Marvin Levy

DOT HS-801 433
DOT HS-801 434
DOT HS-801 435
DOT HS-801 436

ANALYSIS OF HIGH RISK GROUPS FOR ALCOHOL COUNTERMEASURES

Contract No. DOT-HS-4-00989, DOT-HS-4-00990,
DOT-HS-4-00991, DOT-HS-4-00992

March 1975

Final Report

PREPARED FOR:

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
WASHINGTON, D.C. 20590

Technical Report Documentation Page

1. Report No. DOT HS-801 433	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle ANALYSIS OF HIGH RISK GROUPS FOR ALCOHOL COUNTERMEASURES; PHASE I: HIGH RISK DRIVER STUDY PLAN REPORT		5. Report Date March 1975
		6. Performing Organization Code
7. Author(s) M.H. Wagner; J.H. Bigelow; J. Cobb; L. Goldstein; R.E. Kirkpatrick		8. Performing Organization Report No.
9. Performing Organization Name and Address Technical Research Associates, Inc. 10604 Warwick Avenue Fairfax, Virginia 22030		10. Work Unit No. (TRAIS)
		11. Contract or Grant No. DOT-HS-4-00989
12. Sponsoring Agency Name and Address Department of Transportation National Highway Traffic Safety Admin. Washington, D.C. 20590		13. Type of Report and Period Covered 6/1/74 to 12/31/74 Study Design Plan
		14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract

The study plan defines a number of high risk drinking driver groups, specifies variables to be used in developing a predictive model of high risk drinking driving within these groups, and presents a design for a survey research operation which will discover these groups of high risk drinking drivers in the field, gather data on the relevant variables, and inductively develop best predicting equations from the data collected. Questionnaire forms are included, sampling plans and instructions; in fact, all work necessary to begin Phase II of the research project, the conduct of the survey.

17. Key Words Alcohol; drinking driver; survey design; high risk driver survey; survey plan		18. Distribution Statement Document is available to the public through the National Technical Information Service, Springfield, Virginia 22151	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 55	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

U. S. GOVERNMENT PRINTING OFFICE

Introduction

During June 1974 the National Highway Traffic Safety Administration awarded four parallel contracts entitled:

ANALYSIS OF HIGH RISK GROUPS FOR ALCOHOL COUNTERMEASURES

By completion of the six months study, the four contractors (Anacapa Sciences Inc., Highway Safety Research Inst., Ketron Inc., and Technical Research Associates) identified, largely on the basis of a literature review,criteria for selecting groups of individuals thought to have a high probability of being involved in alcohol-related accidents. Table I presents the potentially "high risk" groups of individuals which were identified by the contractors. In addition, detailed plans were prepared for the development and validation of techniques which identify high risk groups of drivers prior to crash involvement; therefore it was decided to combine the four reports into a single volume.

Fred B. Benjamin

Fred B.Benjamin, Contract Technical Manager

Table 1. Potential High Risk Groups Identified by the Four Contractors*

	Ketron	Anacapa	HSRI	TRA
Arrested for Driving While Intoxicated (DWI)				
General	X		X	X
One or more ASAP-DWI violations in past three years		X		
Age				
20-24 years old, one or more moving violations		X		
Under 20 years of age, one or more moving violations		X		
65 years old or older, drives at least one day per week		X		
Young, working class, single, less than 12th grade education				X
Alcohol Abuse				
General (arrested for DUIA, arrested for non-traffic alcohol offenses, admitted to alcohol treatment facility	X			
Previous alcohol-related crashes			X	
Stress				
General (economic problems, divorce)	X			
Divorced previous year, spouse custody of children		X		
Divorcing			X	
Miscellaneous				
Blue-collar worker with high absenteeism rate			X	
Insurance classification as assigned risk			X	
Driver improvement groups				X
Sociopathic risk group (non-traffic arrest risk group)	X			

* Note: all of the contractors identified males for selection in each of their "high risk" groups

TABLE OF CONTENTS

A. The Societal Problem of the Drinking Driver

1. Extent of the Problem

Over the past twenty-five years, the problem of highway fatalities has grown to near epidemic proportions. During 1972, approximately 56,000 persons were killed on the nation's highways.[1] Traffic crashes have been identified as the largest single source of death for individuals under 45 years of age.[2] Because the traffic safety problem primarily involves the young, the total number of useful man-years of labor lost due to traffic crashes has been growing and is now approaching the loss from heart disease and cancer.[3] Hundreds of thousands of persons each year are seriously injured. Billions of dollars in societal losses are sustained each year as the result of traffic crashes.

In 1968, a report from the Secretary of Transportation to the Congress,[4] stated:

> "The use of alcohol by drivers and pedestrians leads to some 25,000 deaths and a total of at least 800,000 crashes in the United States each year. Especially tragic is the fact that much of the loss of life, limb, and property damage involves completely innocent persons."

The problems of alcohol related crashes were first recognized and reported in 1904, but it wasn't until the 1950's that highway safety investigators began to understand the precise relationships of the elements of alcohol and driving. Today it is indisputable that alcohol is the most significant single factor leading to fatal crashes.

Alcohol also lies beneath a major portion of the violent injuries and deaths in this country.[5] It has a two-pronged effect on the human body. On the one hand, coordination and perception are impaired. On the other, judgment is affected and individuals are led to greater risk-taking. Thus, the driver who drinks excessively not only reduces his ability to control his vehicle but is led to drive in a more hazardous fashion.[6] The result is that half of the deaths on U.S.

---

[1] Accident Facts, 1973 Edition, National Safety Council

[2] Vital Statistics of the United States, (1968).

[3] National Center for Health Statistics; Department of Health, Education and Welfare, (1969).

[4] 1968 Alcohol and Highway Safety Reprot; National Highway Traffic Safety Administration, (August, 1968).

[5] Secretary; Health, Education and Welfare; Alcohol and Health, First Special Report to Congress, U.S. Department of Health, Education and Welfare, 121 pp., p. 40, (December, 1971).

[6] Committee on Mediocolegal Problems, AMA; Alcohol and the Impaired Driver, AMA Chicago, Illinois, pp. 234 (1970).

highways are related to alcohol.[7]

2. Societal Costs

The estimated monetary loss to society as the result of motor vehicle crashes range from $25 billion to $46 billion, depending upon the source of information (such as the National Safety Council or the National Highway Traffic Safety Administration). In a recent report by the National Highway Traffic Safety Administration (NHTSA),[8] the average societal loss (earnings lost, etc.) for a traffic fatality was $200,000; the average cost as the result of a non-fatal traffic related injury was $7,300, while the estimated property damage cost was $300. These costs do not include such intangible items as the "value" of a human life, the grief and sorrow of family and friends, the literal pain and suffering of those injured, the extensive inconvenience to the general public, and the diminished social welfare to the entire nation.

With the excessive use of alcohol playing such a major role in traffic crashes in the country, a considerable reduction in alcohol-related crashes would bring about a substantial decrease in these societal costs.

3. Identification of High Risk Groups

It has long been cited that the problem drinker constitutes the major threat of vehicular crashes caused by the excessive use of alcohol. Waller and Turkel, in their 1966 article entitled, "Alcoholism and Traffic Deaths," stated:[9]

> "It is believed that the majority of drivers and pedestrians involved in traffic accidents after drinking are not social drinkers. However, among younger drivers social drinking appears to present more of a problem. Greater attention must be given to the fact that most fatally injured pedestrians are handicapped by extreme youth, intoxication or old age and that more appropriate methods for separating these persons from traffic will have to be developed. Also, it is thought that greater success will be achieved in the prevention of drinking accidents by more emphasis on identification and treatment of alcoholism among first-offense drunken drivers and less on the punitive approach."

---

[7] U.S. Department of Transportation, 1970, Report of Activities Under the Highway Safety Act of 1966, Vol. II, U.S. Department of Transportation, NHTSA, pp. 50 (1970).

[8] Societal Costs of Motor Vehicle Accidents; Preliminary Report, U.S. Department of Transportation, NHTSA, (April, 1970).

[9] Waller, J.A.; Turkel, H.W.; Alcoholism and Traffic Deaths, New England Journal of Medicine, September 8, 1966.

In a study of the comparison of alcoholics and other licensed drivers in King County, Seattle, in 1969, Crancer and Quibing concluded that an examination of violations and accidents on a driving record may lead to identification of problem drinkers and serve as a basis for effective treatment and license control programs for this group. There have been many studies and reports of the identification of high risk drivers on the basis of data of crashes or convictions of alcohol-related traffic offenses. Charles Rosenblatt, in his report entitled, "Recognizing the Drinking Driver," which was a study of traffic fatalities in Wayne County, Michigan, stated:

> "From these data on the crash-involved alcoholic d drivers, it appears that younger drivers with high rates of driving convictions are a disproportionate part of the drinking driver problem. What is also apparent, from the offenders' high rate of driving convictions, is that these individuals are already well known to our courts. However, they are probably seen as driving violations, not as problem drinking drivers. This may be because these younger drivers often have not developed the characteristics associated with late-stage chronic alcoholism. These factors combine to render the courts ineffective in dealing with the problem of the young alcoholic driver."

Another study in this area was the exploration of a comparison of persons found in the Maryland Psychiatric Case Register and the National Driver Register. In this 1972 report by Rosenberg, Goldberg and Williams, it stated that:

> "Since convicted drunken drivers constitute a group with a high rate of alcoholism, it is evident that such convictions represent a significant means of case findings. It is also apparent that the NDR (National Driver Register) has potential for several research studies in the alcoholism area, including one in which an estimate of the prevalence of alcoholism in the United States might be obtained."

---

[10] Crancer, A., Jr.; Quibing, D.L.; The Chronic Alcoholic as a Motor Vehicle Operator, Northwestern Med., Seattle, 1968, pp. 42-47, 1969.

[11] Rosenblatt, C.A.; Recognizing the Drinking Driver, HIT Lab Reports, May, 1971.

[12] Rosenberg, N.; Goldberg, I.D.; Williams, G.W.; Alcoholism and Drunken Driving, Quarterly Journal of Studies on Alcoholism, p. 33, 1972.

Other studies have combined the identification of problem drinkers from driving records together with a predictive type of device. In a major work by Mortimer, Filkins and Lower, in regard to the preparation of a questionnaire to identify problem drinkers, the reported results of Phase I indicated that the examination of the driving records of the control and alcoholic samples showed that the alcoholics had significantly more violations and accidents. Therefore, such data can also be used to supplement the test scores in reaching a diagnosis in persons scoring in the presumptive problem drinker category. A court procedures manual was developed to provide background information to the court worker, and described the use of scoring keys to derive a diagnosis. It concluded that further field testing and validation are needed to ascertain the continuing effectiveness of the procedures incorporated in the manual.

