drivers. Using the joint criterion, all of the young normal drivers passed the road test, approximately 95% of the mature control group drivers passed the road test, and only 25% of the cognitively impaired (patient) group passed the road test. The Competency Screen resulted in a 5% error in predicted road test performance: it predicted a pass for 29 of the 33 drivers who passed the road test, and predicted a fail for 33 of the 34 drivers who failed the drive test. The screen reduced the number of drivers who needed to be tested by 67%. Only 33% of the drivers in the sample received an indeterminate score on the competence screen: 54% of the indeterminate drivers passed the road test and 45% failed the road test.	DriveAble Testing, March 1997; Dobbs, 1997

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Driving Advisement System (DAS)** Visuo-motor (pursuit tracking); movement speed; speed of information processing; consistency of performance; laterality; acquisition (learning) of procedures; self-modulation (impulse control); and meta-cognition (self-appraisal)	• 60 licensed drivers aged 18-86 deemed to be safe drivers and free from serious neurological impairment (standardization sample) • 60 traumatic brain injury and cerebrovascular accident survivors 60 traumatic brain injury and cerebrovascular accident survivors **PROCEDURES (Cont'd)** False alarms are also recorded on trials where the gas pedal is released before the "B" appears. Performance is compared to comprehensive driving evaluations in driving rehab centers, and may include an on-road exam. The choice reaction time test builds on the simple reaction time test by adding an equal number of "H" (horn) and "B" (brake) stimuli, in an unpredictable sequence. The object is to be as quick as possible without making errors in pedal activation. The reversing choice reaction time test builds on the procedures used in the choice reaction time segment. On a random half of the trials, a sign appears in the center of the screen that says, "pedals reversed." When this happens, the person must press the brake pedal when an "H" appears, and press the horn pedal when a "B" appears. The program switches unpredictably between the "ordinary" mode and the "pedals reversed" mode, demanding rapid adjustment.	A more comprehensive protocol that uses the same IBM compatible system as the EDS. The DAS is an hour long protocol designed for advising persons who seek to resume driving following brain injury, caused by head injury or stroke. The DAS software costs $500.00 and the foot pedals are an additional $200.00. Its procedures address the complexity of information processing, and breaks responses down into a decision and an execution component. As the task demands increase in complexity, the choice component of reaction time is expected to increase, but not the execution component. Momentary contact switches are activated by three pedals, laid out on a floor plate with a middle gas pedal, a left brake pedal, and a right horn pedal; the horn and brake pedal are equidistant from the gas pedal. A steering wheel senses rotation of approximately 270°. There are five parts to the appraisal: self appraisal; a pursuit tracking task ("On the Road"); a simple reaction time procedure ("Brake"); a choice reaction time task ("Decide"); and a reversing choice reaction time task ("Inhibit"). In the self-appraisal portion, ratings are obtained for eight parameters: reaction time, decision speed, movement speed, speed of adaption, consistency, concentration, field of vision, and impulse control. After each parameter is explained carefully, the subject uses the steering wheel to move a marker that represents his/her present status on a display in comparison to "other safe drivers." In the pursuit tracking task, the display contains an abstract representation of a road with a small rectangular block representing the vehicle, which can only be moved laterally. The road itself changes, creating an illusion of movement. The subject's task is to hold down the gas pedal to keep the vehicle moving along the road and to use the steering wheel to maintain the vehicle in the center of the road. Modifiable parameters include speed of progress, roadway width, roadway curviness, length of course, amount of preview of the roadway above the vehicle. In the simple reaction time test, the subject holds down the accelerator until the letter "B" appears either in the right or left signal box. Then, s/he moves the foot from the gas to the brake as quickly as possible, and replaces the foot on the gas to resume driving. Resumption time (brake to gas), choice time (appearance of B to release of gas), and execution time (release of gas to press of brake) are measured in 100ths of a second.	Gaylord Hospital (Wallingford, CT)	The execution times of the standardization group in "Brake," Decide," and "Inhibit," do not increase with increasing task complexity and substantiates that these times are reflective of motor functioning and not mental processing. In contrast, the choice times increased with increasing complexity. Gianutsos and Campbell (1988) have found that the DAS measures correlated with an on-the-road assessment (pass/fail criterion) in a group of 60 traumatic brain injury and cerebrovascular accident survivors slightly better than the Porto Clinic Glare (a device used in predriving assessments typically conducted in occupational therapy settings, that screens visual acuity, visual fields, depth, glare recovery, color vision, and reaction time in approximately 20 min. Performance criteria are based on performance of Marine recruits). Additionally, the DAS and Doron simulator correlate well with the outcome of a comprehensive evaluation (Gianutsos and Campbell, 1991).	Gianutsos et al. (1992)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: ***Easy Driver™***	170 Subjects: age range 15-91, 89M 81F Older and younger groups divided at 55 yrs. old for analysis of preferred speed, and divided at 65 yrs. for traffic event RT.	Computer-video display and recording system *Easy Driver™* which runs from a Macintosh microcomputer and a standard large-screen color TV monitor, with a dual pedal control unit (brake and accelerator). Drivers view driving scenarios while they operate brake and accelerator pedals to drive at preferred speeds under various conditions, and to brake in response to events occurring in the video. Scenarios include traffic events in which drivers may respond to the onset of brake lights in a lead vehicle or rapid closures of gaps between vehicles, intrusions of other vehicles and pedestrians (high and low illumination conditions), stop signs and traffic signals, and tennis balls (small, high contrast target) or basketballs (large, low contrast target, used in day and in dusk conditions) rolling into the road in suburban residential areas (indicating possible incursion of child). Drivers proceed at their own pace in several scenarios including highway driving in excellent road conditions in light traffic, wet snow/rain, heavy rain, and night driving with oncoming headlight glare. Independent Variables: • Preferred driving speed: Speed in MPH for: 1. 4 lane road, dry 2. 2 lane road, wet 3. Heavy Rain 4. Headlight Glare • RT to Traffic Events: critical events included: 1. Stopped schoolbus 2. Lead vehicle brakes, city driving 3. Lead vehicle brakes, rural 4. Pedestrian Incursion, day 5. Pedestrian Incursion, night 6. Hit ped. (pedestrian stands in road, scene stops with ped directly in front of car hood) 7. Basketball in road, day (low contrast) 8. Basketball in road, dusk 9. Tennis ball in road, day (high contrast) • Simple RT measure: RT measured to traffic light changing from green to red. Dependent variable: Global Accident Risk (GAR) =Total number of reported at-fault crashes for each driver, with the addition of up to 3 more points for self-reported medical or driving problems (dizziness, attentional lapses, severe arthritis, poor vision, and poor vehicle control). The resulting range of scores was 0-13.	Data collected at 4 sites in Fla, Vermont, NYU, and suburban NYC.	• Performance differences between 109 older S's (aged 55-95) and 61 younger S's (aged 15-54) included slower driving speeds by older S's, particularly in the poor visibility conditions and under headlight glare conditions; longer (but not signif.) simple RT; longer RT's to traffic events such as braking in response to lead vehicle brake lights, a ped., and the basketball (dusk) scenarios; late braking by 40-90 year olds in response to a school bus pulling into their lane; and lack of response by a substantial number of older S's to the tennis ball and basket ball (dusk) scenarios. • Two S's age 74 and 75 accidentally depressed the gas pedal in response to the hit ped. and tennis ball scenarios, rather than the brake. • Although difference in RT not significant, a mean diff. of 75 msec translates to a stopping dist. of 4.4 ft at 40 mi/h. • Using GAR score as a criterion, mult. regress. anal. were performed to determine which scenarios would best predict driving perf. Using scores for hit ped., schoolbus, and tennis ball scenarios, plus simple RT for the entire sample, a multiple R=.39 was obtained, accounting for 12-15% of the variance of GAR scores. • Regress. anal. performed separately for older and younger S's using 65 years as the criterion age split. For the older S's, RTs from hit ped., tennis ball, basketball (dusk) and city brakes yielded an R=.47, accounting for 22% of the var. in GAR scores. For young S's, schoolbus, hit ped., & tennis ball yielded an R=.41, accounting for 16% of the variance.	Schiff & Oldak (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Elemental Driving Simulator (EDS)** (Tracking, simple reaction time, complex reaction time, divided attention, complex visual perception, judgment)	1,475 ITT Hartford Insurance Co. policyholders for whom past driving histories were available through insurance records, divided into two groups based on the presence or absence of recent at-fault accidents. Driver age ranged between 50 and 80+ and was distributed as follows: • 26 percent of the sample were between 50-64, • 54 percent were between 65-74, • 20 percent were over 75. Participants were active drivers who had (generally) been pre-screened for risk in the insurance underwriting process. Also, participants who came in for testing appeared confident in their driving abilities.	A quasi-driving simulator which includes a steering wheel, accelerator and turn signal, provided scores on three subtests. These subtests included a basic steering experience; a steering experience combined with using a turn signal when prompted with an on-screen stimulus; and a complex experience in which the turn signal task stimulus reverses the appropriate response. Phase 1 is a preview tracking task which requires the subject to steer a simulated vehicle which moves at a fixed pace in the center position of the driving lane. Measures of lateral position are taken 8 times per second. In Phase II, a two-choice RT test is added to the steering task, where as the road advances, a small, one-character stimulus face appears unpredictably on either side of the roadway. The subject must turn the signal lever on the steering column toward the face as soon as possible, while maintaining a steady position in the center of the road. Reaction times are stored along with the steering measures. In Phase III, a contingency is introduced into the reaction time test such that when the face is flashing ("hazard"), the subject must away from it, and when it is steady, the subject must signal toward the face. Insurance and motor vehicle department records provided information about the following variables: at-fault accidents, non-fault accidents, non-accident claims, violations and convictions, miles driven, age, gender and marital status.	Testing rooms in hotels in 15 cities throughout Connecticut, Florida, and Illinois	Performance on the EDS yielded a low but significant correlation with at-fault accidents ($r = -.09$, $p \leq .05$). Sample selection bias (policy holders with poor functional capabilities may have declined to participate) and testing under noisy conditions (hotel sites) may have contributed to the low correlations. Additionally, a higher correlation may have been attained if an important procedure had been followed in test administration (according to the test developer). The EDS should be administered as a one-on-one test with a test administrator trained in its use. Each phase should be preceded by sufficient practice to ensure that the subject is comfortable with the task. The theory is that driving is a highly practiced task, and the subjects should be encouraged to continue in the practice mode until they feel they have reached their best level of performance. Also, this approach contributes to the clinical acceptance, as people believe they have been given the fairest possible chance. In this study, time was a limited commodity, and therefore subjects were "rushed in and out," with little practice. This resulted in not obtaining good baseline steering practice and therefore a subset of the subjects were unable to complete all three phases of the test.	