The predictive models themselves have long been the subject of controversy. An indication of this is found in the usage of many different predictive devices in the various ASAP's in the country. In some instances, a predictive model was used initially, only to be discontinued and another system employed. In 1968, Selzer, in an evaluation of the Michigan Alcoholism Screening Test (MAST), concluded that the reliability of the test in uncooperative or untruthful subjects is unascertained.

Even when there has been some showing of a significant rate of success, there has been negative reports of subsequent countermeasure activities. Pollack, in a four year study on the "Drinking Driver and Traffic Safety Project," reported that a simplified prediction model was developed which improves the discrimination between drinking drivers and non-drinking drivers by approximately 10%. A similar level of achievement was achieved for recidivist drunk drivers compared with one-time drunk drivers. This report also evaluated different intervention methods. He found the results of this evaluation to be inconclusive, but suggested that there was little difference between the conventional and the experimental treatments, or among different experimental treatment methods.

4. Study Objective

The objective of this study is to develop a procedure by which an individual, through a group identification process, can be predicted as a potential high-risk driver. It has long been a desire of NHTSA to develop such a prediction indicator. Most of the models developed to date relied upon the initial introduction into the system through some deviant driving behavior or traffic crash. If some method or methods can be developed to determine these persons prior to a crash, together with some feasible means of introducing effective countermeasures, it would substantially minimize the risk of future crashes.

---

[13] Mortimer, R.G.; Filkins, L.D.; Lower, J.S.; Court Procedures for Identifying Problem Drinkers--Report on Phase I. Final Report, Phase II, University of Michigan, Highway Safety Research Institute, July 21, 1971, November 30, 1971.

[14] Selzer, M.L., Michigan Alcoholism Screening Test (MAST), Preliminary Report, University of Michigan Med. Ctr., J-34, pp. 143-145, 1968.

[15] Pollack, S., Drinking Driver and Traffic Safety Project, University of Southern California, ~~Final Report, May, 1972.~~

B. The Study Problem

1. Problems of Predicting Accidents

Alcohol related accidents are difficult to predict even though they may comprise almost 50 percent of most fatal accidents (DOT 1968 Alcohol and Safety Report). To understand this difficulty, it is well to examine the problems involved in predicting any type of automotive accident. Three characteristics of accidents make control and prediction difficult. First, they are rare events per unit of exposure whether measured in years or miles travelled per driver. Second, they are generally the resultant of multiple causation which, in turn, makes studies of accident causes difficult and focusing in on one specific variable, alcohol involvement, also difficult. Third, the accident records of individual drivers have low stability over time so that their predictability is limited.

Some recent findings suggest that alcohol related driver fatalities are not necessarily a distinct category. The University of Southern California Drinking Driver and Traffic Safety Project for NHTSA concluded that "The drinking driver involved in the fatal crash should not be regarded as a distinctively different type from the non-drinking driver in the fatal crash population.....Applications of effort should be directed toward all types of drivers likely to become involved in a serious crash." (Didenko et al., p. 65)

They also found that "A record of past alcoholic violations was also found in one of the patterns for the deceased non-drinking drivers. The evidence is quite clear that a way of life that involves heavy use of alcohol is potentially dangerous even when there is no drinking prior to driving."

Since alcohol related accidents are so rare and are not necessarily distinct from other categories when fatalities are involved, the next sections analyze the basic statistical characteristics of accidents and violations. This includes the rarity and stability of accidents and violations and the correlation between accidents and violations. The implications of these statistical characteristics of accidents are then discussed.[16]

2. Rarity of Accidents

In one year of driving in California, from 7.7 to 8.6 percent of males are involved in reported accidents; from 4.0 to 4.3 percent of females are involved. Over 93 percent of all drivers are accident-free in one year (The 1964 California Driver Record Study, Part II, 1965). The same study showed 13.9 to 17.2 percent of all drivers involved in reported accidents in three years exposure; 82.8 to 86.1 percent are accident-free.

Young drivers have a higher involvement rate. Harrington's California data (1971) showed 14.5 percent of males and 9 percent of females involved in accidents in their first year of driving; in the first four years, 45.2 percent of males and 28 percent of females are involved. Lauer's (1952) Iowa data and Burg's (1967) California data show elevated rates per 100,000 miles for drivers aged 16-24 compared with drivers in the middle-age range. Pelz and Schuman (1971) in Michigan found annual rates for males 16-24 considerably higher than for those 35-44.

---

[16] The following sections are based on materials prepared by our consultant, Leon G. Goldstein, Ph.D.

3. Stability of Accident Records

Correlations of number of accidents in one year with number of accidents in another year ranged from .04 to .05 for males and .03 to .04 for females in a California study on very large numbers of drivers (Coppin, McBride and Peck, 1965). Correlations of accidents in two three-year periods were .07 for females and.13 for males in California (Burg, 1968), and .11 for combined sexes in a Connecticut study (House Document No. 462, 1938).

However, increasing numbers of accidents sustained by drivers in one period are predictive of increasing mean accidents in a subsequent period (Coppin, McBride and Peck, 1965):

Accident Frequency		Mean Accidents in Subsequent Period	
1961	N	1962	1963
0	138,343	.068	.060
1	9,072	.123	.102
2	547	.161	.146
3+	44	.386	.273

From the Connecticut Study:

Accidents		Mean Accidents
1931-33	N	1934-36
0	26,259	.101
1	2,874	.199
2	398	.324

4. Rarity and Stability of Violations

Part II of the California Driver Record Study (1965) showed from 9.4 to 10.5 percent of female drivers involved in violations in each of three years; for males th the percentages ranged from 21.3 to 24.0 percent. For three three-year periods, the percentages who were violation-involved ranged from 33 to 41.3 percent for the sexes combined. California data (Coppin, McBride and Peck, 1965) showed correlations of violations in two one-year periods ranging from .14 to .15 for females and .22 to .25 for males. California data (Burg, 1968) for two three-year periods showed correlations of .34 for females and .48 for males.

Progressive numbers of violations in one period are predictive of increasing mean violations in another period (Coppin, McBride and Peck, 1965):

Violation Frequency 1961	Male Drivers N	Mean Violations 1962
0	65,777	.235
1	15,406	.480
2	3,926	.743
3	1.112	1.034
4	340	1.174
5	95	1.179
6	41	1.780
7+	29	1.621

5. Correlation Between Accidents and Violations

California data on approximately 95,000 drivers (Williams, 1958) showed the correlation between convictions and accidents in a three-year period was .26. A later study (Part IV of the 1964 California Driver Record Study, 1965) showed an r of .27 for a three-year period with nearly 150,000 cases; excluding violations that resulted from accidents, the r's were .23 for total group, .22 for males, and .16 for females. Other California data for six years of driving (Burg, 1968) showed correlations ranging from .22 to .26 for females and .25 to .29 for males in concurrent three-year periods; for six years, r's were .33 for females and .32 for males. For non-current three-year periods in this study, the r's for females ranged from .13 to .17 and .12 to .18 for males. For one-year periods, California data (Coppin, McBride and Peck, 1965) showed r's ranging from .08 to .12 for 86,000+ males and from .05 to .07 for 61,000+ females; the higher figures are for concurrent periods.

For young drivers, the correlations between violations and accidents are somewhat higher. Harrington (1971) found r's of .21 for over 8,000 males and .20 for nearly 5,800 females in their first year of driving; for the full four years, the r's were .29 for males and .26 for females. This would seem to be an important consideration in identifying young problem drivers as compared with older problem drivers.

Another way of looking at the correlation between accidents and violations is to examine the mean accidents for groups with successive numbers of violations. Data from California (Williams, 1958) show the following for 94,935 drivers in a three-year period:

Violations	N	Mean Accidents	Percent Accident-Free
0	55,757	.09	92.1
1	20,613	.19	82.9
2	8,753	.27	76.9
3	4,320	.35	71.7
5	1,242	.56	58.6
6	725	.51	61.5
7	450	.50	61.6
8	266	.55	60.2
9+	512	.66	55.1

As violations increase, mean accidents per driver increase and percent of the group who are accident-free decreases, very regularly with a reversal in the 6- and 7-violation groups. But even among the very extreme who have 9+ violations in three years and whose mean accident rate is 7.3 times that for the zero-violation g-oup, over 55 percent are accident-free!

More important, for the driver improvement mission, is the way mean accidents in one period are related to violations in a prior period. For North Carolina, we have data on 2.5 million drivers in two two-year periods showing the following (Stewart and Campbell, 1972):

		Subsequent 2-Year Period	
Violations in 2-Year Period	N	Mean Accidents	% Accident-Free
0	2,096,935	.110	90.2
1	298,645	.204	82.8
2	73,216	.286	77.1
3	21,907	.359	72.4
4	7,224	.400	70.2
5	2,579	.372	71.7
6	1,042	.430	70.7
7+	674	.383	70.3

As violations in the first period increase, mean accidents in the second period increase and precent accident-free decrease, very regularly with some reversals or levelling off after four violations. But, again, even among the extreme violators with 4 to 7+ violations in two years, at least 70 percent of them are accident-free in the subsequent two years. The possible effects of enforcement and/or rehabilitative efforts on these subsequent accident rates cannot be determined from these data alone.

6. Implications

From the basic statistics on rarity and instability of accidents and violations (on record, of course) and the low correlations between them, several important facts are immediately deducible:

1. Any group of drivers who are identified as having an above average record of accidents or violations in one period will have a closer to average record in a consecutive period--simply as a function of the (far) less than perfect correlation of driving records in consecutive periods. Similarly, those with below average records in one period will also have closer to average records in a subsequent period for precisely the same reason. Any of the tables presented above can be used to illustrate this:

a. in the first table, the group of California drivers who each had two accidents in 1961 had an average of .161 in 1962--a reduction of 92 percent!

b. In the second table, the group of Connecticut drivers who each had two or more accidents in 1931-33 had an average of .324 in 1934-36--a reduction of at least 84 percent!

c. In the third table, the group of California drivers who each had four violations in 1961 had an average of 1.174 in 1962--a reduction of 71 percent! Those who had 7+ in 1961 had a mean of 1.621 in 1962--a 77 percent reduction!

d. All of the groups in the three tables who had zero accidents each in first period had means greater than zero in the next period: .068, .101, and .235.

This is what is meant by "regression toward the mean" or "centripetal drift." And these changes take place without the intervention of driver improvement programs. In order to assess the possible effect of such a program on "worse than average" drivers, we must assess the effect of regression under the same driving conditions and exposure; and the only way to do that adequately is with the use of a properly designated control group. Highway safety people who announce effectiveness of their treatment of problem drivers because 70 percent (or 80 or 90 percent) of those treated do not return in the next year are simply oblivious of these basic facts

2. Programs which show an effect on violations, while encouraging, do not necessarily affect accidents and vice versa. If our real goal is reduction of accidents, that is the criterion we must ultimately apply to test a given program.