Brown, Greaney, Mitchel, and Lee (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Elemental Driving Simulator (EDS)** (Tracking, simple reaction time, complex reaction time, divided attention, complex visual perception, judgment)	• 50 normatively-aged drivers (average age 41) • 1145 community residing older drivers (average age = 69) • 82 drivers seeking driver rehabilitation related to a CNS disorder (average age = 37)	IBM-compatible PC, a 10-inch diameter steering wheel controlling a 150K linear potentiometer with turn signal, and a momentary contact foot pedal. Apart from the computer, the EDS costs about $2,000 and includes a full day of training. Testing requires about 20 minutes, although 30 minutes should be scheduled to allow for sufficient practice by the poorest performing segment. The system is elemental in its technical simplicity and in its simulation of the elements of driving-related cognitive abilities. It is employed to assess people with known or suspected cognitive impairment. The assessment protocol begins with a self-appraisal of cognitive abilities related to driving: steering control, speed of reaction, self-control (impulsivity), field of view, consistency, and adjustments to changes and complexity. Each of these areas is then assessed in increasingly complex simulated steering tasks. Phase 1 is a preview tracking task which requires the subject to steer a simulated vehicle which moves at a fixed pace in the center position of the driving lane. Measures of lateral position are taken 8 times per second. In Phase II, a two-choice RT test is added to the steering task, where as the road advances, a small, one-character stimulus face appears unpredictably on either side of the roadway. The subject must turn the signal lever on the steering column toward the face as soon as possible, while maintaining a steady position in the center of the road. Reaction times are stored along with the steering measures. In Phase III, a contingency is introduced into the reaction time test such that when the face is flashing ("hazard"), the subject must away from it, and when it is steady, the subject must signal toward the face. The rehab sample received a comprehensive driving evaluation that included medical and driving history, vision screening, EDS, Doron simulator, and a road test. A pass or fail decision was made about each individual.	Gaylord Hospital (Wallingford, CT)	The performance of the 50 normatively-aged drivers was more consistent and substantially better than that of 1145 community residing older drivers and the group of 82 drivers seeking driver rehabilitation related to a CNS disorder. As a group, the older drivers performed almost as poorly in terms of steering ability, two-choice simple reaction time, and in complex reaction time as the rehabilitation patients who failed their driving exam. The failers were always worse than the passers, however the difference in performance was significant only for steering unsteadiness. Case examples have shown also that observations of actual on-road performance are consistent with conclusions based on the EDS; persons who perform poorly on the EDS have been observed to exhibit lane drifting, poor steering control, failure to make head checks, impulsivity, and difficulty in making adjustments during a 1.5 hr drive.	Gianutsos (1994)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **University of Illinois/Atari Interactive Driving Simulator**	6 subjects w/ hemianopic visual field deficits, 2F 4M age 53-80 (mean 71 yrs) 7 Older controls 3F, 4M age 62-83 (mean 70) Data collected from 31 younger controls in an earlier study also analyzed	Interactive driving simulator [developed in collaboration with Atari Corp (Milpitas, CA)], is composed of a seat, steering wheel, gas and brake pedals, and an automatic transmission. The visual display consists of three 62.5 cm color monitors displaying a 160° horizontal viewing field and a 35° vertical viewing field of a computer-generated environment to a driver sitting 57.5 cm from the center screen. Stimuli are computer-generated images of a simulated roadway with traffic, signs, and painted roadway lines. The video scene was updated 20 times per second. Simulator performance MOEs included • Mean speed (in MPH) • Average slowing and stopping to traffic signals • Number of lane boundary crossings • Mean Break pedal pressure • Mean Gas pedal pressure • Number of simulator accidents • Lane position • Steering angle • Vehicle angle to the road Six staged driving simulator challenges required visuocognitive/motor skills to avoid an accident; three of these were intersections with cross traffic. Eye and Head Movement recorded for each subject Self report of accidents over the previous five years was also collected for each subject **FINDINGS (Cont'd)** • simulator accidents occurred only for 2 subjects in the older normally-sighted group. • Two of the four older subjects who had real world accidents also had the longest slowing times, the longest stopping times, and the most accidents in the driving simulator. • no signif. diff. between mean brake pedal pressure among the 3 groups, but greater variability in brake pedal pressure for both older groups, compared to normally sighted younger controls.	Univ. Illinois at Chicago Eye Center	• significantly more lane boundary crossings for the older patient group, but no significant differences between the older and younger control groups this performance measure ($p<.01$); • greater variability in lane position among the older patient group with no consistent differences in absolute lane position between the two control groups ($p<.05$); • greater deviations in steering angle by both groups of older drivers compared to the younger control group, but no significant differences between the older patient and older control group on this measure; • no significant differences between the three groups in their vehicle angle to the road performance measure; • longer slowing times by 4 older controls and 3 older patients when compared to the younger controls, but no differences in mean slowing times between the two older groups, due to a large variability among individuals; • prolonged stopping times by both older driver groups when compared to the younger control group; • slower avg. speeds exhibited by both older groups when compared to the younger group, but no differences in mean speed between the older patients and older control subjects; • lower avg. pedal pressure and greater variability in accelerator pedal pressure by both older groups in comparison to the younger group, but no differences between the 2 older groups on this measure;	Szlyk, Brigell, & Seiple (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **University of Nevada, Las Vegas (UNLV) subtests:** **Form Detection** (speed of discriminating between forms); **Visual Tracking** (tracking and stopping a moving stimulus); Cognitive Overload (divided attention)	1,475 ITT Hartford Insurance Co. policyholders for whom past driving histories were available through insurance records, divided into two groups based on the presence or absence of recent at-fault accidents. Driver age ranged between 50 and 80+ and was distributed as follows: • 26 percent of the sample were between 50-64, • 54 percent were between 65-74, • 20 percent were over 75. Participants were active drivers who had (generally) been pre-screened for risk in the insurance underwriting process. Also, participants who came in for testing appeared confident in their driving abilities.	•form detection: the ability to discriminate between forms presented outside the center of the visual field •visual tracking: the ability to track a moving object presented outside the central field of vision •cognitive overload: form detection task coupled with visual tracking task. Computer tests were administered on a Macintosh Plus microcomputer with a number pad. Subjects were seated in front of the computer monitor at a distance of 24 inches. Task instructions were provided by the computer and were followed by short practice sessions. <u>Form detection task</u>: a square or a cross appeared in 1 of 10 locations around the perimeter of the screen. S's were to press the "K" key if they saw a square, and the "D" key if they saw a cross. The size (2.2 x 2.2 cm or 1 x 1 cm), type (square or cross), and location of the stimulus varied randomly, Stimulus duration was constant at 500 ms. <u>Visual tracking task</u>: a small white cross (1 x 1 cm) randomly appeared in 1 of 4 locations around the screen. A square (1 cm x 1 cm) simultaneously appeared 7 cm away from the cross. The cross moved towards the square at 1 of 2 speeds (7 or 14 cm per s). S's were to stop the cross by pressing the space bar as soon as it was completely enclosed by the square. The direction and speed of movement varied randomly. Cognitive overload task: a trial started with a fixation point immediately followed by the presentation of a cross moving toward a square in the center of the screen. The S was to stop the cross when it was completely enclosed by the square. While the cross was moving, a square or cross appeared in 1 of 10 locations near the edge of the screen. S's were to press the "D" key for a cross and the "K" key for a square. The speed of tracking was constant at 14 cm/s. The kind and size of the stimulus in the detection task varied randomly. Insurance and motor vehicle department records provided information about the following variables: at-fault accidents, non-fault accidents, non-accident claims, violations and convictions, miles driven, age, gender and marital status.	Testing rooms in hotels in 15 cities throughout Connecticut, Florida, and Illinois	The UNLV Tests produced correlations for 2 subtests: Form Detection mean time ($r=0.10$) and the Visual Tracking accuracy in the Cognitive Overload task ($r=0.09$) were predictive of at-fault accidents.	Brown, Greaney, Mitchel, and Lee (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ATTENTION/ PERCEPTION/ COGNITION Multiple Capabilities: **Washington University Visual Attention Tests**	Participants recruited from Alzheimer's Disease Research Center (ADRC) at Wash. Univ. School of Medicine 58 healthy elderly control subjects, mean age = 76.8; Clinical Dementia Rating =0 65 subjects with Dementia of the Alzheimer's type (DAT), mean age = 73.7; Divided into 2 groups: 36 Ss with Clinical Dementia Rating = 0.5 (very mild DAT) and 29 Ss with CDR = 1.0 (mild DAT) All S's had corrected acuity of at least 20/50	Three computerized tests of visual attention were employed to study the relationship between specific aspects of visual attention and driving skills in DAT: The UFOV task (Visual Attention Analyzer) was used as a measure of early attentional processing, and the size of the functional field of view available for target identification was used to examine relationships with on-road driving performance and dementia severity. A visual monitoring task measured the ability to detect infrequent changes in a visual display (vigilance), where S's had to respond when a target "X" occurred in a series of scrolling "O"s while monitoring one or two lines on a computer screen. In the visual monitoring task, 2 types of errors were possible: errors of omission (missing the target) and errors of commission (false alarming in the absence of the target). A visual search task was used to examine the ability to select a target that was either present or absent in an array of distractors. There were two types of errors: miss errors (responding that a target is not present in the array when it really is present), and false alarm errors (responding that a target is present in the array, when it really is not present) S's were administered the on-road, in-traffic driving test (see On-road Performance Measures of Driving Safety: Washington University Road Test at the end of this Compendium). Driving performance ("high" vs "low") was based on a median split on drive test scores. **FINDINGS (Cont'd)** •In the visual search task, there was no difference in miss or false alarm errors for Ss with high vs low drive test scores in CDR 0 and CDR 0.5 groups, but a large increase in false alarm errors was shown for CDR 1 poor-performing drivers compared to CDR 1 Ss who performed well on the drive test.	Washington University School of Medicine Road test conducted on urban medical school and urban highways and streets	•Percent reduction in UFOV was greatest in the mildly demented Ss (CDR = 1), particularly for CDR 1 Ss who also showed poorer performance on the drive test. The reduction in UFOV for mildly demented Ss with low (poor) drive performance scores was 90%, compared to 60% for mildly demented Ss with high (good) driving performance. The larger reductions in UFOV for Ss with low drive scores occurred primarily in the selective attention component of the UFOV task, where the S must localize a peripheral target embedded in an array of distractors. Percent UFOV reduction for very mildly demented Ss (CDR = 0.5) was 40% for Ss who performed poorly on the road test, and 32% for Ss who performed well on the road test. For non-demented Ss (CDR = 0), there was little difference in UFOV reduction as a function of drive performance (28% reduction for good performers and 30% reduction for poor performers). •In the visual monitoring task, there was no differentiation in miss or false alarm errors for Ss with high vs low drive scores in either the healthy control group (CDR = 0) or the very mild DAT group (CDR = 0.5). There was a large increase in false alarm errors for CDR 1 individuals (mildly demented) with poor driving performance (@ 20 errors) compared to CDR 1 Ss with good driving performance (@ 5 errors).	Duchek, Hunt, Ball, Buckles, and Morris (1997)