3. The rarity of the event affects the size of samples and length of exposure one needs to test the effectiveness of a given program. Since violations are about three times as frequent as accidents, it is much easier to detect changes in violation rate than in accident rate with the same size of sample and exposure. Since only a small percentage reduction in accident rate can be reasonably anticipated from new programs--of the order of 10 to 25 percent--very large samples of both experimental and control groups, and considerable periods of exposure, are required.

4. The rarity of accidents and violations means that only a small percentage of drivers are identified by their records for driver improvement actions. And since such records "improve" by regression to the mean, typically by as much as 70 to 85 percent, drivers so identified account for only a small percentage of accidents or violations in a subsequent period. The total possible impact of even highly successful driver improvement programs must, then, leave the largest portion of the highway accident problem virtually untouched. For instance, in the North Carolina study cited (Stewart and Campbell, 1972) on 2.5 million drivers, those who had one or more violations in the first two years--all of the violators, that is--were involved in 29 percent of the accidents in the second two years; 71 percent happened to other drivers. The drivers who had two or more violations were involved in only 10 percent of the accidents of the second two years; 90 percent occurred to others.

Similarly, from the Connecticut study cited, the total of drivers who had accidents in the first three years were involved in 21 percent of the accidents in the second three years; 79 percent occurred to others. Accident repeaters of the first period were involved in less than 4 percent of the accidents of the accidents of the second three years; 96 percent occurred to others. Figures from the North Carolina study are very close to these.

Clearly, even the best possible driver improvement programs (as currently defined in connection with point systems) must leave most of the safety problem untouched. Other programs are also vitally necessary--inital preparation of drivers, licensing, surveillance, law enforcement, traffic control, traffic engineering, highway engineering, automotive design for safety, and public information; and the various efforts need to be integrated.

It warrants emphasizing that all of this pertains to accidents in general that are on record. We know next to nothing about accidents that are not recorded. Also, fatal accidents are a very special matter: (a) they are extremely rare--one fatality in something like 1,800 to 2,000 man-years of average driving; (b) alcohol is implicated in perhaps half the highway fatalities (this varies with drivers, passengers, and pedestrians); and (c) it appears that there are important personal differences that characterize the people involved. Reduction of fatal accidents, or of fatalities, is a very special and extremely important part of more general accident or injury prevention.

II RESULTS OF TASK I: Identification of Groups and Related Work

A. Prior Research--A Brief Overview

Although prior research has been relatively unsuccessful in predicting accident involvement of drinking drivers, the types of work accomplished are significant. Variables considered have concerned such demographic variables as age, sex, marital status, etc.; attitudinal variables based on opinion questionnaries or other measuring devices and behavioral variables included indicators of driving behavior, drinking behavior, and related types of behavior. Some of the studies have distinguished between relevant data gathered by interviewing respondents and indicators which are matters of public record and, therefore, easily available to decision makers. A number of types of groups have been studied including known driving while intoxicated (DWI) drivers, both ASAP and non-ASAP, problem drivers (as defined by the need to undergo driver improvement training) determined by points or other state systems, known groups of alcoholics and control groups devised to provide information on the population at large in comparison or contrast with the experimental groups.

Groups of drivers involved in both fatal and non-fatal accidents and both involving drinking and not involving drinking have also been subject to various kinds of research and analysis.

The types of analyses have ranged from relatively limited percentage type analysis of data to relatively sophisticated treatments including such analytical manipulations as regression analysis, factor analysis, the development of weighted prediction equations, etc. There are some limitations even in these more sophisticated methods. For instance, in none was there evidence of cross validation, thereby making it likely that the correlation coefficients would be artificially high, and the predictive power of the equations based on these not functionally effective as might be supposed.

The results of the research are mixed, however, there is generally poor success in actually predicting with a high degree of probability those drivers who will be involved in drinking related accidents or even in drinking related driving offenses. This extensive bibliography included as part of this report contains a significant sampling of the work done to date. In addition to looking at problem drinkers and problem drivers and the interrelationship of drinking and driving, some research on drinking patterns has also been examined and is included in the bibliography. Clearly, the problems associated with drinking in American society are extensive. Much of the adult population is involved, and a high percentage of these people may from time to time be at risk as drinking drivers

A number of studies have indicated that age, sex, marital status and occupational level of drivers are associated with alcohol related accidents, the dependent variable of this study. Clark (1972) and Perrine (1971) among others have demonstrated that young males constitute a high-risk group. With data from the Grand Rapids study, Zylman (1973) has identified a curvilinear relationship between age of driver and the role of alcohol in crashes. However, a linear component is of greatest significance which indicates that alcohol increases the chances of crash involvement most with teenage drivers and least with drivers 25-69 years old. The 20-24 age group is intermediate. This trend peaks with drivers 60-69 and the probability of an alcohol involved crash increases for drivers over 70.

Carlson's study of age, exposure and alcohol involvement in night crashes found that three factors which explain the crashes of young drivers are learning to drive, learning to drive after drinking, and the large amount of night driving that they do.

Studies by Perrine and a number of other researchers have indicated that non-married marital status and low occupational levels including unemployment are disproportionately associated with alcohol related accidents.

Several studies have indicated that previous driving behavior is often a good predictor of involvement in alcohol related crashes. The Perrine and Clark studies already cited the one by Filkins et al. provide pertinent findings. Clark found that the average number of crashes for DWI's was almost three times higher than for average drivers. The Michigan DWI's had four times as many driving convictions as the controls and Perrine found that the Vermont DWI's had seven times as many convictions as the average of the controls. The Vermont study also showed that 60 percent of the DWI's had one or more previous suspensions of their drivers license and that 44 percent had two or more suspensions. The same studies have shown that drivers with lifestyles including heavy use of alcohol are more likely to be involved in crashes.

In the California study at USC, Didenko et al. found that accidents, traffic violations and arrests all helped to predict potential drunk drivers from the driving population as well as to predict recidivist drunk drivers.

Drinking is a delicate topic for survey research and the relevant findings are few. In the Vermont study, Perrine developed a quantity-frequency index for preferred beverage and found that it provided some useful predictive information. For example, he found that daily beer consumption were associated with various negative drinking-driving behavior indicators.

In the Vermont study, self-reported wine consumption varied inversely with the criteria variables, but this might prove to be a regional phenomenon which would produce a different finding in, say, California.

Studies in Michigan, Vermont, and California have generated enough useful information to indicate that the prediction of drivers who will be involved in alcohol related accidents is a difficult but possible operation with several kinds of predictors which show promise. The previous driving record is clearly useful. Self-reports of drinking behavior are also useful although this is a delicate area and there is doubtless some distortion in the responses. Age, sex, and other demographic variables also have some predictive power. All of this sheds some light on the most likely groups and individuals who will become involved in alcohol related accidents.

B. Development of Criteria.

The criteria for delineating and selecting high risk groups are by definition those characteristics or variables which are more highly associated with high risk drinking and driving. We also define certain intervention points as a place at shich it is appropriate to define groups for purposes of research and, hopefully for later intervention and application of countermeasures. Therefore, our criteria for selection reflect not only the characteristics or variables associated with higher risk driving and drinking, but the first selection stage for both the survey and for possible intervention. It is hoped that intervention at such points will provide fruitful access both for research purposes and for intervention and countermeasures based upon the research. The possible intervention points defined as suitable for initial definition and selection of the high risk population are:

a. driver education;

b. initial licensing;

c. relicensing;

d

d. individuals engaged in job related driving who are trained at work for such driving;

e. multiple traffic offenders which in some states are identified by point systems and slated for driver improvement courses, those referred to in California, for instance, as negligent operators, etc.; and

f. DWI, both ASAP and others

It is hypothesized that the individuals in the various groups defined as a first stage in the selection process are appropriate for the study, that is, some of the individuals are high risk drinking drivers. The next step is to select from within these groups. The second stage selectors will be applied variably to different groups at each of the intervention points, depending upon the characteristics of the drivers which are represented at each of the six intervention points. These second stage selectors are the following: sex; age; driving records including violations, accidents and drunk driving; education; occupation; marital status; and criminal record. Third stage variables which will be used to determine the best predictive equation from among all the variables involved are more fully delineated below.

It is possible that a number of these variables will have relatively high predictive value. Therefore the research design includes some additional second stage selective variables data on which may be introduced in the development of predictive models if findings with regard to some of these are especially promising and the individuals are selected into the highest risk groups for further study. This would prevent narrowing down too radically the population which is considered to be at a higher risk than the population at large, and would allow for gathering additional information on a number of related characteristics or variables. In this way, the best predictive equations could be generated empirically.

C. Specification of Associated Characteristics or Variables

These Characteristics or variables, rather than being used for initial selection, will be used first as a basis for collecting information and later for appropriate statistical analysis including regression analysis. Regression will be used to see if predictive equations can be developed using these particular variables. They would include at least the following:

1. Demographic Variables:-

    a. sex

    b. age

    c. socio-economic status as indicated by education=

        (1) education

        (2) occupation

        (3) income

        (4) residence

    d. marital status

    e. parental-marital problems

    f. parental drinking problems

    g. region of country

    h. residence

        (1) center city

        (2) surburban

        (3) rural

    i. ethnicity

    j. religion

2. Behavioral Variables:-

    a. driving behavior and record including violations and accidents and whatever other data used for profiling the driving record, as indicated below

    b. Drinking behavior including all items related to the data necessary for establishing a drinking profile, or index, as specified below.

    c. drinking-driving behavior based on survey responses, records, and other sources.

    d. criminal record

    e. juvenile recore

    f. social service agency contacts

g. suicide attempts

h. lifestyle variables and some additional detail on their interaction with drinking/driving and high risk drinking/driving

3. Attitudinal Variables

This includes attitudes toward:

a. drinking

b. aggression and aggressive behavior

c. authority

d. suicidal tendencies, impression

e. stress factors, particularly with regard to job, family, or school

f. driving, speed, etc.

g. risk taking

h. causes of accidents

i. indicators of alienation or maladjustment

j. indicators of impulsivity and non-conformity

k. perception of social pressures as support for drinking

l. unfavorable expectations of the future

m. preceptions of looseness of social control

D. Delineation of Groups

After considering the six populations in the initial selection, it was decided to eliminate the friver education group and the group at initial licensing since they would have no past driving records. Although there is some interesting research being done on drinking behavior in this group, and some attempts are being made at predicting certain teenagers as potential future drinkers, it is not developed to the point where any intervention measures or public policy of legal intervention could be based on it. It is anticipated that developments in research will be such that it can be applied at a later date and the resulting savings in accidents and costs can be realized.