II.C. PHYSICAL CAPABILITIES

1. **Balance**

    (a) Tandem Stand

2. **Gross Mobility**

    (a) Number of Blocks Walked
    (b) Number of Foot Abnormalities
    (c) Rapid Pace Walk
    (d) Usual Pace Walk

3. **Range of Motion**

    (a) Left-Knee Flexion
    (b) Neck Flexibility
    (c) Multiple Measures (Trunk, Neck, Shoulder)

4. **Reaction Time**

    (a) Brake Reaction Time (Doron)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
PHYSICAL CAPABILITIES Balance: **Tandem Stand**	101 licensed drivers (39 females and 62 males) age 72-90 (mean age = 78.3) who were members of a preexisting study cohort engaged in longitudinal studies of a community-dwelling cohort of older people (at Buck Center for Research in Aging)	Subjects were required to stand with the heel of one foot touching the toe of the other foot, with both feet pointing straight ahead, for 10 seconds. This test was scored in terms of pass vs fail. An on-road driving exam was given by the project driving instructor (owner/operator of a driving school in San Francisco) based on the California Driving Performance Evaluation (DPE), and using the same scoresheet as used for the MDPE given in San Jose by these researchers. A weighted error score was calculated as total # of unweighted errors, plus twice the sum of critical and hazardous errors. Concentration errors were also noted. Critical errors = errors which would in normal circumstances cause test termination (turning from improper lane, dangerous maneuver, examiner intervention needed). Hazardous errors = dangerous maneuver or examiner intervention. Concentration errors = subject unable to proceed to field office at end of test, or drove past the street on which the field office was located and did not recognize their error. (See On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium).	Novato, Marin County California; Buck Center for Research in Aging	Performance on the tandem stand was not significantly correlated with weighted error score on the road test (r=0.108, p=.284)	Janke and Hersch (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
PHYSICAL CAPABILITIES *Gross Mobility:* **Number of Blocks Walked**	283 community-dwelling individuals age 72 to 92 (mean age = 77.8) from the Project Safety cohort living in New Haven, CT who drove between 1990 and 1991. 57% were males.	An assessment of activity level included (1) self-reported independence in basic and instrumental activities of daily living (6-9 activities vs 0-5 activities); (2) number of flights of stairs walked in an average day; (3) number of blocks walked in an average day (0 v.s. 1+); and (4) higher level physical activity assessed using Yale Physical Activity Survey. Driving frequency was also assessed: daily vs every other day vs 1-2 times per week vs less than 1 time per week. The outcome variable was self-reported involvement in automobile crashes, moving violations, or being stopped by police in the year following administration of the test battery.	New Haven, CT. Subjects were interviewed and given the assessments in their homes by a trained research nurse.	In the activity domain, walking less than 1 block per day was associated with adverse events (relative risk 1.9, 95% CI, 1.1-3.5). 21% of the subjects who walked less than 1 block per day had adverse driving events, compared to 11% of the subjects who walked 1 block or more each day. This difference was significant at the $p < .05$ level. Driving frequency was not significantly associated with the occurrence of adverse events. A multivariate analysis adjusting for driving frequency and housing type found the following factors to be associated with the occurrence of adverse events: poor design copying on the MMSE (relative risk 2.3, 95% CI, 1.5 to 5.0), fewer blocks walked--0 versus $\geq$ 1 (relative risk 2.3, 95% CI 1.3 to 4.0) and more foot abnormalities--3 to 8 versus 0 to 2 (relative risk 1.9, 95% CI, 1.1 to 3.3). Combining these 3 factors to assess their ability to predict adverse driving events showed that if no factors were present, 6% of drivers had adverse events; if 1 factor was present, 12% had events; if 2 factors were present, 26% had events; and if all 3 factors were present, 47% had events.	Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
PHYSICAL CAPABILITIES Gross Mobility: **Number of Foot Abnormalities**	283 community-dwelling individuals age 72 to 92 (mean age = 77.8) from the Project Safety cohort living in New Haven, CT who drove between 1990 and 1991. 57% were males.	The number of the following foot abnormalities was noted in addition to the ability to stand on toes and heels: toenail irregularities, calluses, bunions, and toe deformities such as hammer toes. Analyses were conducted for 0-2 foot abnormalities and for 3-8 foot abnormalities. The outcome variable was self-reported involvement in automobile crashes, moving violations, or being stopped by police in the year following administration of the test battery.	New Haven, CT. Subjects were interviewed and given the assessments in their homes by a trained research nurse.	Persons with 3 or more foot abnormalities were more likely to have adverse events (23% had adverse events) compared to persons with 0-2 foot abnormalities (10% had adverse events). The difference was significant at $p<0.01$ level. The relative risk = 2.0, CI 95%, 1.0-3.8. Four of the factors in this study that were significantly associated in bivariate analyses (design copying, number of blocks walked, number of foot abnormalities, and rapid pace walk time) were entered into binomial relative risk models and were adjusted for driving frequency and housing type. The factors that remained significantly associated with adverse driving events were impaired design copying, fewer blocks walked and more foot abnormalities. A multivariate analysis adjusting for driving frequency and housing type found the following factors to be associated with the occurrence of adverse events: poor design copying on the MMSE (relative risk 2.3, 95% CI, 1.5 to 5.0), fewer blocks walked--0 versus $\geq$ 1 (relative risk 2.3, 95% CI 1.3 to 4.0) and more foot abnormalities--3 to 8 versus 0 to 2 (relative risk 1.9, 95% CI, 1.1 to 3.3). Combining these 3 factors to assess their ability to predict adverse driving events showed that if no factors were present, 6% of drivers had adverse events; if 1 factor was present, 12% had events; if 2 factors were present, 26% had events; and if all 3 factors were present, 47% had events.	Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
PHYSICAL CAPABILITIES Gross Mobility: **Rapid Pace Walk**	283 community-dwelling individuals age 72 to 92 (mean age = 77.8) from the Project Safety cohort living in New Haven, CT who drove between 1990 and 1991. 57% were males.	Timed performance measures included in this battery of tests included hand signature, 3 chair stands, usual pace walk (walk 10 feet each up and back including a turn at usual pace), rapid pace walk (10 feet each up and back as fast as the participant felt safe and comfortable), and foot tap (10 taps alternating between two circles on a mat). Procedures for rapid pace walk are as follows: Measure out 10 foot walk. Say, "I want you to walk just as you normally do. If you use a cane or walker, you may use it if you feel more comfortable. I want you to walk all the way past the end of the course at the other end, turn around, and walk back like this." (Demonstrate). "Now, I want you to walk down and back at a comfortable pace" (usual-pace walk). "Now I am going to time you. Go as fast as you feel safe and comfortable."(rapid-pace walk) Start timing when subject picks up first foot. Stop timing when last foot crosses finish line. The outcome variable was self-reported involvement in automobile crashes, moving violations, or being stopped by police in the year following administration of the test battery.	New Haven, CT. Subjects were interviewed and given the assessments in their homes by a trained research nurse.	The timed performance test most strongly associated with adverse events (traffic accident, violation, stopped by police) in the year following testing was the rapid-pace walk (> 7 seconds versus $\leq$ 7 seconds [relative risk, 2.0, CI 1.0-3.8]). 9% of the faster walkers had adverse driving events, compared to 17% of the slow walkers. This difference was significant at the $p < .05$ level. Four of the factors in this study that were significantly associated in bivariate analyses (design copying, number of blocks walked, number of foot abnormalities, and rapid pace walk time) were entered into binomial relative risk models and were adjusted for driving frequency and housing type. The factors that remained significantly associated with adverse driving events were impaired design copying, fewer blocks walked and more foot abnormalities. **Foot tap** time showed a trend toward association with adverse events in the study, and is face valid as a measure of ability to move leg/foot from gas to brake pedal.	Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
PHYSICAL CAPABILITIES Gross Mobility: **Usual Pace Walk**	101 licensed drivers (39 females and 62 males) age 72-90 (mean age = 78.3) who were members of a preexisting study cohort engaged in longitudinal studies of a community-dwelling cohort of older people (at Buck Center for Research in Aging)	Subjects walked back and forth along a 10 ft path for a 60-second period. This test was scored in terms of pass vs fail. An on-road driving exam was given by the project driving instructor (owner/operator of a driving school in San Francisco) based on the California Driving Performance Evaluation (DPE), and using the same scoresheet as used for the MDPE given in San Jose by these researchers (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium). A weighted error score was calculated as total # of unweighted errors, plus twice the sum of critical and hazardous errors. Concentration errors were also noted. Critical errors = errors which would in normal circumstances cause test termination (turning from improper lane, dangerous maneuver, examiner intervention needed). Hazardous errors = dangerous maneuver or examiner intervention. Concentration errors = subject unable to proceed to field office at end of test, or drove past the street on which the field office was located and did not recognize their error.	Novato, Marin County California; Buck Center for Research in Aging	Performance on the 10 ft walk was not significantly correlated to weighted error score on the drive test ($r=0.174$, $p=0.083$)	Janke and Hersch (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
PHYSICAL CAPABILITIES Range of Motion: **Left-Knee Flexion**	283 community-dwelling individuals age 72 to 92 (mean age = 77.8) from the Project Safety cohort living in New Haven, CT who drove between 1990 and 1991. 57% were males.	A battery of physical performance items included balance (side-to-side stand, tandem stand, single-leg stand, and withstanding a sternal nudge), and was scored on a 4-point scale, with 1 point given for each item done without instability. Strength and range of motion were determined using manual muscle testing of shoulder abduction, grasp, hip flexion, knee flexion, and knee extension: these were categorized as good (full resistance and full range of motion versus fair or poor (less than full resistance or range of motion). The outcome variable was self-reported involvement in automobile crashes, moving violations, or being stopped by police in the year following administration of the test battery.	New Haven, CT. Subjects were interviewed and given the assessments in their homes by a trained research nurse.	Impaired left-knee flexion was associated with adverse events (relative risk 2.9, CI 95%, 1.2-6.7). 13% of those with intact left-knee flexion had adverse driving events compared to 36% of drivers with impaired left-knee flexion. This difference was significant at the $p < .05$ level. Left-knee flexion was not entered into the relative risk model due to the small number of participants in the group displaying impaired ability ($n=11$). Differences in performance on the balance or other range of motion measures were not associated with the occurrence of adverse driving events.	Marottoli, Cooney, Wagner, Doucette, and Tinetti (1994)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
PHYSICAL CAPABILITIES Range of Motion: **Neck Flexibility**	60 subjects across 4 groups (15 S's each group): •Age 30-50 with impairment •Age 30-50 no impairment •Age 60-80 with impairment •Age 60-80 no impairment Impairment was defined by a combined static range of movement of the head/neck and visual field of less than 285 degrees. 285 degrees was based on the functional requirements for driving, in the absence of a definition of impairment in the literature. S's were recruited through local ads and agencies (AARP and Arthritis Foundation). All held valid driver's license and drove at least 10 mi/wk	The behavior of drivers at simulated T-intersections was investigated to determine the relationships between the range of movement of the head and neck, the visual field, and the decision time for a simulated traffic maneuver. 18 video-taped intersection scenarios provided 2 levels of traffic volume (light traffic = gap lengths of 8 s or more; moderate traffic = gap lengths of less than 8 s) and 3 levels of intersection sight distance (AASHTO standard, less than standard, and above standard). Each scene covered a 180-degree field of view. Subjects depressed the brake in the simulator at the beginning of each scene, and released the pedal when they thought it was safe to turn left. An audible beep signaled that decision timing was beginning for each scene. Subjects' response time was the principal dependent measure. Static range of motion was measured with a goniometer, and visual field was measured with an Ortho Rater.	Turner Fairbank Highway Research Center at FHWA	•Differences in average decision time between young/middle aged and older drivers were significant (11.3 s vs 13.3 s, p=.04). Older drivers took 2 seconds longer to decide to turn at T-intersections than younger drivers. [A smaller left-turn decision time indicates better driving performance, because it provides a driver with a larger gap into which he/she can maneuver and accelerate without affecting the speed of the traffic stream] •Average decision times by age and impairment level are shown below. Differences were significant at the p=.08 level. Age 30-50 with impairment 11.4 s Age 30-50 no impairment 11.3 s Age 60-80 with impairment 14.4 s Age 60-80 no impairment 12.1 s •Younger impaired drivers were able to compensate for their impairment (their decision times were not affected by their reduced head/neck flexibility), but older impaired drivers were not. •Older impaired drivers are at a greater risk at intersections as a result of their slowed decision making ability coupled with their inability to turn their heads/necks to check for intersecting traffic. Intersections with limited sight distance or skewed geometry further exacerbate problems for this group.	Hunter-Zaworski (1990)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
PHYSICAL CAPABILITIES Range of Motion: **Neck Flexibility**	82 "referred" subjects aged 60-91 (26 of which were identified as probably being cognitively impaired to some degree). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment.	Subject's neck rotation to the left and right was measured manually with a goniometer. Multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance (weighted error score) on a standard DMV road test, (see On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium), and comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance.	California DMV Field Office	No significant correlation between neck flexibility and weighted error score on drive test.	Janke & Hersch (1997) Staplin, Gish, Decina, Lococo, and McKnight (*in press*)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
PHYSICAL CAPABILITIES Range of Motion: **Multiple Measures** **•Trunk** **•Neck** **•Shoulder**	105 drivers licensed in Nebraska, aged 65-88 (mean age = 71.4). 54 were females (mean age = 70.5 years); 51 were males (mean age = 72.2 years). All subjects were volunteers, and were paid $25.00 for participating. 36 had taken a driver education course in the past 10 years.	Measures were taken in the clinic with the subject seated upright in a straight-back chair with both feet on the floor. These included: (1) Neck flexion, (2) Neck extension, (3) Neck rotation to the left, (4) Neck rotation to the right, (5) Neck lateral bend to the left, (6) Neck lateral bend to the right, (7) Left shoulder flexion, (8) Right shoulder flexion, (9) Trunk rotation to the left, (10) Trunk rotation to the right. Measures were also taken in the car with the subject seated behind the steering wheel, the seat belt fastened, and the subject's hands in their normal driving position on the steering wheel. These included: (1) Neck flexion, (2) Neck extension, (3) Neck rotation to the left, (4) Neck rotation to the right, (5) Neck lateral bend to the left, (6) Neck lateral bend to the right. Three measures of each motion were taken and the average of the three was used. The driving performance of the subjects was evaluated using the on-street driving performance measurement (DPM) technique developed by Vanosdall and Rudisill (1979). The subjects were evaluated by a driver education expert trained in the use of the DPM technique, while they drove in their own cars. The DPM route was a 19-km circuit designed to evaluate the subjects in the situations that are most often involved in the accidents of older drivers. Therefore, their performance was evaluated at 7 intersections where they were required to make left turns at 5 intersections and right turns at the other 2 intersections. Four of the left turns were made from left-turn lanes onto four-lane divided arterial streets in suburban areas, and one was made from a left turn lane onto a two-lane one-way street in an outlying business district.	University clinic, and in-vehicle, on-road test.	None of the range of motion measures were significantly correlated with driving performance. All of the measures had relatively low correlations; the highest correlations were for the in-clinic measures of: trunk rotation to the right (0.17, p= 0.074), trunk rotation to the left (0.14, p=0.156), and neck lateral bend to the right (0.15, p= 0.1156) NOTE: DPM maneuvers did not include maneuvers that require extreme head/neck rotation ability (e.g., lane changing, passing on high-speed roadways).	Tarawneh, McCoy, Bishu, and Ballard (1993).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
PHYSICAL CAPABILITIES Reaction Time: **Brake Reaction Time (DORON)**	105 drivers licensed in Nebraska, aged 65-88 (mean age = 71.4). 54 were females (mean age = 70.5 years); 51 were males (mean age = 72.2 years). All subjects were volunteers, and were paid $25.00 for participating. 36 had taken a driver education course in the past 10 years.	Measured with Doron L225 driving simulator. Two 2x3 cm rectangular red lights mounted 4 cm apart on the dashboard simulator flashed in alternating fashion. When both lights turned on at the same time, the subject was to release the gas pedal and press the brake pedal as fast as possible. Six trials were obtained from each subject; the mean time was used to measure the brake reaction time. The driving performance of the subjects was evaluated using the on-street driving performance measurement (DPM) technique developed by Vanosdall and Rudisill (1979). The subjects were evaluated by a driver education expert trained in the use of the DPM technique, while they drove in their own cars. The DPM route was a 19-km circuit designed to evaluate the subjects in the situations that are most often involved in the accidents of older drivers. Therefore, their performance was evaluated at 7 intersections where they were required to make left turns at 5 intersections and right turns at the other 2 intersections. Four of the left turns were made from left-turn lanes onto four-lane divided arterial streets in suburban areas, and one was made from a left turn lane onto a two-lane one-way street in an outlying business district.	University laboratory.	The correlational coefficient between simulator brake reaction time and driving performance score was -0.15, which was not significant ($p=0.1182$).	Tarawneh, McCoy, Bishu, and Ballard (1993)