In considering the group scheduled for relicensing, it was decided to make a second stage selection based on the following criteria: the relatively young, male, working class background, single, with less than a 12th grade education.

Groups of employees are very good for intervention, particularly if the employers can be motivated to comply with the program requirements. However, professional drivers are a relatively low risk group in terms of the accidents per miles driven or accidents as functions of exposure. It was decided that these employees may not be one of the highest risk groups,and would not constitute as high a priority for selection at this time as some of the others. (It should be a useful study at a later time to try to find cooperative employers and work with them in isolating problem drinkers; then relate this to driving behavior and see what can be accomplished.)

The driver improvement groups, those with the high points or multiple moving violations, are a prime target, Further selection in this group is necessary in order to find those problem drivers who also have a drinking problem.

The DWI-ASAP is, of course, a very likely group for high risk drinking drivers. This is an important group since they have already clearly demonstrated behavior patterns which show them to be a high risk.

Basically, then, three groups are selected out of the six for the purpose of TASK II: young males at relicensing, the driver improvement group,and those persons arrested for driving while intoxicated.

E. Further Information on the Groups.

1. Additional Data

In 1971 there were two million persons who were disabled beyond the day of the traffic accident as the result of 1,300,000 disabling injury accidents involving 2,400,000 drivers. In the same year, there were 54,700 deaths caused by motor vehicle accidents (Accident Facts,1972 edition).

The same source indicates that a study in the state of Washington during 1970 indicated that drivers 20 to 34 years old were involved in about half of the fatal accidents involving drinking drivers. Drivers in this age group were also involved in almost half of all accidents involving drinking drivers. In this study, it was found that 22.1 percent of the drinking drivers involved in accidents were 20 to 24 years old while 26.7 percent of the drinking drivers involved in fatal accidents were in this age group. This compares with 11.3 percent of all drivers which this age group comprises nationally.

Other figures for 1971 from the same source show that 18.4 percent of all drivers involved in accidents were 20 to 24 and 18.9 percent of the drivers in fatal accidents were in this age group. These are estimates of the Statistical Division of the National Safety Council.

2. Groups and Selection Criteria

The first two groups (driver education and initial licensing) were not selected because they do not have a driving record as yet and probably little or no drinking record. It is also likely that any criminal record, if it existed, would be juvenile records and difficult to obtain.

Of the relicensees, it was decided to select young males as a high risk group. It was decided not to work with groups in the employment situation. Negative operators will be studied, and the ASAP-DWI group is the final choice. All these selectees are the most likely to recidivate.

3. Feasibility and Legality of Study and Intervention

The most feasible program for intervention is the study of the DWI group and the driver improvement group. Relicensing is next and then licensing and driver education. The least feasible of all is the employment situation because of the logistical complexities of dealing with the multitude of employers involved. Intervention is most feasible for the DWI-ASAP driver improvement groups.

There is no legal constraints to working with any of these groups. However, there may be legal limits and safeguards on information which can be obtained with regard to specific variables, such as problems dealing with disclosure and confidentiality. These problems, however, do not create significant differences between the groups, but can affect certain types of information. For this reason, there does not appear to be any significant legal impact on a decision with regard to the groups.

4. Effectiveness Considerations

The effectiveness question is an important one to add to the other elements of the high risk drivers study plan. It raises a question about the utility of the work being done on identification of groups and the application of appropriate countermeasures to selected high risk drivers in terms of the ultimate outcome of Phase III, the longitudinal study. Are we reasonably certain that the results of Phase III will provide a basis for reducing alcohol related accidents and alcohol related driver fatalities in amounts which are significant?

To answer this question, several facets of the question must be examined. An important consideration is the phenomenon of "regression toward the mean" of problem drinking drivers. For this study, it implies that a substantial majority of drivers in alcohol related accidents in one period will be accident-free in a succeeding period.

The regression effect denotes that the records of drinking drivers will "improve" simply because of this effect whether there are any countermeasures and whether they are effective. It also means that most of the "worst" drinking drivers in any given number of years will not be found in the "worst" category--however defined--in a succeeding period.

The regression phenomenon also implies that the "high risk" drivers of one five-year period will, for the most part, be lower risk drivers in a succeeding period.

The general implication of all this is that any countermeasures directed to drivers with previous accident or violation records would leave untouched a majority of the drivers involved in alcohol related accidents next year.

Another aspect of the problem is the very low frequency of alcohol related accidents in any population of drivers. In the nation, there are an estimated 120 million drivers and an estimated 9 million problem drivers. Moreover, it is recognized that the vast majority of all drivers are drinking drivers at one time or another.

From this large population, there are some 24,500 drinking-driving fatalities per year which cost some $6 billion. The loss of life and high cost makes any reduction in these accidents desirable, but since the drivers who are involved constitute such a small fraction of the population at risk, the task of prediction means that from over 1,000 drivers, the one who will become an alcohol related driver fatality must be correctly identified so that countermeasures may be opportunely applied.

This statement of the problem is extreme. The present objective is to identify individuals who will become involved in alcohol related accidents, and the prediction is not necessarily for just one year ahead. Nevertheless, predictability is so low, according to implications of previous studies, that "noise level" or random fluctuations become major problems in discerning the effects of specific countermeasures.

5. Design Implications of Effectiveness Considerations

The design of a validity study with adequate measures of effectiveness--which takes into consideration the difficulties stated above--presents several technical problems. Care must be taken not to attribute driver improvement to countermeasures until other possible sources of improvement are eliminated and the inference is clear. For example, the driving records of young drivers tend to improve as their driving experience increases. Young drivers are also a group very likely to be involved in alcohol related accidents. Any "improvements" in the records of drivers treated with certain countermeasures must be examined closely with natural improvements as well as the regression effect in mind.

The most sophisticated approach would insist on an experimental design with experimental and control groups. The most rigorous scientific design standards would insist that the control groups be taken from the same jurisdiction as experimental groups. However, judicial and legal requirements, including constitutional guarantees, probably preclude such rigorous standards of proof. An approximation of this standard can be built into control groups which are in jurisdictions with similar characteristics, populations and rates of growth.

This is not a proper place for a lengthy elaboration of all the design requirements necessary to produce reliable measures of effectiveness, but a few other major requirements will be mentioned. Because of the relative rarity of alcohol related accidents in any given jurisdiction, very large samples will be necessary to make sure that the effects of countermeasures are not confounded with the "noise" of measurement error, sampling error, etc.

Because of the above, a long period will be necessary to make reliable judgments about the effectiveness of any countermeasure or set of countermeasures. The stipulation in the RFP Statement of Work that Phase II shall include the monitoring of driving records over a period of five years is a recognition of this fact and constitutes an appropriate period, judging from previous studies. It should be recognized that the findings of the first two or three years of the period may not necessarily indicate the final conclusions of the study.

A review of research on traffic accidents in general as well as alcohol related accidents indicates that in terms of the national population of drivers, they have very low predictability. This may be modified by more sophisticated studies utilizing more complex predictive techniques. However, in the light of the general quality of the studies reviewed, major improvements in predictability do not seem likely.

The low predictability of alcohol related accidents when overall driver characteristics are used as predicators may be interpreted in terms of more general research strategy. If the general research question is expanded to "What are the antecedent conditions or variables that account for the variance of alcohol related accidents?," then the outline of the answer is that the total variance may be segmented into different sources which account for it: weather conditions, day-night variation, urban-rural conditions, secondary-primary-interstate variation, etc., in addition to driver characteristics.

From this vantage point, the low predictability of alcohol related accidents (and traffic accidents in general) using driver characteristics as a predictor may be an indication that the driver accounts for only a fraction of the total variance. If this is true, then even the best designed study will find relatively low predictability of drivers who will become involved in alcohol related accidents.

Finally, it should be added that low predictability may also be affected by errors of measurement. In this case, errors of measurement would include the misclassification of accidents, as well as violations which are not noted by police. Such things reduce the reliability of measurement and this reduces the correlations between predictor and criterion.

This preliminary examination of measures of effectiveness indicates that the most optimistic expectations for results which can be effective in the reduction of alcohol related accidents must be fairly modest. This raises questions about some of the assumptions in the Statement of Work. The low predictability mentioned here is in sharp contrast with the objective of positively identifying specific individuals who will be involved in alcohol related accidents.

In a similar vein, the chances of identifying drinking drivers involved in fatal crashes seem modest when the USC Drinking Driver and Traffic Safety Project found that 88 percent of these drivers had no prior drinking-driving conviction (Didenko et al., p. 9). Under such circumstances, the effectiveness of even ideal countermeasures would be quite limited in reducing fatalities.

Our assumption is that NHTSA is aware of such apparent upper limits on effectiveness measures and that expectations are conditioned by the constraints implicit in the predictive situation.

One way to improve predictability is by the selection of subsets of drivers with high probabilities of becoming involved in alcohol related accidents. This will increase the correlation with the criterion. But at the same time, it will reduce the proportion of total accidents which can possibly be predicted or impacted via intervention. For example, if drivers 20-34 years old account for about half the fatal accidents involving drinking drivers, then countermeasures which reduced 10 percent of such accidents in this age group would result in an overall reduction of only 5 percent in the universe of accidents so defined. Smaller groups would result in even smaller upper limits on overall effectiveness.

In terms of research strategy, this is an optimization problem. In moving from the total population of drivers involved in alcohol related accidents to small, very high risk groups, at what point is the correlation with the criterion maximated while the size of the high risk group is minimized? The optimizing problem could also include the determination of groups most responsive to countermeasures. This problem will be addressed in Task II in further detail.

F. Selection of Groups

The final decisions of group selection during Phase I resulted in three groups chosen for further study. Each of the three groups are described below. Information on second stage selectors relevant to them is also presented.

The first group consists of young male drivers who are to be identified and interviewed at the time of their first driver relicensing. In this group, the high risk individuals are tentatively defined as those who are single and who already have a record of multiple violations. In this subgroup, questions to provide data for further analysis will include number of years of education completed, occupation, number of employers in last five years and data on alcohol consumption including preferred beverage, amount consumed, and typical frequency of consumption.

From the driving record, information will be obtained on violations, arrests, license suspensions or revocations, etc. This will be cross-checked by direct questions to the relicensee.

The second group consists of DWI's/DUI's (A major concern is that those persons in ASAP jurisdictions are not comparable with those in other jurisdictions. An effort will be made to design around this difficulty.) Information will be collected on age, education completed, occupation, and employers in the last five years. Questions on alcohol consumption and driving exposure will be the same as for the other two groups.

The third group will consist of problem drivers as indicated by bad driving records. Second stage selection will consist of identifying those who have DWI arrest records or other indications of lifestyle that includes heavy alcohol consumption. It is this subset which is of primary interest, and questionnaires similar to those for the other two groups will be administered. The three basic categories of information will be: (1) biographic-demographic; (2) driving behavior; and (3) drinking behavior.