II.D. MULTIPLE FACTORS

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1. **Self-Reports**

   (a) Driving Habits Survey
   (b) Panel Data Set (medical & functional limitations, demographics)

2. **Number of Observed Problems**

3. **Test Batteries**

   (a) Automated Psychophysical Test (APT)
   (b) Johns Hopkins University
   (c) Salisbury Eye Evaluation
   (d) University of Alabama at Birmingham (UAB)
   (e) University of Helsinki
   (f) University of Iowa
   (g) Yale University

4. **Literature Review- Medical Conditions**

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Self Reports: **Driving Habits Survey**	3,238 drivers ages 65+, who applied for renewal of North Carolina driver's license	Brief survey included: • frequency of making trips (almost never, < once/week, 1-2 days/week, 3-6 days/week, every day); • average number of miles driven daily (none, <5, 5-9, 10-19, 20-49, 50+); • average miles driven weekly (<10, 10-19, 20-29, 30-49, 50-99, 100+); • average miles driven yearly (less than 1,000; 1,000-2,999; 3,000-4,999; 5,000-9,999; 10,000-14,999; 15,000-19,999; 20,000-24,999; 25,000+); • avoidance of driving under certain conditions (dark, heavy traffic, etc.); • involvement in any police-reported crashes; • medical conditions and medications that might impact driving. Dependent variable: involvement in a police-reported motor vehicle crash during the three-year period immediately preceding license renewal.	Eight NC driver's license offices, representing a mix of urban and rural locations in the western, central, and eastern portions of the State.	Correlational coefficients for average annual crashes and: trip frequency = 0.052 ($p<0.003$) daily miles = 0.051 ($p<.004$) weekly miles = 0.029 ($p<.10$) yearly miles = 0.049 ($p<.01$) There is a trend of higher crash rates for higher categories of exposure or mileage. Note: all of the cognitive tests were significantly correlated with each other. Trails A & B and AARP Reaction Time test had highest correlations with one another, with r-values ranging from .60 to .73. Correlations of Short Blessed test with these 3 measures ranged from .44 to .46. The NC Traffic Sign Recognition test had the lowest correlations with the other measures.	Stutts, Stewart, and Martell (1996)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Self Reports: **Driving Habits Survey**	121 licensed drivers forming groups composed of : • 47 normal/nondemented elderly (mean age 72.9) • 29 middle-aged/nondemented controls (mean age 40.6) • 45 cognitively impaired drivers (mean age 73.3) • 28 with mild dementia • 8 with moderate dementia • 9 with cognitive impaired but not meeting the criteria for dementia	This interview consisted of 5 multi-item questions (56 items total) eliciting information about driving problems the subject might be experiencing. The questions were concerned with driving faults, changes in driving ability, level of concern about deficits with driving skill and potential driving mishaps, difficulties with driving maneuvers, and the extent to which various factors interfered with driving. Subject's self appraisals were compared to collateral ratings of driving problems and to performance on a cone avoidance task. The cone avoidance task required a subject to maneuver a test vehicle through a course of traffic cones, hitting as few as possible. On each of three trials, the participant was asked to estimate the number of cones he/she expected to hit. The difference between predicted and actual hits provides an index of subjects' abilities to estimate the difficulty of the task while taking account of their score on the previous trials. A negative score where actual hits are greater than predicted hits, suggests that the driver is overconfident and can not adequately assess task difficulty in relation to own skill level.	Cognitive battery given at Clinic for Alzheimer's Disease and Related Disorders (University Hospital, Vancouver B.C) CDAM testing performed at a local Rehab Center MVB Road test conducted by license examiners on a class 5 course Cone Avoidance test conducted on off-road course	Results from the Driving Interview revealed that both elderly groups drove fewer miles and more often avoided demanding driving situations than the mid-age drivers. The demented elderly drove fewer miles than the normal elderly, however they did not limit their exposure to high-risk driving situations such as driving after dark and in rush hour as did the normal elderly. The demented elderly claimed that their exposure was higher than that estimated by their collaterals. On both measures examining the accuracy of subjects' self-appraisals, the demented group was overconfident about their performance abilities. The demented subjects hit more cones than predicted in the Cone Avoidance Task and also reported significantly lower levels of driving performance problems than their collaterals did. There was no difference in self and collateral driving appraisals for either mid-age controls or the normal elderly.	Tallman, Tuokko, and Beattie (1993)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Self Reports: **Driving Habits Survey**	17 subjects (age 57-97; mean age = 75); 6 females and 11 males. 8 S's were referred from local mental disorder clinics or from local physicians because of possible dementia and associated driving problems. 9 S's were community residents who did not have suspected dementia or driving problems.	A questionnaire, developed specifically for this study, that included specific questions about: driving frequency, problem areas in driving (e.g., braking, turning), ratings of driving ability compared to other drivers, and restrictions in driving. An on-road driving assessment was performed with the subject driving with a certified driving examiner in a dual-brake vehicle. Simple maneuvers were first performed in a parking lot, then subjects joined the flow of traffic and traveled over a prescribed route in moderate to heavy traffic. Subjects were scored on the basis of errors or omissions that correspond to points on the State of New York road test exam; higher scores indicate poorer performance. Therefore a total score was used as well as a determination of whether the subject met or exceeded state standards ("pass") or failed to meet standards ("fail"). In addition, a pass/fail rating was given for the subjects' performance in steering control, braking, acceleration, judgment in traffic, observation skills, and turning skills (particularly left turning).	Clinical tests: University Laboratory On-road driving evaluation: parking lot and in-traffic (moderate to heavy traffic situations)	The group that failed the road exam drove significantly fewer miles (mean = 2,313) than those who passed the road exam (mean = 6,188). There were no significant differences in terms of how drivers who failed the on-exam and drivers who passed the on-exam described their driving skills; 61% of the drivers who failed the driving exam saw themselves as either "a little better" or "much better" than their peers in various domains of driving skill (passing vehicles, entering expressway, parking, backing up, turning, steering, dealing with heavy traffic, braking) compared to 69% of the drivers who passed the exam, who also saw themselves as either "a little better" or "much better" than their peers. Drivers who passed the on-road exam and drivers who failed the on-road exam took similar numbers of medications on average, however, the 6 subjects who took some form of psychoactive medication (antidepressant, antimanic, antipsychotic, anxiolytic, or sedative/hypnotic agents) were all in the group who failed the on-road driving exam	Cushman (1992)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Self Reports: **Driving Habits Survey**	• 102 "referred" subjects aged 60-91 (34 of which were identified as probably being cognitively impaired to some degree). 47% of the noncognitively impaired referred drivers had visual impairment noted on their record, and 24% of the cognitively impaired had a visual disability noted). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment. • 33 paid "volunteers" aged 56-85, recruited through signs posted at study site or word of mouth.	9-question situational avoidance measure derived from Hennessy (1995), which asked subjects whether they avoided certain driving situations. Answers ranged from "never" to "always" of 4-choice scale; avoidance measure took into account both number of situations avoided and strength of avoidance reported. Three tiers of analyses were conducted in this research: (1) logistic regressions to determine what combination of tests, observations, or survey variables, with what weightings, would best predict whether a subject was a volunteer or referral; (2) multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance on road tests; and (3) comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance on nondriving tests and driving tests. (See On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium)	California DMV Field Office	Strength of avoidance was significantly correlated with group (Volunteer vs. Referral), r=.368. Average score for referrals = 18.99 Average score for volunteers = 14.03 Strength of avoidance was also significantly correlated with age (r=.423). Avoidance score correlated significantly with weighted error score on drive test (r=.4394, p<.000) for combined referral and volunteers, as well as for the referral group only (r=.3573, p<.001) Amount of avoidance did not discriminate between cognitively impaired referral subjects and cognitively unimpaired referral subjects.	Janke & Eberhard (1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Self Reports: **Driving Habits Survey**	101 licensed drivers (39 females and 62 males) age 72-90 (mean age = 78.3) who were members of a preexisting study cohort engaged in longitudinal studies of a community-dwelling cohort of older people (at Buck Center for Research in Aging)	9-question situational avoidance measure derived from Hennessy (1995), which asked subjects whether they avoided certain driving situations. Answers ranged from "never" to "always" of 4-choice scale; avoidance measure took into account both number of situations avoided and strength of avoidance reported. An on-road driving exam was given by the project driving instructor (owner/operator of a driving school in San Francisco) based on the California Driving Performance Evaluation (DPE), and using the same scoresheet as used for the MDPE given in San Jose by these researchers. (See On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium). A weighted error score was calculated as total # of unweighted errors, plus twice the sum of critical and hazardous errors. Concentration errors were also noted. Critical errors = errors which would in normal circumstances cause test termination (turning from improper lane, dangerous maneuver, examiner intervention needed). Hazardous errors = dangerous maneuver or examiner intervention. Concentration errors = subject unable to proceed to field office at end of test, or drove past the street on which the field office was located and did not recognize their error.	Novato, Marin County California; Buck Center for Research in Aging	Avoidance of specific driving situations was not significantly correlated with weighted error score on the drive test (r=.18)	Janke and Hersch (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Self Reports: **Driving Habits Survey**	257 community dwelling, active drivers, ages 56-90. 137 males, 120 females Mean age = 70 years	Objectives: (1) to examine self-reported driving avoidance in a cohort of drivers with objectively established visual and cognitive functional capabilities; (2) to examine the interrelationships among functional impairment, avoidance, and crash risk. The Driving Habits Questionnaire (DHQ) asked questions about driving exposure and the avoidance of potentially challenging driving situations. The driving exposure question was, "How many days/week do you drive?" The avoidance questions were: (1) "do you avoid driving at night?"; (2) "do you avoid high-traffic roads?"; (3) do you avoid rush-hour traffic?"; (4) "do you avoid high speed interstates/expressways?"; (6) "do you avoid left-hand turns across traffic?"; and (7) "do you avoid driving in the rain?" Responses covered a range of 5 options from 1=never to 5=always. At-fault crash involvement for the previous 5-year period was compiled from records obtained from the Alabama Department of Public Safety. Visual and cognitive performance were also measured as follows: Visual Acuity - ETDRS chart Contrast Sensitivity - Pelli-Robson chart Visual Field Sensitivity - Humphrey Field Analyzer Useful Field of View - Vision Attention Analyzer Cognitive Function - MOMSSE **FINDINGS (Cont'd)** •Avoidance of driving in rain: Group 1 signif less avoidance than each other group; Group 2 signif less than Group 5; Group 3 signif less than Group 5. •Subjects with higher number of crashes in prior 5 years reported more avoidance of driving in rain (r=0.20, p=.002), making left turns (r=0.18, p=.004), and driving during rush hour (r=0.15, p=.018). •Avoidance and at-fault crashes in subsequent 3 years could not be evaluated due to driving cessation or death in 52 subjects, most of whom were functionally impaired.	University of Alabama, Birmingham	•Older drivers who were more visually and/or cognitively impaired tend to report more avoidance and less exposure. •Relationships between mental status and the avoidance items were weaker than those between visual function and avoidance, with the exception of mental status, which showed the strongest relationship with driving alone compared to all other functional measures. •5 functionally groups were defined based on the number of vision problems and UFOV score: Group 1 (unimpaired) = 0 vision problems & unimpaired UFOV Group 2 = 1-2 vision problems; unimpaired UFOV Group 3 = 0 vision problems; impaired UFOV Group 4= 1-2 vision problems; impaired UFOV Group 5 (most impaired) = 3-4 vision problems and impaired UFOV ($\geq$ 40) •All groups reported a similar level of avoidance of night driving. •Avoidance of heavy traffic: Group 1 (not impaired) reported signif less avoidance than Groups 4 and 5 (most impaired); Group 3 significantly less than Groups 4 & 5 •Avoiding rush hour: Group 5 reported signif more avoidance than all other Groups •Avoiding high speed roads: Groups 4 and 5 signif more avoidance than Group 1. •Avoiding driving alone: Groups 4 and 5 signif more avoidance than Group 1. •Avoidance of left turns: differed signif across all 5 groups	Ball, Owsley, Stalvey, Roenker, Sloane, and Graves (1998).