Available estimates indicate that between 1 and 2 percent of the drivers in many jurisdictions become problem drivers in a year. For example, in California, 1.6 percent of the driver population become "negligent operators" per year, but only 0.8 to 1.0 percent are actually processed. (If a jurisdiction could be persuaded to randomly assign a set of problem drivers to processing or non-processing groups, this could constitute one aspect of the study and an experimental test of one kind of countermeasure.)

It should be noted that the three high risk groups proposed for a predictive study here are not mutually exclusive categories. Moreover, the degree and kinds of overlap seem to vary from one state to another depending on legislation and enjorcement patterns as well as local drinking and driving customs. Our research design will take this overlap into account. Depending on the jurisdictions finally selected for study, this might possibly require the collapsing of DWI's and problem drivers into one group if the overlap substantially reduces the proportion remaining in one of the groups.

In the problem driver group, the high risk individuals will be defined as those who have on their record (prior to the "points" resulting in the problem driver classification) prior citations, arrests (traffic or non-traffic), license suspensions, or crashes. It is expected that during the study, both increasing amounts of these characteristics as well as certain combinations will turn out to be good predictors of drivers who will become involved in future alcohol related accidents.

In the DWI/DUI group, the high risk individuals will be tentatively identified as those who are not married, with a low status occupation, and high school graduation or less in education completed. Previous violations, both traffic and non-traffic, may be added to the list as the research operation is finalized and implemented.

III THE STUDY PLAN

A. Introduction

The purpose of this section of the report is to present a detailed study plan for Phases I and III. The goal of Phase II is to develop techniques which will permit the identification of drivers most likely to become involved in alcohol related crashes. The goal of Phase III is to carry out a validation study which used these techniques and tests their reliability.

The ultimate goal of the three phases of this work is to produce a significant capability for the reduction of alcohol-related crashes. This capability must have two components. First, predictive techniques must be generated which will permit the identification of the drivers who are most likely to become involved in alcohol-related traffic crashes. Second, once salient characteristics of these dirvers are known, appropriate countermeasures must be designated which will be appropriate and effective for each major type of driver identified.

It is most important that the outcome of this work be a strategy for reduction of alcohol-related crashes with sufficient effectiveness to merit putting it into practice. Statistically, significant results will be of only academic interest if they do not also provide good prospects for operational effectiveness.

During the execution of the Task I work, we discovered and reported that the prospects for the effective identification of high-risk drivers are probably modest at best. Our analysis has resulted in the conclusion that successful identification of these drivers must be approached as an optimizing problem which results in a group of drivers which is not so small that even the best countermeasures would allow for significant reduction in the target accident rate, and not so large that poor predictability precludes any other results.

After careful consideration of the effectiveness question, we have decided that the options which should be reviewed during Task II should be expanded to at least consider other means to achieve the end of reducing alcohol-related traffic crashes. A careful review of previous research suggests that the predictive leverage which can be derived from any combination of driver characteristics is probably marginal in utility and actually useful only in combination with heroic countermeasures. Until the validation study is completed, however, the above is only an educated guess which may be disproved by empirical evidence.

Because of the upper limits which seem to bear on the production of driver characteristics, we believe that alternative research and intervention options should be considered by NHTSA. In this report the principal alternative will remain the identification of high risk drivers so that appropriate countermeasures will improve their accident record. However, a brief proposal will be added to suggest a strategy which involves getting closer to the accident. Further pilot work along this line is recommended later in this report as work which could be carried out instead of, or in addition to, Phases II and III. This is a suggestion for another possible means to achieve the same end of reducing alcohol-related crashes.

Both disabling injury and fatal injury accidents associated with alcohol use have very high social costs in terms of lives cut short, pain and suffering, hospitalization and other medical costs, property damage and working days lost due to injuries, including permanent injuries and disabilities. Since these national costs are so high, an outcome from this study plan, which a validation study could demonstrate responsibility for saving, say, 24 of the 24,500 lives lost in the target accidents annually, could be very cost-effective. In like terms, a savings of 240 of the estimated 240,000 persons injured in the target accidents each year could justify a program of countermeasures in several states.

What follows is a Study Plan for Phases II and III which is designed to achieve higher levels of effectiveness than those stated above. After a general introduction to the research strategy, the various elements of the study plan will be presented. While the plans presented here only cover Phase II, the design takes into consideration the needed inputs for the validity study and its desired end products.

B. Phase II End Product

The end product of Phase II will be a risk prediction technique for the selection of high risk groups. An important quality quality of the research design presnted here is that it adds an extra step after prediction to assure that the results are practical and useful for the application of effective countermeasures.

The basic prediction technique used in the analysis plan is regression. Each driver characteristic with possible predictive power will be correlated with the criterion. An examination of the matrix of correlation coefficients will yield a general idea of the predictive power of the data which has been collected. Each correlation, when squared, will indicate the proportion of variation in the criterion which can be accounted for by a particular predictor variable.

But total predictive power is lost to the extent that the various predicator variables are themselves intercorrelated. Multiple regression is the technique needed to extract the required information from the correlation matrix. Its final results will consist of a selection of some six or seven predictor variables which in combination provide maximum practical predictive power. Each predictor variable in the final multiple regression equation is assigned an appropriate weight through the operations of this technique. These weights tell the relative importance of each driver characteristic in predicting the criterion. This is the analysis aspect of the risk prediction technique.

Multiple regression is a powerful predictive technique when used in the context of good research design. It can also produce very unstable results which vary a great deal from one sample to another, and sometimes result in more heat than light being shed on a prediction problem. This research design proposes to take these matters into account and generate cross-validated multiple regression equations which are corrected for "shrinkage."

It must be pointed out that the mean or average values of each predictive driver characteristic do not, when added together, produce a profile of a high risk driver. Since this is the case, a gap is left between good predictive results and their application to real drivers in the form of appropriate and effective countermeasures.

It is here that the extra step is added in our research strategy. A correlation matrix is the point of departure not only for multiple regression analysis but for factor analysis as well. A particular kind of factor analysis can provide the information which will bridge the gap to applying the results to actual drivers.

Q factor analysis is sometimes called inverse or obverse factor analysis. It was devised by Stephenson (The Study of Behavior, University of Chicago Press, 1953), and it has been used in many kinds of research designs during the last twenty years. Q technique uses correlations between persons to produce person clusters or factors. The more common R technique uses correlations between variables.

In the present case, Q factor analysis will be used to produce a typology of high risk drivers. This will include a most commonly occurring type, a second most common type, etc. And for each type, the Q factor analysis will yield information on average age, educational background, etc. for each major type in the population of high risk drivers. This is precisely the kind of information needed to decide just which kind of countermeasure would be most appropriate for each major type of high risk driver. Further details will be presented in the analysis section.

It has already been pointed out that small savings of lives and injuries--in terms of percentage improvements--could result in dollar savings which make the effort cost effective. But an important problem in this situation is to determine whether such small changes in accident rates are due to program effort such as countermeasures, or whether they are just random fluctuations due to change. As the ASAP evaluations have made clear, the sorting of small but important program effects from chance variation is difficult, if most impartial observers are to be convinced.

In the present case, two approaches to this problem through research design will be carried out. One approach is to make as certain as possible that the sampling design stipulates enough cases in each sample so that results will be sensitive to small changes in crash rates. However, the number and quality of driver records in a given jurisdiction put one kind of limit on sensitivity to change. Very small changes cannot be noted when they are confounded with this "noise leve."

The other approach is to make an effort to reduce measurement error by choosing jurisdictions with good information systems to serve as locations for the study. Good driver records will be necessary but not sufficient grounds for choosing a jurisdiction as a study location. In addition to good driver records, we would hope to find study locations with above average data bearing on alcohol related crashes. At best this is a "soft area." We understand that the state of Colorado has BAC data that is above average in both quantity and quality, i.e. reliability. Cook County, Illinois and King County, Washington are two other locations reputed to have maintained reliable and relatively complete BAC data.

In terms of good driver records, there are a number of states which can qualify as candidates for study locations. Tentative choices include California, New York, Pennsylvania, North Carolina, Florida, North Dakota, West Virginia, and Washington.

C. Data Requirements and Sources

1. Introduction

The data which will be utilized in the Phase II Study basically will be derived from two sources: the driver records maintained by the states, and a series of interviews with individuals who have been selected and who participate in the study either as members of the groups which are defined as high risk drinking drivers, or those selected for control groups. For some of the control groups, in order to avoid the possible "contamination" of an interview or other social stimulus which might result in changed behavior, the data used will be derived solely from state records. This, in turn, makes it very important that adequate records be kept and be made available to the researchers in those states which are selected for carrying out this study.

The data to be collected comprises not only that data necessary to construct a drinking behavior index and a driving behavior index, but also some additional data which is labeled for purposes of convenience, a social behavioral index.

It is planned to collect the data in such a form that it can be analysed, with computer assistance, and the actual development of the indices will be accomplished inductively. This will allow for the generation and use of the best obtainable predictive equations as one of the outputs of the study. It is anticipated that not all of the data collected will be of utility in the final predictive model, but enough data on enough variables is being collected so that that information with greatest utility can be selected from the larger body of data generated in the field work.

2. Drinking Data

The following types of data will be collected and used in the development of the drinking index:

1. Beverages consumed (list all)

2. Preferred beverage

3. Beverage normally consumed (This may differ from item 2 above)

4. Amounts of beverages usually consumed (At a time, or a sitting, or occasion - if this is recorded as a variable, get information on the maximum consumed and about how often this happens and what is a more "usual" consumption)

5. Amounts of time spent in drinking (Again, if there is variation, report on the norms and maximums. Basically items 4 and 5 are aimed at finding out how much is drunk over what period of time)

6. Frequency of drinking (In terms of how many times, day, week, month, year, etc., and also, relative amounts)

7. Place of consumption (This is important because it varies on the travel which in turn bears on possible driving while under the influence - bars, other places of entertainment, at home, at others homes, at a cottage, or at a boat or other places - specify.)

8. The social situations involved in drinking (After work, Friday nights, Saturday nights, cocktail before dinner, just social get-togethers, while engaged in other activities such as bowling, hunting, fishing or other types of recreations.)

9. Separate reporting as to whether or not respondent drives much after drinking; if he drives after heavy drinking; how often; and how does he handle it.

10. Terms of self classification as a drinker or non-drinker including non-drinker, light social drinker, moderate social drinker, heavy social drinker, problem drinker, alcoholic, etc.

The source of all data on drinking behavior will be the interviews with respondents and selected control group members. However, provision will also be made to collect and use information on drinking behavior, such as results of breath tests and blood tests, and the resultant BAC levels, if this data is available for ASAP or other DWI individuals.