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Self Reports: **Panel Data Set (medical & functional limitations, demographics)**	Remaining eligible drivers in 1993 (507 female drivers and 375 male drivers) who participated in the Iowa 65+ Rural Health Study from 1981-1993. The study included all noninstitutionalized individuals in two counties age 65+. [The resulting sample was 6,553 female person-years and 5,414 male person-years]	Survey data from in-home and telephone interviews included demographic attributes, onset of medical conditions, symptoms and ailments, functional status, physical functioning, physical activities, vision, drug use, cognitive abilities, and annual miles driven. The survey data were linked to crash files maintained by the Iowa DMV. --- FINDINGS (Cont'd) <u>Single model for both genders</u>: **-annual miles driven** **-living alone** **-experiencing back pain** study limitations that may inhibit generalization to other populations: (1) study area included 2 rural counties (so, effects of other factors such as traf.mix, geom. design, travel speed found in urban areas unknown); (2) residents were affluent (effects impacts of income and employment status).	Data analysis conducted at Oak Ridge National Laboratory	<u>Risk factors that determine the probability of an older female being involved in a crash</u>: **-increasing annual mileage** increases the odds ratio (of a crash): from 6,000 to 12,000 mi/yr the increase is 1.5x; from 6,000 to 18,000 the increase is 2.3x; from 6,000 to 24,000 the increase is 3.4 x) -older females who have **difficulty extending their arms above their shoulders** have an increased probability of being involved in a crash (e.g., an older female with difficulty extending arms over shoulder is more than twice as likely to be crash involved than another female with no difficulty, given that both drive 6,000 mi/yr). **-living alone** **-persistent back pain** **-difficulty seeing friend across street** <u>Risk factors that determine the probability of an older male being involved in a crash</u>: **-annual miles driven** **-living alone** **-being employed** **-having a history of glaucoma** **-having impaired cognitive ability (low score on word recall test)** **-persistent back pain** **-using anti-depression drugs** (doubles the crash probability and is the single most influential risk factor other than the amount of driving)	Hu, Trumble, Foley, Eberhard, and Wallace (1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS **Number of Observed Problems**	• 102 "referred" subjects aged 60-91 (34 of which were identified as probably being cognitively impaired to some degree). 47% of the noncognitively impaired referred drivers had visual impairment noted on their record, and 24% of the cognitively impaired had a visual disability noted). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment. • 33 paid "volunteers" aged 56-85, recruited through signs posted at study site or word of mouth.	The nondriving test administrator noted "problems" or disabilities manifested by a subject during the testing process. Observable problems included: tremors, stiffness, difficulty in understanding test instructions, and impaired balance. Three tiers of analyses were conducted in this research: (1) logistic regressions to determine what combination of tests, observations, or survey variables, with what weightings, would best predict whether a subject was a volunteer or referral; (2) multiple linear regressions were conducted to arrive at the best linear combination of variables for predicting performance on road tests; and (3) comparisons were made between cognitively impaired and cognitively non-impaired referral drivers to determine whether there were differences in performance on nondriving tests and driving tests. (See On-road Performance Measures of Driving Safety: California MDPE at the end of this Compendium)	California DMV Field Office	Referral group performed significantly worse than the volunteer group (Average no. Observed problems for referrals = 0.41, for volunteers = 0.00). The only subjects noted to have observable problems were in the referral group; although the observer could have been biased as she was not blinded to group, she was aware of potential bias and tried to guard against it. (Note: this variable was not significantly related to age) A model using number of observed problems plus Pelli-Robson errors with a cut-point of $p=.80$ of being a referral, gave specificity of 97 percent (32 of 33 volunteers classified correctly) with sensitivity of 71.4 percent (70 of 98 referrals in the model correctly classified). The cognitively impaired group had significantly more observed errors (average = 0.85) than the cognitively nonimpaired group (average = 0.19) The correlation between number of observable problems and weighted error score on the road test was significant when referrals and volunteers were combined ($r=.3944$, $p<.000$) and for the referral group only ($r=.3185$, $p<.001$)	Janke & Eberhard (1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Test Batteries: **Automated Psychophysical Test (APT)**	360 drivers age 62+, currently licensed and driving, divided into 2 groups: 249 drivers referred to licensing agencies for reexam ("incident-involved"), by police, family, courts, physicians, & licensing personnel. Mean age = 80.6. 55.9% of the group was male. Subjects with physical problems such as stroke, severe arthritis, or loss of consciousness were excluded. 111 drivers not previously referred for reexamination, obtained by solicitations through senior citizens groups ("incident-free"). Subjects were paid $ 50.00 for taking the test. Mean age = 75.2. 60.3% of the group was male.	Objective: To examine the relationships between age-related psychophysical deficiencies of drivers and deficient driving performance. Independent Variables: 22 measures were assessed using a PC (battery takes 30-60 minutes): Correlations: Time / Error Sensory: Static Visual Acuity .30 / 18 Low Contrast Acuity .23 / 18 Dynamic Visual Acuity .24 / 21 Attentional: Range of Attention (UFOV) Simple Response .26 Choice Response Simple Image .34 / .31 Complex Image .34 / .24 Selective Attention 30 / .29 Divided Attention 15 / .36/.36 (dist) Perceptual: Perceptual Speed .28 / 24 Motion Detection 24 / .36 Field Dependence 12 / .24 Cognitive: Information Processing Digit Matching .18 / 42 Figure Matching .25 / .33 Missing Pattern NS / .39 Short Term Memory Digit Matching .34 / 30 Figure Matching NS / .22 Delayed Short Term Memory Digit Matching .30 / 33 Psychomotor: Simple Reaction Time Abstract Image 28 Meaningful Image .30 Choice Reaction Time Abstract Image 35 / .24 Meaningful Image .31 / .39 Visual Tracking / 33 (dist) Dependent Variable: presence or absence of deficiency in driving performance, operationalized as observed incidents of deficient driving resulting in referrals to State licensing authority for reexamination.	Pontiac, MI Phoenix and Tucson, AZ	•APT performance generally scored in terms of *time* (mean time on individual exercise for correct responses) and *error* (proportion of responses that were incorrect). For visual acuity measure, correctness measure was level of acuity. For visual tracking measure, correctness was distance error averaged across exercises. •All correlations between APT performance (both time and error) and observed driving deficiency (presence vs absence) were significant ($p < .01$, 2-tail), and positive (longer time and more errors were related to presence of driving deficiency). See correlations in procedures section. •The cognitive abilities error measures were most highly correlated with driving performance. The 3 information processing measures and the measure of delayed short-term memory showed fairly strong correlations between accuracy and safe driving. •Attentional and perceptual measures (speed and accuracy) showed small to moderate correlations with driving perf. Signif. but low correlations found between driving perf. and static, dynamic, & low contrast visual acuity accuracy scores. Both speed and accuracy of psychomotor abilities showed small to moderate correlations w/ driving perf. •Analysis of total score distributions for incident-involved and incident-free drivers showed a high degree of accuracy in identifying the most deficient of the incident-involved drivers. A score below +6 identified @ 80% of the incident-involved drivers, and included 20% of the incident-free drivers.	McKnight and McKnight (accepted by AAP, 1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Test Batteries: Johns Hopkins University	300 drivers over age 65 who visit their primary care physician for medical care will be evaluated. Drivers will be selected in 2 age groups: age 66-75 and age 76+	**In Progress Study** The purpose of the study is to characterize the cognitive functioning of older drivers, and to identify a short screening test that can be easily implemented in a physician's office. *General Cognitive Function*: Modified Mini-Mental State Examination (10 min). Will include the standard modification (Folstein et al., 1975), plus (1) inclusion of both serial sevens subtraction and spelling "world" backwards; (2) digit span forward and backwards; (3) adding change; (4) naming the current and previous 4 presidents ; (5) a 10-item picture confrontation naming task; (6) an additional sentence repetition item; (7) 2 additional construction figures to copy. *Visual Information Processing*: Visual Reproduction (10 min). Test of immediate visual memory (Wechsler, 1987), where subject will view a stimulus line drawing for 10 s and must draw the design from memory after the stimulus is taken away. Four stimulus cards are presented, one at a time. Motor-Free Visual Perception Test (10 min). Will assess visual discrimination, figure-ground extraction, visual closure, visual memory, and spatial relationships. Subjects choose the appropriate response from among 4 choices for each item. *Attention*: Trail-Making Test (5 min). Test of visual conceptual and visuomotor tracking involving motor speed and switching attention. Parts A and B will be given. Brief Test of Attention (15 min). This is a brief test of auditory selective attention with 2 conditions, each with 10 trials (Schretlen and Bobholz, 1992). A tape recorder presents a series of digits and letters on each trial. The same series of digits and letters is presented for each condition. In one condition, subjects must count the number of digits presented. In the other condition, they must count the number of letters presented. The total number of correct counts is tallied across conditions. Questionnaire data will also be obtained.	Johns Hopkins University (general medical setting)	Not reported to date	Principal Investigator: Penelope Keyl