3. Driving Data

The data to be collected with regard to driving record, will be relatively limited for two reasons. First, prior studies indicate that not much detail really helps in predicting later crashes or infractions. However, some work indicates that the best single indicator of possible DWI or alcoholic related accidents is a reckless driving citation. It is necessary to allow for variation across states, in terms to the legal structure and classification of offenses, so the data specifications are relatively simple and yet provide the necessary information. It should be possible to get the following information:

1. The number of moving violations for a given period, one, two or three years.

2. The number of non-moving violations.

3. The number of non-traffic offenses.

4. The number of license revocations or suspensions.

5. The number of specific offenses such as reckless driving, citations and driving while intoxicated under the influence or other related alcohol driving offenses.

Where states have point systems,the total points for any given period of years also should be collected. In the analysis, the comparability of the various states points systems will have to be developed in greater detail. Where relevant data on the number and severity of crashes, including minor property damage, personal injury, or permanent disability resulting from accidents and fatalities in which the respondent may have been involved, are available, this too will be collected.

It is anticipated that there will be a need to gather some of this information from respondent interviews, since some states will not have complete and detailed information, and it is anticipated that all crashes, especially those of a minor nature, will not have been reported.

4. Behavioral Data

Attitudinal and behavioral information will be collected in the interviews with anticipated high risk drinking drivers and with selected control group respondents. Data will be collected on the following:

Attitudes toward:
- Drinking
- Aggression and aggressive behavior
- Authority
- Driving, speed, etc.
- Risk taking

Preceptions of stress factors:
- At work
- On the job
- In family situtations
- At school
- Elsewhere

Indicators of:
- Alienation or maladjustment
- Impulsivity or non-conformity
- Suicidal tendencies

Perceptions of:
- Social pressures as support of drinking
- Unfavorable expectations of the future
- Looseness of social control

5. Demographic and Related Data

Demographic and related data will be collected in the interviews. In addition, such data as is available from state records will also be obtained, including such items as age, sex, and whatever else may be available. Those items to be gathered in the interviewing process include:

- Sex
- Age
- Socio-economic status as indicated by:
  - Education
  - Occupation
  - Income
  - Residence
- Marital status
- Possible parental marital problems
- Possible personal marital problems (see stress above)
- Parental drinking problem
- Region of country
- Ethnicity (if possible without offending respondents)
- Apparent race
- Religion

D. Proposed Questionnaire and Data Collection Forms

The form for the questionnaire has been developed to the furthest extent practical without gathering OMB clearance for a full scale pretest in the field. It has been possible to carry out limited testing with the number of trial respondents held at nine or less. The document to be used will of course be fully pretested and improved as may be indicated, in the course of carrying forward the full scale study. It is anticipated that few changes will have to be made as a result of the pretest. The specimen questionnaire is presented as Appendix I. It may have to be modified somewhat for use with each of the target groups and the control population, and may also be adjusted for differences from state to state.

Our work has been based on some preliminary, limited, small scale pilot testing. In the process we have learned that, due to the variability of state records and the format of these records, it is essential to design a specific form for each state, after it has been selected and compliance is secured from its officials. This should be done, of course, with the overall research specifications for data requirements kept in mind, so that there will be as much comparability between states as possible. Similarly, the specific questionnaire to be used with respondents may have to be adjusted to account for some variability from state to state, for purposes of getting information essential for matching the respondents with their public record. This detail must be checked at the time for each of the states. Nevertheless, it is possible to present questionnaire documents and data collection sheets which are indicative of the information to be collected in the format in which it may be gotten and which, in turn, will provide the basis for the pretests in each of the states to be used. We feel that each of the questionnaire forms (they may be modified for each of the three risk groups,and for each of the three or four states) must be given a pretest in order that one can be cognizant of the needs for modification. There are peculiar problems with the reliability and validity, but mainly the reliability of self-recorded drinking behavior and the instrument must be carefully evaluated.

Following the pretest and finalization of the interview questionnaire will come the related finalization of the data collection instruments for working with the state records. These may take the form of the data print-out formats where the computerized capability of such states can provide output in the necessary format; the format can include punch cards, magnetic tapes or other forms to transfer data to the firm for analysis.

E. Operational Plan

1. Selection of States

As the initial task, a number of states should be selected for the survey to be carried out and we believe, given the budget constraints, three or four states would be optimal. These should be selected to represent different parts of the country in order that the variation in driving sub-cultures, which has been noted by other researchers, can be allowed for.

Work done by Wilbur Smith Associates indicated that tailgate distances are normally closer on the West Coast than in other areas of the country. As a result of this, when crashes occur, more cars are involved in multiple collisions. Other variations in the driving sub-cultures are readily apparent to the sensitized observe, such as the differential treatment of traffic lights at intersections in, say, downtown Washington in contrast with the Virginia suburbs or other cities. In Washington, yellow,and in fact red lights, are stretched to allow one, two or three more cars through the intersection. In other nearby jurisdictions, this pattern does not prevail, probably as a result of differential enforcement patterns on the part of police, although it is now certainly a part of the learned driving sub-culture.

The geographic areas to be represented should also take into account what is known about differential drinking patterns in various parts of the country. We know that the industrialized north east and the West Coast, have higher per capita patterns of consumption. (See the new studies and data contained in Alcohol and Health, published by the U. S. Department of Health, Education and Welfare, pre-print edition, June 1974, particularly the table on page 3 showing the apparent consumption by states of each major beverage class. This is summarized in Table 1a, page 4, done by the 9 census sub-regions.)

We believe that a number of states should be selected in order that the next step could be carried out. This step is the accumulation of the state of their records and, more importantly, the availability or potential for cooperation with the state officials. Having good records will not help if the state officials will not provide access to these records. Our strategy for mounting the research calls then for selecting a number of states in the industrialized north east, middle America, the great plains and midwest and the far west as well as the south or south west. Then, following this initial selection, states should be approached to see if they are willing and able to cooperate by making available their records for sampling and for other forms of manipulation. If this is possible, arrangements should then be made to further refine the sampling frames for the driving record information. The next step would involve the development of the appropriate techniques for moving from the state records to the defining of the high risk groups, contacting the groups through means determined most appropriate for each group in each state as will be detailed somewhat below.

We are mindful that a number of these studies which have started out with good research designs, have not been able to carry out all or parts of their designs. This often involved problems with the data base either in terms of its make-up, its accessibility, its format, i.e., whether it has been successfully computerized or not, and if so, whether the programs and other forms of software can be generated which will retrieve information where needed. In addition, there are administrative problems involved in securing access to this data, getting permission from state officials and others to cooperate with the research project in giving information and data which they may have available to researchers.

If it can be determined that three or four states would be sufficient for this research, then the second part of this selection can be initiated. This would require getting state records to determine how many individuals are involved in the various groups, as defined below; making an actual determination of sampling rates which will result in large enough samples to be satisfactory for the types of analysis proposed to be carried out; and working with the problem of obtaining the records of the individuals to be contacted. The purposes of interviewing them are to determine their drinking behaviors and certain of the social behavior index data items which are not matters of public record.

2. Define Universe, Sample Frames, and Control Groups

We have specified for each of the states selected, three groups to be used in this preliminary study.

The groups or universes involved are:

1. Young male drivers who will be identified and interviewed at the time of their of their first relicensing. In this group the high risk individuals will be tentatively defined as those who are single and who already have a record of multiple violations. In the sub-group, questions will be asked in order to provide data for further analysis which will include such things as number of years of education completed, occupation, job history, number reported for the last five years, etc. From the driving records, information will be obtained on violations, arrests, suspensions and other data.

2. The second group to be worked with in each state consists of DWI/DUI's. We recognize that those in ASAP jurisdictions are not comparable with those in other jurisdictions due to differential enforcement patterns. Efforts will be made to design a sample so that it will take into account this situation. Information will be collected on drinking behavior, the socio-economic factors, etc., and other information which will allow the data to be tied directly to the driving record and other matters of public record.

3. The third group that we have defined for inclusion in the study in each of the states will consist of problem drivers. These are those who have a high number of points and who are defined as habitual offenders and signaled out for intervention techniques.

We recognize that the three hybrid groups proposed here are not mutually exclusive. There is some difference in the judgments of those in the field as to the degree and kinds of overlap between the groups. There are, furthermore, indications that this varies from one state to another depending upon legislation and upon enforcement patterns as well as upon local drinking and driving customs. We will attempt to carry out the research and the analysis in such matters that these factors can be taken into account.

Because of the differential factors involved in each state, slight differences in the driving records and the laws, etc., it will be necessary to specifically define, in each of the states, the categories of relicensees to be included, specify exactly the definition of those who are DWI's or DUI's, etc. For each of the states to be included in the study, a clear set of definitions of operationalizing the basic concepts will have to be made in such a manner that culpability is maintained to the greatest degree possible, while at the same time, allowing for the variety and the idiosyncratic ways conducted in each of the states which would be subjects in the study. It seems advisable some of the control groups should be developed strictly off official records so that no personal contact with individuals could be identified with the study. Therefore, there will have to be specific definitions of each requirement in each of the states. Let us briefly consider what needs to be done. Let us define the three groups as young relicensees, poor drivers and drunk drivers for ease of referral. In each state it will be necessary to specifically operationalize this definition and to devise ways and means for contacting individuals in each of the three groups. For poor drivers, it will be necessary to go to state records, and if they are being selected for treatment, special consideration of one sort or another be given to select individuals from this list. This will be the sampling frame. In the drunk driver group, it will also be necessary to develop a sampling frame. In the states which have ASAPs, there should be some from ASAPs counties or cities and other from non-ASAP counties or cities.

The preferred method of sampling for all of these groups is the selection of a random sample of driver records from State motor vehicle agencies. From these records name and address lists will be generated which will serve as the sample from which appointments may be made to interview subjects at their homes.

In the high risk groups themselves, we want to see if, in fact, they have more accidents. This will call for sampling at a very high rate because of low incidence of accidents.

There should be a control sample of similar size selected at random. In addition, a control group should be determined which is defined, collected, studied, followed and analyzed, etc., solely off of the state records. This, perhaps, should be broken down into a control group which closely matches the high risk group defined originally and another group which is designed to be more representative of the total population of drivers. These are not really experimental groups because intervention techniques are not specially being designed in experimental forms. Some of them are already experiencing intervention techniques. Others will not, even if they are defined as high risk groups. What you have is a high risk group, a non-high risk control group, a non-high risk non-contacted control group, and a similar high risk non-contacted control group.

Actual determination of sampling frames must be carried, at the time of the study, for each group in each state.

3. Specify Precision Desired, and Sampling Rates and Procedures

The sample size for each of the groups mentioned will need to be quite substantial. One reason for this is that crashes are a fairly rare event. Estimates based on conjectural information derived from California indicates that there is about one crash per year for each 60 males aged 20-24. Thus, if we had 6,000 such males in the sample, approximately 100 crashes will be expected to occur. Approximately 12,000 cases per group would suffice to offer a meaningful pool of crash data.

Above and beyond this, there is the additional problem that for a longitudinal survey such as the one described here, a certain number of members of the research panel become unreachable through the course of the survey. The usual estimates of panel membership attrition may not be suitable to use in this instance because of the higher mobility of young men and the fact that those characteristics which make the groups to be studied high risks may be characteristics of mobility and non-trackability. Assuming a 20% panel attrition per year there would be a 56% panel loss in four years and a 60% panel loss in five years. Therefore, in order to get 12,000 cases still available at the end of five years, an initial sample of 30,000 cases will be required for each cell.

4. Validation of Procedured

The data collection forms, including the data collection procedures from the State Motor Vehicle Departments, the questionnaires, and the tracking, need to be pretested in order to insure that the data to be collected will be suitable for subsequent analysis. In addition, the pretest will offer better timing estimates than are currently available for the interview length and will allow better budget estimating parameters. About five to nine pretests will suffice for each developed form.

5. Sampling

Once the states have been selected in which the research program is to be undertaken samples of each of the four groups of drivers will need to be drawn. The recommended procedure for doing this sampling is somewhat dependent on the structure of the files in which driver license records are kept. In general, however, the sampling technique will be one of isolating the universe of driver records which fall in each group, defining a sampling fraction to yield enough cases in each category, and picking every nth record, where n is the denominator of the sampling fraction.

6. Data Collection

In as many cases as is feasible, it is recommended that members of the sample panel be contacted by telephone and interviewed using that medium. However, some percentage of the respondents will have unlisted telephones, will have moved, or otherwise be unavailable to telephone interviewing. For this subset, tracking and personal interviewing will be required. Given the current structure of the questionnaire, it is anticipated that anything over 200 man-months of telephone interviewing will be required. On top of this will be required personal interviewing on the order of 50 to 100 man-months.

It has been alluded earlier that the questionnaire content is somewhat sensitive, however, similar to that used in prior successful market research studies for the alcoholic beverage industry. Therefore, aside from the difficulties of tracking, the interviewing does appear to be feasible.

7. Data Processing

The major data processing effort appears, at this stage, to lie in the area of data editing and coding. Since it is anticipated that different states have different data format, the major task will be the design and structuring of compatible files so that members of the sample panel will be represented in the same way in the research files. The coding operation for the open-ended questions, including occupational status and some of the attitudinal questions, should be processed in the following manner. For each open-ended question, the coding analyst will list a random sample of responses and will extract those ideas which appear with relatively more frequenty than others. The ideas are reviewed by the project director in terms of the study objectives, and are to be returned to the coding operation where a code is constructed. In this process numbers are assigned to each category of ideas. The code is then tried on the original random sample of responses and is cross validated with a second sample. When this has been accomplished, responses can be coded with exceptional situations drawn to the attention of the study director.

8. Data Analysis

Once the data files have been constructed, in machine readable format, the development of detailed analysis of the file can be accomplished. The plan for doing this analysis is detailed below in section F.

9. Preparation for Long-term Study

Once the file structure is developed and the requisite systems planning accomplished in order to maintain currency of the data, the ground work will have been laid for the execution of the longitudinal study. Prior to the development of the prediction model, tabulations and reporting concerning the attidudes and behavior of each of the groups will be available and differences can be analyzed among the groups with respect to attitudes and reported behavior which will be of value in the development of discrimination indices.

F. Analytic Plan

There are three fundamental components of the analysis to be undertaken. The first is the assessment of differences among the four groups with regard to attitudes and behavior and the development of indices based on those differences. The second task is the development of profiles of each group using obverse or Q type factor analysis. The third component is the development of a predictive model using accident occurrence as the dependent variable and the interview and driving history data as independent variables.

The inter-group differences will be assessed using the technique of multiple classification analysis. This technique will use group or sample membership as the dependent variable and driving history or interview data as independent variables. To the extent that group membership can be predicted from this data, the classification variables will be considered as likely candidates for the differential prediction model.

The driver profiles to be developed using the obverse factor analytic technique will give an indication as to the within-group profile differences that exist. Additionally, efforts can be made to determine whether there are between sample profile similarities or differences which could yield clues as to the targetability of countermeasure programs. For example, if a particular pattern of drinking behavior and attitudes emerge in one of the target groups, but not in a control group with a lower accident rate, it may be desirable to target a countermeasure program at that constellation of behaviors in the target group rather than pursue a broad gauge countermeasure program.

Because of the computational requirements involving a type factor analysis, it is suggested that no more than 600 cases in a group be used to develop the profile structure. These people should be randomly selected from the sample. Once the profile has been developed, it should be cross-validated using a second sample of similar size.

The core of this research program is the development of the prediction model for alcohol related crashes. It is anticipated, as mentioned above, that approximately 200 crashes will be observed in the highest risk group. Approximately 100 of these crashes will serve as the dependent variables in the development of the prediction model. The historical, attitudinal and behavioral data collected will be used to determine if it is possible to predict crach occurrence from the data collected. Assuming that this does occur, the remaining 100 crashes will be used to cross-validate the model. That is, the regression weights developed will be applied to the data concerning the other 100 drivers involved in crashes. A correlation coefficient will be computed between the weighted data and crash occurrence. If this correlation is as high or nearly as high as the multiple correlation developed in the initial regression, the model will be deemed successful and usable in the prediction of alcohol related crashes.

IV. DISCUSSION OF ADDITIONAL RESEARCH RECOMMENDATIONS

A. Retrospective Studies Using Existing Data From Selected States

In the course of designing the survey research reported above, it became apparent to the research design staff that although some quite sophisticated work has recently been done in the area of alcohol related accident analysis, much more carefully designed and conducted analytical studies need to be done. Far more sophisticated statistical techniques and quantitative modeling capabilities exist which would very usefully be applied in the area of alcohol impaired driver accidents. In examining the question of which states had information systems on drivers and violations, it became apparent that some large, sophisticated, and relatively untapped data bases exist from state to state to which such sophisticated analytical and modeling techniques could usefully be applied.

A number of the variables which are thought to be relevant to predicting rates of alcohol related accidents for various populations, groups, or statistical aggregates are represented in these existing data bases. Such factors as age, sex, place of residence, driving violations, and some accident information are available in machine manipulatable format in a number of states. California, to mention only one, already has significant analyses being done using its computerized information system. Other studies in states such as Michigan and Vermont have also made use of state data bases, the information contained in them, and significant aspects or attributes of drivers and driving behavior.

Given the high quality of some of these state information systems, it should be both possible and fruitful to do some retrospective studies of drivers and alcohol related driving offenses and accidents.

The analytical approach suggested above could be used, with some modification, on the existing data. Multiple regression analysis could be used together with other multivariate analytical techniques. Based on the results, predictive models could be built and then tested against the actual results. As is often done in econometric modeling, a model could be developed based on a five-year span of data and then used to predict the fifth year based on the prior four years. With large data bases, such as exist in the larger states, double samples could be drawn, the prediction model developed on one, then tested on the other.

Such careful analyses which, incidentally, avoid many of the high costs of generating original data in the field can result in refined estimates of the weight, or relative importance, of the various variables studied. They can also be used to highlight areas where additional, more refined data needs to be developed. In the longer term, data banks can be expanded to pick up and maintain such additional information so that further refined studies can be carried forward. Such work can also be used to guide the specification and development of other behavioral data through questionnaires, driver surveys, and related techniques. However, it is to be hoped that useable predictive models can be developed based on existing information. This, in turn, would allow for selection and intervention actions to be based on such data without recourse to other sources or forms of information.

The work could also result in significant recommendations for changes and improvements in the various data collection and storage activities.

In summary, much benefit could potentially be derived from sophisticated retrospective statistical studies of the existing data currently available in a number of states.

B. Technological Advance in Alcohol-Related Crash Reductions

Some of the methods that have recently been promoted as new innovations in reducing alcohol related crashes deal with mechanical devices or chemical therapy. They are primarily designed to either prevent a driver from starting his motor vehicle when it is determined that he is in an impaired condition or to monitor his driving performance while the vehicle is in operation. These devices will take certain steps to discontinue this operation when that performance exceeds a safe driving limit.

A great deal of work and experimentation has been expended on various alcohol interlock devices. As of this time, only a few of these devices warrant further study. Some of these are the Divided Attention Tester (DAT), the Continuous Tracking Tester (CTT), and the Breath Analysis Device. The major problems dealing with the first two instruments, the DAT and the CTT, is that these devices have not been sufficiently precise to prevent all (or most) drivers who have a BAC above .10 percent from operating their vehicles (false negative), and a certain number of drivers will be prevented from such operation although their BAC level will be below .10 percent BAC (false positive). Because of the relatively high numbers of such false positives and false negatives, the practical use of such devices does not show much promise at the present time. The breath analysis device does not have these drawbacks. In fact, the present technology would work almost perfectly in detecting the precise BAC of the prospective driver. The difficulty in this countermeasure, though, is the relative ease in circumventing the device by any number of methods. (The simplest method would be for the driver to maintain a sufficient quantity of fresh air in a syringe-type container to feed to the analyzer.)

Another new concept in alcohol countermeasures is called a "sober pill." The object of this experiment is for the person to reduce his impairment level by ingesting a chemical substance after attaining this level. The drug is then designed to act as a "blocking agent" against the effects of alcohol upon the brain. While this will not physically lower the person's BAC, the intent of the countermeasure is to substantially improve the person's driving capabilities. There have been initial tests conducted on a number of different known chemical agents and combination of such agents. Some of the results appear promising. Obviously, a great deal of additional research is required before any definitive positions can be taken. Certainly, though, this seems to be an area where further investigation should be supported and encouraged.

One other such promising technique for use as an alcohol countermeasure is referred to as a "Continuous Monitoring Device." In this instance, this device which is preset to reflect an individual driver's normal steering variations will react mechanically, either with the horn sounding, blinking lights, or both, when the driver's performance level falls moderately below the registered norm. A similar type of device is presently in use in trucks as a warning device to its drivers when they are in danger of falling asleep. While there are many considerations that must be taken into account for this device to be used to detect a worsening of a driver's performance due to alochol impairment, the concept deserves some further research.