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Test Batteries: **Salisbury Eye Evaluation**	2,320 community-dwelling persons between age 65-84 in the Salisbury, MD Metropolitan area Mean age = 72.1 years 42% male, 58% female 27% African American 73% Caucasian	**In Progress Study** Salisbury Eye Evaluation (SEE) includes 4 population-based studies aimed at studying risk factors for age-related eye disease and the relationship between visual impairment and disability in an aging population. Each participant is administered a 2-hour in-home interview including mental status, medical history, diet history, and Activities of Daily Vision questionnaire. S's then underwent a 4- to 5-hour clinic examination that included: Refraction (Humphrey Autorefractor) Visual Acuity (ETDRS Chart) Contrast Sensitivity (Pelli-Robson Chart) Glare Sensitivity (Brightness Acuity tester) Stereoacuity (Randot Circles Test) Visual Fields (81-point, single-intensity test strategy on Humphrey Field Analyzer; tests points over a 60 degree radius field with a single target intensity of 24 dB) - UFOV - Assessment of Reading, Face Recognition, and Mobility - Ocular Disease Assessment - ADLs -General health Dependent measures will come from State Accident Reports (retrospectively 5 yrs, prospectively 4-5 yrs)	Salisbury, MD; in-home interviews and clinic evaluations	Report on visual function in Investigative Ophthalmology & Visual Sciences, (1997), but no data avail on ability of tests to predict driving performance. <u>Vision Characteristics</u>: Acuity: mean = .01 logMar (20/20) +/- 1 line Contrast sensitivity: mean = 1.6 +/- 0 .2 Humphrey visual fields: mean 17.6 +/- 2.3 points missed Randot Stereoacuity test: mean = 1.92 +/- 0.5 log arc sec. UFOV: 39% of participants had UFOV loss greater than 40%	Principal Investigator: Gary S. Rubin, Lions Vision Center Baltimore, MD Rubin, West, Munoz, Bandeen-Roche, Zeger, Schein, Fried (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Test Batteries: **University of Alabama at Birmingham** Multivariate Model: - Mental Status Exams - Number of Health Conditions - Comorbid Medical Condition Score - Physical Activity - Falls Efficacy Scale - Mobility & Balance - Depression - Life Satisfaction - Cataract/no Cataract - Cataract Symptom Score - Global Measure of Vision - Visual Acuity - Contrast Sensitivity - Disability Glare - Visual Field Sensitivity - Useful Field of View - Visual Performance Tasks of Everyday Life - Age - Gender	Older drivers age 55-90 randomly selected from age and crash stratified cohort residing in Jefferson County, AL Group 1 =older adults who have cataract surgery (n=144) Group 2= older adults with cataract who do not have surgery (n=137) Group 3= older adults with good eye health (n=105)	**In progress study** (Project 2 of Roybal Center) Improving Visual Function: Impact on Driving The project is an intervention evaluation study to determine how improvement in vision impacts crashes and driving habits. Other Objectives: To determine the natural progression of crash frequency and driving habits in a group of older adults who, at the outset of the project, are in good eye health. To determine whether certain factors serve as effect modifiers, thus altering the relationship between improvement in visual sensory function and crash frequency/driving habits. Prospective study where all subjects are assessed once annually, with the 1st visit before cataract surgery, then annually after surgery for 2 years. Crash data from 5 years prior to enrollment and 3 years following enrollment are obtained from Alabama Dept. of Public Safety.	Roybal Center University of Alabama at Birmingham	The mental status exams were not scored as of the date of the progress report. The following bivariate associations were statistically significant: One or more at-fault crashes are associated with: • **Reduction in UFOV of 40% or more** • **African American Race** • **History of Falling** • **Not using a beta-blocking drug** • **Self-reported difficulty in visual tasks** • **Cataract** • **Acuity loss** • **Contrast sensitivity loss** • **Increased disability glare** • **Visual field loss** Findings indicate that functional measures are of greater relevance than specific medical conditions in the identification of at-risk elderly drivers.	Principal Investigator Cynthia Owsley, Richard Sims Advisory Committee Meeting No. 4 (January, 1996) A3B13 Newsletter (July,1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Test Batteries: **University of Alabama at Birmingham** -Age -Race (African American, Caucasian) -Use of Beta-Blocking Drugs -Use of Alpha-Blocking Drugs -Use of Diuretic Drugs -Positive Urinary Opiates -Falls in Past 2 Years -Reduced UFOV -Performance Oriented Mobility Assessment (Poma) -Gender -Medical Diagnoses -Disordered Sleep -Depression -Alcohol Consumption -Grip Strength -Supine and Sitting Blood Pressure - Reported and Documented Hearing Impairment -Walking Time -Driving Exposure -Mental Status -Comorbidity Status	174 drivers ages 55-90 (mean age 71.1), residing in Jefferson County, AL. Case drivers has at least 1 state-recorded at-fault crash in the 6 years preceding the assessment (n=99) Controls had no state-recorded at-fault crashes in the prior 6 years (n=75)	**Objective:** to explore associations between a history of at-fault vehicle crashing in older subjects (between 1985-1991) and several medical and functional variables collected on them in 1991. 7 Questionnaires and 10 physical examination/performance measures were employed to assess medical and functional domains. Lists of drivers and number of crashes for each driver were made available by the AL Dept. of Public Safety. Questionnaires: 1-Medical History (medical diagnoses, self-reported health, prior hospitalizations & nursing home admissions, and number of falls in prior 2 years) 2-Current prescriptions and over-the-counter meds (CHS procedures--systolic Hypertension in the Elderly Program & Cardiovascular Health Study) 3-Depression Scale (Center for Epidemiological Studies) 4-Short Michigan Alcoholism Screening Test & estimate of weekly alcohol consumption 5-Self-reported hearing function (Hearing Handicap Inventory in the elderly) 6-Physical functioning in ADL's & IADL's (CHS & Supplement on Aging from Nat'l Health Interview Survey) 7-Driving exposure and avoidance of situations Physical Exams/Performance Measures: 1-Supine, sitting & standing blood pressures 2-urine screens for amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates, & phencyclidine 3-POMA (balance and gait: chair stand, balance eyes closed, neck turning, reaching up, bending over, sternal nudge, initiation of gait, gait height, path deviation, turning while walking) 4-Timed 15 ft walk 5-Bilateral hand grip strength (Jamar dynamometer) 6-MOMSSE 7-Hearing (Welch-Allyn audioscope) 8-Acuity (ETDRS chart) 9-Contrast Sensitivity (Pelli-Robson) 10-UFOV	UAB at Birmingham	At univariate level, crash-involvement was significantly associated with Black Race (p=0.002), difficulty reaching out (p=.042), not using a beta blocker (p<0.001) not using an alpha blocker (p<0.031), not using a diuretic (0.050), having positive urinary opiates (p=0.040), falling in prior 2 years (p=0.004), failing UFOV (p=0.001), older age (p=0.018), poorer visual acuity (p=0.001), poorer contrast sensitivity (p=0.032), poorer performance on MOMSSE (p=0.024). Low POMA scores were marginally significant (p=0.077), suggesting worse balance and gait among drivers who crashed. No significant difference between cases and controls for driving exposure. All non-collinear variables that were significant at the univariate level were entered into logistic regression models. The following variables provided the best fit of the data: •UFOV reduction of 40% or more (OR = 6.1, CI = 2.9-12.7, p<0.001), •African American race (OR = 6.6, CI=1.7-26.2, p<0.007) (NOTE: only 14.9% of sample was African American & only 4 were non-crashers. Thus there were too few control subjects to provide sufficient info about this assoc.) •Not taking a beta-blocking drug (OR = 4.3, CI=1.2-15.0, p=0.23) •Having fallen in prior 2 years (OR= 2.6, CI=1.1-6.1, p=0.025). Failure to find assoc. between crashes and use of benzodiazepines, antidepressants, or narcotics may reflect low utilization of drugs in sample.	Sims, Owsley, Allman, Ball, and Smoot (1998)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Test Batteries: **University of Helsinki**	Five cohorts: novice drivers getting their license in 1997 drivers age 35, in 1997 drivers age 50, in 1997 drivers age 60, in 1997 drivers age 70, in 1997 Samples of 300 drivers will be drawn from driver record files	**In Progress Study 1997-2001**: "Driving Skills and Abilities in Novice and Elderly Drivers: a 5-Year Follow-Up Study" This program will include a test of a new system to predict elderly drivers' driving ability and include support for maintained mobility. Drivers will include 5 age groups, including drivers who will be 60 years old and 70 years old in 1997. Samples will be tested in driving schools (laboratory tests of visual acuity, contrast sensitivity, visual fields, cognitive and attentional tests, plus a battery for coherence of information processing developed by prof. V. Virsu, Dept. Of Psych) and will take a driving exam in their own vehicle. Driving exam includes detailed observation of critical driving behavior, used in present finnish driving exam. Drive test also includes feed back and supportive analysis of mobility needs and optimum means to fulfill them. Educational materials developed for elderly people by a concurrent program at Traffic Safety Organisation of Finland will also be used. Half the sample will then be undergo test and support sessions every year. Accidents and exposure will be evaluated. A sample will be tested in instrumented vehicles where measures will be made of distance and lane keeping performance, crossing management, merging onto a major road, and divided attention when doing in-vehicle tasks and using navigation information.	20 driving schools in Finland		Program directed at the Traffic Research Unit by professor Heikki Summala, funded in part by the Ministry of Transport Heikki Summala, Ph.D. Professor of Traffic Psychology Dept. Of Psychology Traffic Research Unit P.O. Box 13 (Meritullinkatu 1 A) 00014 University of Helsinki Finland heikki.summala@helsinki.fi

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Test Batteries: **University of Iowa**	39 licensed drivers: • 21 with Alzheimer Disease, recruited from a registry in the Alzheimer's Disease Research Center of the Dept. Of Neurology, Univ. Of Iowa, Iowa City. Diagnosis relied on recommendations made under Dept. of Health and Human Services Task Force on AD (NINCDS-ADRDA) • 18 controls without AD, recruited from volunteers in the local community ——— **PROCEDURES (Cont'd)** **Dependent Measure**: Driving performance is measured in Iowa Driving Simulator. Crashes or near misses can occur to 4 events on 2-lane highway (e.g., slower moving or stopped lead vehicles). Also, headway, lane deviations, abrupt braking, and potential injury severity are measured.	**Objectives**: To determine fitness to drive for neurological patients. Three goals: (1) to test hypothesis that drivers w/ AD are more at risk for crashes than controls w/o dementia of similar ages; (2) to determine what specific driver safety errors preceded a crash; and (3) to determine how such unsafe events are predicted by visual and cognitive factors sensitive to decline in aging and AD. <u>Cognitive Tests</u>: • Temporal Orientation (date, day, time of day) • Information & Block Design (from WAIS-R) (Verbal and nonverbal intellectual capacity)--age scaled scores are reported • Benton Visual Retention Test (BVRT)--sensitive to early mental decline • Controlled Oral Word Assoc. (COWA)--S's must generate as many words as possible that begin w/ a certain letter within a 1-min time limit. Good detector or early abnormal decline • Benton Van Allen Facial Recognition Test (Faces)--measures visuoperceptual capacity (scores corrected for age & educ. level) • Rey-Osterreith Complex Figures Test (CFT)-Copy (S's must copy complex geometric figure. Visuoconstructional ability, independent of memory function) • Trail Making A & B (measures executive function)--scale score equivalent of test raw score is reported • WAIS-R Digit Span, Forward & Backward--immediate and working memory (age scaled scores reported) <u>Visual Perception Tests</u>: • Far & near visual acuity • Dynamic visual acuity • Static spatial contrast sensitivity (Pelli-Robson Chart) • Motion direction discrimination using random dot cinematograms • 3-D structure from motion (SFM)--using orthographic projections of spatially random dots on a mathematical model of a rotating cube or square <u>Attentional Tests</u>: •UFOV • Starry Night Test (visual and sensory function and attention over a spatial array over time).	University of Iowa, CDC Study	• 6 of 21 (29%) S's with AD had crashes, vs. 0 of 18 controls • Odds Ratio (OR) Estimates and exact P values (Fisher) of predictors of crashes follows: <u>Variable</u> — <u>OR</u> — <u>P</u> •Rey-Osterreith CFT-Copy <20 — 57.61 — <.001 •3-D SFM>15 — 44.94 — <.001 •Trails B<3 — 30.19 — <.001 •WAIS-R Block<6 — 40.78 — <.001 •BVRT Correct <4 — 12.30 — .01 •UFOV Total loss ≥ 50% — 18.13 — .002 •Faces <40 — 58.53 — <.001 •WAIS-R Digit <10 — 10.04 — .02 •Temporal Orientation<0 — 20.14 — .004 •WAIS-R Information<10 — 24.56 — .002 •Starry Night<1 — 29.83 — .001 •COWA<30 — 24.56 — .002 •Alzheimer Disease — 8.91 — .02 •Age>70 y — 0.74 — >.99 •Sex, M — 3.17 — .39 •For UFOV, among 15 S's with total UFOV loss ≥50%, 6 had at least 1 crash, while none of the 23 S's w/ total UFOV loss <50% had any crashes. •In development of multivariate model, after adjusting 1st step for results of Rey-Osterreith Complex Figures Test (the most significant), no other factors were significant. •Crashes were "looked but didn't see," reacted too slow, and evasion of primary hazard and colliding w/ secondary hazard.	Rizzo and Dingus (1996) Rizzo, Reinach, McGehee, and Dawson (1997)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS Test Batteries: **Yale University**	125 community-living cohort of older persons who are active drivers, followed longitudinally (ages 77+)	**In progress study**. In this study currently under conduct, a test battery was used to assess multiple domains of visual, cognitive, and physical abilities potentially relevant to driving. Tests were included only if they were brief, required little or no equipment, and could be administered by a trained interviewer to facilitate future in-office use. Test battery included: <u>VISION</u> Near Acuity - Rosenbaum Card Far Acuity - Graham Field Chart Central Visual Fields - Amsler Grid Peripheral Visual Fields - Manual Assessment Contrast Sensitivity - Pelli-Robson Chart <u>COGNITION</u> General Cognitive - MMSE, Traffic Signs Awareness - Aware of Driving/Memory Problems; Confidence in Driving Ability; Prediction of memory Verbal Memory - WMS-R Logical Memory Subtests Visual Memory -WMS-R Visual Reproduction Subtests Visuospatial - Hooper Visual Organization; Embedded Figures; Visual Imagery Attention - Number Cancellation Psychomotor - Symbol-Digit; Number Connection Reaction Time - Manual Assessment Executive - Trails B; Visual Distractors; Problem Solving <u>PHYSICAL</u> Range of Motion (ROM)/Strength - Manual Muscle Test; Dynamometer Sensory - Examination of Light Touch, Vibration, Proprioception, Stereognosis Coordination/Dexterity - Ball Drop; Finger Tap, Tweezer Test Foot Problems - Manual Examination Physical Performance - Rapid Pace Walk Outcomes included the self-report of a crash, moving violation, or being stopped by police, during the previous 5.75 years.	In-house (Yale University School of Medicine) by trained interviewers	Initial results (prospective findings not available yet): The following factors were associated with adverse events in bivariate analysis Initial multivariate results (Risk Ratio and probability): Near Acuity (<20/40 bilateral) RR=1.9, p=0.024 Contrast Sensitivity ($\leq$1.35) RR=1.5, p=0.078 Number Cancellation ($\leq$48 correct) RR=2.0, p=0.006 Hooper VOT ($\leq$16 correct) RR=1.5, p=0.059 Neck ROM (unable both directions) RR=2.2, p=0.001 Hand ROM (unable to touch crease) RR=1.8, p=0.015 Tweezer Test (>15.8 s) RR=1.6, p=0.038 Of the 125 subjects still driving at the time of the interview, 50 (40%) reported an adverse event in the previous 5.75 yrs. The factors independently associated with adverse events in multivariate analyses adjusting for driving frequency were: near vision worse than 20/40 (Risk Ratio 11.9; 95% Confidence Interval 1.3, 109.1); limited neck range of motion (rr=6.1, CI=1.7,22.0); and poor performance on a visual attention task ($\leq$48 correct on number cancellation), RR=3.0, CI=1.2, 7.8. If none of these factors were present, 21% reported events; if one was present, 45% reported events; if two or three were present, 87% reported events.	Principal Investigator: Rich Marottoli

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
MULTIPLE FACTORS **Literature Review: Medical Conditions and Their Direct and Indirect Impact on Driving Performance**		**In Progress Study**: Medical Fitness and Crash Risk (Project 476). Goal of study: to identify shortcomings in current Ontario driver medical standards and review practices that may not stand up to judicial scrutiny due to a lack of scientific evidence to justify the setting of such standards. Four main objectives: (1) assess and compare medical standards and medical review practices in selected progressive jurisdictions with those in Ontario; (2) critique program evaluation studies in selected jurisdictions; (3) comment on landmark legal decisions or impending court challenges within the jurisdictions; (4) review the scientific literature on medical conditions and their direct and indirect impact on driving performance. Regarding objective (4), literature on performance and epidemiological studies was reviewed for 7 medical conditions: diabetes with and without insulin; organic brain disorders; seizure disorders; sleep disorders; monocular vision and restricted vision.	Sponsored by Ministry of Transportation in Ontario.	Draft report submitted 10/4/96; conclusions and recommendations not released. Not available until end of 1997.	MacGregor, Smiley, Dooley, and Tasca (1996)

II.E. ON-ROAD MEASURES OF SAFE DRIVING PERFORMANCE

1. **California Modified Driving Performance Evaluation (MDPE)**
2. **California Area Driving Performance Evaluation (ADPE)**
3. **Washington University Road Test (WURT)**

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ON-ROAD PERFORMANCE MEASURES OF DRIVING SAFETY **California Modified Driving Performance Evaluation (MDPE)**	• 75 "referred" subjects aged 60-91 (26 of which were identified as probably being cognitively impaired to some degree). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment. • 31 paid "volunteers" aged 56-85, recruited through signs posted at study site or word of mouth.	Based on the California Driving Performance Evaluation (DPE), this driving test measures the constructs of visual search, speed control, and directional control, and it features a fixed number of possible errors, objective scoring criteria, and the scoring of elements of specific ("structured') maneuvers at specific locations. Examples of structured maneuver errors are "inadequate traffic check," "poor lane position," and "turns too wide or too short." A subset of errors defined as *critical driving errors* were listed in a separate section of the DMV score sheet. These are serious errors; under normal testing circumstances (i.e., other than a research situation), a driver's test would immediately be terminated. Critical errors included: examiner intervention; driver strikes object; drives up/over curb/sidewalk; drives in oncoming traffic lane; disobeys sign/signal; dangerous maneuver; inappropriate reaction to school bus; inappropriate reaction to emergency vehicle; inappropriate speed; inappropriate auxiliary equipment use; turn from improper lane. A subset of critical errors was also defined as *hazardous errors*, with the belief that these errors are predictive of driving impairment. These included "dangerous maneuver" and "examiner intervention." A weighted error score serving as the primary criterion (dependent) variable for these analyses was calculated by adding the total number of errors (regardless of severity) to twice the sum of critical and hazardous errors. Since hazardous errors are a subset of critical errors, and critical errors are a subset of total errors, this scheme weighted hazardous errors by a factor of five and other critical errors by a factor of three. Confusion (concentration) errors were also recorded, when a subject was unable to proceed to field office at end of test, or drove past the street on which the field office was located and did not recognize their error. Test times ranged from 30 to 45 min.	The MDPE was conducted along a fixed route near the Santa Teresa office of the DMV.	There were significant correlations between the following driving measures and group--referral vs volunteer: unweighted errors (.460); weighted errors (.470); hazardous errors (.388); critical errors (.386); and confusion errors (.418). Test failure was not significantly correlated with group. The following variables were also significantly correlated with age: unweighted errors (.395); weighted errors (.409); and critical errors (.355). There were no significant differences between cognitively impaired referrals and cognitively nonimpaired referrals on total errors, critical errors, or hazardous errors. Cognitively impaired referrals had significantly more "confusion errors" than cognitively nonimpaired referrals. This particular MDPE measure was the only driving performance measure where there was a difference in driving performance between cognitively impaired and cognitively nonimpaired drivers.	Janke & Eberhard (1998) see also : Janke & Hersch (1997) Staplin, Gish, Decina, Lococo, and McKnight (*in press*)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ON-ROAD PERFORMANCE MEASURES OF DRIVING SAFETY **Area Driving Performance Evaluation (ADPE)**	• 15 "referred" subjects aged 60-91 (26 of which were identified as probably being cognitively impaired to some degree). The drivers were referred to the DMV for reexamination due to a medical condition (by physician, optometrist, ophthalmologist), a series of licensing test failures, a flagrant driving error (police referral), or some other indicator of driving impairment. • 31 paid "volunteers" aged 56-85, recruited through signs posted at study site or word of mouth.	Based on the California Driving Performance Evaluation (DPE), this test is given in the subject's home neighborhood. The road test route was free-form, rather than pre-planned (of necessity); structured maneuvers could not be assigned to specific points on the route. Unweighted score = total # of errors, without regard for severity of error. Weighted score = total # of errors, plus twice # of critical errors plus twice # of errors defined as hazardous. Critical errors = errors which would in normal circumstances cause test termination. Hazardous errors = dangerous maneuver or examiner intervention.	Self-chosen routes in a subject's neighborhood area (familiar routes)	The following variables were significantly correlated with group–referral or volunteer--with correlation in parenthesis: unweighted errors (.386); weighted errors (.410); test failure (.297); hazardous errors (.378); and critical errors (.373). All of the above were also significantly correlated with age, except for test failure and hazardous errors, with the following correlations: unweighted errors (.367); weighted errors (.370); critical errors (.305) Correlation between MDPE and ADPE for all subjects was .705 for unweighted errors and was .737 for weighted errors. For referral groups, correlations were .675 and .708 for unweighted and weighted errors, respectively. For volunteers, correlations were weak: .414 for total errors and .324 for weighted errors.	Janke & Eberhard (1998) see also : Staplin, Gish, Decina, Lococo, and McKnight (*in press*)

FUNCTIONAL TEST	SUBJECTS	PROCEDURE/TEST DESCRIPTION	WHERE APPLIED	FINDINGS	RESEARCHER(S)
ON-ROAD PERFORMANCE MEASURES OF DRIVING SAFETY **Washington University Road Test (WURT)**	Participants recruited from Alzheimer's Disease Research Center (ADRC) at Wash. Univ. School of Medicine •58 healthy elderly control subjects, mean age = 76.8; Clinical Dementia Rating =0 •65 subjects with Dementia of the Alzheimer's type (DAT), mean age = 73.7; Divided into 2 groups: 36 Ss with Clinical Dementia Rating = 0.5 (very mild DAT) and 29 Ss with CDR = 1.0 (mild DAT). All S's had corrected acuity of at least 20/50 Short Blessed Test scores (mean and sd) for CDR 0, CDR 0.5, and CDR 1.0 were 1.4 $\pm$ 2.1, 4.8 $\pm$ 5.9, and 14.2 $\pm$ 6.7, respectively. Scores for this test range from 0 (no impairment) to 28 (maximal impairment). A univariate ANOVA indicated a significant difference across CDR groups on the Short Blessed Test. NOTE: no analyses were reported in this article regarding the relationship between performance on the Short Blessed Test and driving performance; however, LH provided the following stats: correlation between global rating on WURT and Short Blessed test perf. was signif. (r=-0.56, $p<0.0001$). Mean and sd SBT: Safe: mean =3.4, s.d.= 5.1 Marginal: mean =5.1 s.d.=5.7 Unsafe: mean=12.3* s.d.=9.1 * $p<0.0001$	Objective: To assess the reliability and stability of a standardized road test for healthy aging people and those with dementia of the Alzheimer type (DAT). •The WURT is a 9.6-km course with urban 2-, 4-, and 6-lane streets providing various road and traffic conditions to enable detection of driving behaviors associated with crashes in the elderly: failing to yield right-of way, responding inappropriately to traffic signs and signals, and difficulty negotiating intersections. •The initial test site (a large empty asphalt parking lot) was used for familiarization of the subject with the test vehicle (standard-model car with automatic transmission, and dual brake pedals). Seven basic motor vehicle operational tasks were assessed on pass/fail basis: insert key into ignition; start engine; shift from park to drive; drive forward 45 m, make a left turn; stop. Ss proceeded from closed course to open segment, unless major safety concerns were detected during familiarization. A commercial driving instructor plus the Principal Investigator accompanied each S during the drive. A global "safe/behavior unlikely to result in crash," "marginal/small-to-moderate risk of crash," or "unsafe/substantial risk of crash" subjective rating of driving performance was made by the instructor & PI. •A quantitative score was also calculated independently by instructor and PI. The best possible score was 108, the worst possible score was 0. A 3-point scale (0=moderate to severe impairment; 1=mild impairment; 2=no impairment) was used at predetermined locations on the following maneuvers: left turns, stops, lane maintenance, speed, traffic awareness, merging, concentration, lane changes, traffic signs, comprehension of directions, attention to task, awareness of how driving is affecting others, judgment, need for intervention by instructor for safety reasons. **FINDINGS (Cont'd)** For specific driving beh., 24 (81%) of the unsafe drivers required assistance [vs 11 (14%) of the safe drivers}. Turn signal use/non use did not discriminate between safe & unsafe drivers. Strongest correlation with the global rating was with qual. judgments on WURT driving perf. These judgments evolved from observing the overall cognitive performance of the subject's driving.	Washington University School of Medicine Urban medical school and urban highways and streets	•There was a significant relationship between global rating and CDR, such that most CDR 0 Ss were rated as "safe" 78% (45/58) compared to 67% (24/36) of CDR 0.5 Ss and 41% (12/29) of CDR 1s. Only 3% of CDR 0 Ss were judged "unsafe," but 19% of CDR 0.5 and 41% of CDR 1s were judged "unsafe." The remaining Ss in each CDR group were rated "marginal." •As dementia severity increased, the quantitative scores decreased. Mean road test scores for the CDR 0, CDR 0.5, and CDR 1 groups were 94.3, 92.0, and 85.6. Correlational analyses showed a significant association between drive performance scores and CDR level. •The quantitative score from the PI and the global rating from the driving instructor were highly correlated, such that safer global ratings were associated with higher quantitative road test scores. Interrater reliability for the driving instructor and PI for the global rating was also high. •Stability of driving behavior over time was examined with a 1-month test-retest paradigm for 63 subjects. The stability of the global rating by the same driving instructor on the same course was 0.53, and for the quantitative score, reliability was 0.76. Few safe drivers at baseline became unsafe at 1 month, and few unsafe drivers at baseline became safe at 1 month. The disproportionate instability came from the "marginal' drivers. It was suggested that visual environmental cuing (e.g., following preceding vehicle) may affect driving performance; cognitively impaired drivers may seek the actions of other drivers to follow the flow of traffic.	Hunt, Murphy, Carr, Duchek, Buckles, and Morris (1997a, and 1997b)

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