Perhaps the most practical method of the identification of high risk groups for alcohol countermeasures is the improved detection of alcohol-impaired drivers during the period of their actual driving. At the present time, most apprehensions are invariably made after the driver has committed some deviant driving behavior. When this behavior is brought to the attention of a law enforcement officer, an arrest is generally made if sufficient evidence is deduced from the investigation. At that time, the driver is removed from the road. Should the capabilities of the police be substantially improved in the detection of such alcohol-impaired drivers on the roadway, theoretically, many crashes can be averted by removing this dangerous situation from the driving scene. While at first glance, these concepts appear somewhat "Buck Rogerish," the concepts have some sound technological basis. Some of the current studies deal with the use of high powered "sniffer" devices and the use of "laser beams," to detect the presence of alcohol within a vehicle on a somewhat random basis. Presumably, this testing can be done as a noncooperative device without the knowledge, consent or cooperation of the drivers. As a result of this type of operation, certain legal questions of "illegal search and seizure" will inevitably be raised. While there are reasonable issues on both sides of the question, on the basis of some recent U.S. Supreme Court decisions, it would appear that this investigation could be sustained as a lawful exercise. While there have been some encouraging experimentation with these types of countermeasures, a great deal of additional research is needed before these programs can be utilized. In addition, a certain amount of research will be required into the legality of such use and the acceptability by the general public. One serious consideration must be the reaction of the drivers and driving organizations to this program. Should there be substantial public clamor against "big brotherism," the prospective countermeasure may never get started. There appears to be strong reasons, though, for this potential countermeasure to receive substantial considerations.

One other area which deserves mention is in the area of alcohol self-testers. The design of this countermeasure is to provide to the general public a device or apparatus where a drinker can test his BAC reading prior to his driving. The devices (coin-operated breath testers) are presently available and marketing research is being investigated by some private firms. Should this countermeasure prove effective, it will greatly reduce the number of alcohol-impaired drivers on the highway. It is too soon, at this point, to accurately gauge the usage of such devices by the general public or its commercial value. Here, again, the need for additional research into the feasibility of the countermeasure is needed before embarking upon a major effort.

C. Special Media Appeals for Larger Groups of Drivers

The work on accidents, reported above, indicates that a large number and proportion of accidents each year involve individuals whose prior driving records, social characteristics, and other relevant attributes do not distinguish them from many other low risk groups and individuals who have no accidents. Even by closely defining a relatively small group of high risk drinking drivers, a large number of others must be left out, some proportion of whom will in all probability be involved in accidents or other alcohol involved driving offenses.

To reach these larger numbers of lower risk drivers is very desirable, however, because they account for so many crashes. The problem is how to do this in some manner which will be effective in changing their behavior and done at a reasonable cost to society.

A mass media campaign should be developed in the following manner to accomplish these ends and should be carefully tested and evaluated to see that it is accomplishing the desired objective: reducing alcohol related accidents and offenses and high risk drinking driving episodes.

First, a number of target population groups should be defined for whom separate messages will be developed. Each group should be defined on the basis of a similar set of values, beliefs, a common subculture, and located physically, socially and economically in such a way that its mass media consumption behavior can also be determined.

For each of the groups so defined, a careful study of group values and beliefs should be conducted. Based on this survey work, a discrete set of messages can be developed (and tested) aimed at influencing drinking-driving behavior in desirable directions.

Not only should the messages be carefully designed so that they engage key values and beliefs for each of the groups, but a careful study of media use should be made in order to determine the best media or combination of media, by which to provide the target groups with the various messages. For instance, inner city blacks might be reached by radio messages on black stations, and Spanish speaking populations reached through their own radio stations or Spanish language programs where these exist. Comic book materials might be prepared for some audiences and TV ads for others. Sponsorship and endorsements, as in drug use campaigns, could be also used and carefully tailored to the target audiences.

Evaluation studies and surveys could be used to measure where members of the target groups are in their use of alcohol related driving patterns, and knowledge, opinions, and values regarding these behaviors. The message campaigns could be designed and used in such a manner that many individuals could be moved through the initial stage of communication, awareness and understanding to the final stage of acceptance and most crucial, commitment (to action).

Use of these stages could similarly be used in a sophisticated evaluation so that progress in moving members of populations through these stages could be perceived, as well as the end state, commitment, and the related objective, reduction in drinking-driving offenses and accidents.

Special message units could be developed for these groups for use at various points in the individual's growth and development, including school or commercial driver education, first licensing, first relicensing, first point accumulation, etc.

Such a sophisticated approach based soundly in communication theory and practice and using careful surveys and other measurements could be carried out at a low cost per person, and could be expected to have the desired effect: reduction in drinking-driving and in alcohol related accidents within each of the large target populations.

D. Summary Overview of Research and Intervention Management

A range of varied activities and programs must be conducted simultaneously and decisions made under conditions of imperfect information as to the best allocation of resources among these various programs. Current intervention programs of all descriptions need to be implemented at greater rates and improved as experience indicates is necessary or possible. In addition, new intervention programs should be designed, pilot tested, and promulgated. Means should be developed, as suggested above, to get closer in point of time to the potential crash. to isolate and deal with higher risk groups, and to devise approaches to large masses of drivers in order to impact a greater proportion of the total number of accidents.

Two types of information at a minimum must be generated and utilized in order to carry forward such a broad scale program. First, there is a great need for much more accurate and detailed information on accidents, alcohol involved accidents and, most importantly, the functional effectiveness of intervention techniques aimed at reducing accidents. A major thrust of the research design above is aimed at creating a survey so that such information can be collected with a satisfactory degree of confidence in the findings. In addition, cost data is required. Relative cost effectiveness measures and estimates can then be made and scarce resources allocated in the best possible manner among alternative programs and projects.

In addition to this effectiveness data, and information on the costs of resources, there is a need to generate and present information which will influence decision makers and driver's behavior in desired directions. Such programs as ASAP require strong political support if they are to be effective in local communities. State and national legislators need to be convinced with effective arguments and need to be provided with good materials so that they can effectively explain to their constituencies the appropriateness of their actions in support of highway safety programs. These politically oriented information materials are as essential to the success of intervention techniques and activities as are well researched, functionally effective intervention actions and techniques.

All of these activities must be carried forward simultaneously and improved as much as possible. They should be based on relevant research findings and careful judgments as to the basis for social and political support of meaningful and truly effective measures.

A P P E N D I X

DRIVER INFORMATION SURVEY QUESTIONNAIRE

Driver Information Survey

QUESTIONNAIRE

Control Information

Respondent: Case # ____________________

Name

Address

Phone No.

Call Backs

Date ____________ Time ____________

Date ____________ Time ____________

Date ____________ Time ____________

Date ____________ Time ____________

Sample Substitution Necessary

Reason ____

____

____

____

Interviewer ____

Edit ______________________

Coded ______________________

Checked ______________________

ADP ______________________

INTRODUCTION:

Please provide all of the information requested below. This driver information survey will maintain as confidential all the information that you provide. It will not be made available to state or local officials, and it will not become part of your driving record. This information is needed for a program sponsored by the National Highway Traffic Safety Administration to help reduce alcohol-related traffic accidents. Information is needed on a wide variety of drivers, and your cooperation will be appreciated.

(1) Date you moved to this address ______ ______
Month Year

(2) Your date of birth: Year______ Month______ Age______

(3) Sex: Male______ Female______

(4) What is your approximate family income? (Check one)

____ Under $3,000
____ 3,000 to 5,000
____ 5,000 to 7,500
____ 7,500 to 10,000
____ 10,000 to 15,000
____ 15,000 to 25,000
____ Over 25,000

(5) Marital status: ____Married ____Separated ____Divorced ____Single/engaged ____Widowed

(6) Race: ____White ____Black ____Oriental ____Latin ____Other (Specify) ________________

(7) Ethnicty: What country or countries did your ancestors come from?

____

____

(If Canada, probe for pre-Canada

(8). Amount of education completed by your father: ____Grade school

____Some high school ____High school graduate ____some college

____College graduate ____Postgraduate study

(9) Father's occupation: Business proprietor/owner/manager________

Professional________

Government________

White collar________

Blue Blue collar________

Domestic or service________

Other________

(10) How many years of education have you completed? (Circle one)

1 2 3 4 5 6 7 8 9 10 11 12 College: 1 2 3 4

College graduate? ____Yes ____No If yes, postgraduate study? ____Yes

(11) Employment Status

____Unemployed, looking for work

____Partially employed

____Fully employed

____Fully employed plus second job

____Unemployed, not looking for work. Reason________

____

(12) If Employed:

Occupation (Describe)________

____

Check: Business proprietor/owner/manager
Government
Professional
White collar
Blue collar
Domestic or service
Other

(13) Number of employers you have worked for during the last five years

(Circle one) 1 2 3 4 5 6 7 8 9

(14) Social Security Number________________________________

(15) Drivers License Number (if different)__________________________

Drinking behavior:

(16) When you get together socially with your close friends, how often are drinks containing alcohol served--nearly every time, more than half the time, less than half the time, once in a while, or never?

	Nearly every time. . . .	1
	More than half the time .	3
	Less than half the time .	5
	Once in a while . . .	7
*(SKIP TO Q.25 AND CROSS OUT Q.34D)	*Never	9

(17) Among your close friends, how many would you say drink quite a bit--nearly all of them, more than half, less than half, only a few, or none?

Nearly all . . .	1
More than half . .	3
Less than half . .	5
only a few . . .	7
None	9
(Don't know) . .	

(18) The next few questions ask you about your own use of various types of drinks.

About how often do you drink wine?

_____Three or more times a day

_____Two times a day

_____Once a day

_____Nearly every day

_____Three or four times a week

_____Once or twice a week

_____Two or three times a month

_____About once a month

_____Less than once a month but at least once a year

_____Less than once a year

_____Never

(19) About how often do you drink beer?

_____Three or more times a day
_____Two times a day
_____Once a day
_____Nearly every day
_____Three or four times a week
_____Once or twice a week
_____Two or three times a month
_____About once a month
_____Less than once a month but at least once a year
_____Less than once a year
_____Never

(20) About how often do you drink whiskey or liquor?

_____Three or more times a day
_____Two times a day
_____Once a day
_____Nearly every day
_____Three or four times a week
_____Once or twice a week
_____Two or three times a month
_____About once a month
_____Less than once a month but at least once a year
_____Less than once a year
_____Never

(21) About how often do you drink any other kind of alcohol?

_____Three or more times a day
_____Two times a day
_____Once a day
_____Nearly every day
_____Three or four times a week
_____Once or twice a week
_____Two or three times a month
_____About once a month
_____Less than once a month but at least once a year
_____Less than once a year
_____Never

____Never drinks or drinks less than once a year
(Skip to Q.37)

____Drinks less than once a month but at least once a year
(Skip to Q.27)

____All other categories
(Continue with Q.23)

WINE

(22)___(HAS WINE ABOUT ONCE A MONTH OR MORE OFTEN, ASK THE FOLLOWING. OTHERWISE, SKIP TO Q.23)

(22a) Think of all the times you have had wine recently. When you drink wine, how often do you have as many as five or six glasses?

*(SKIP TO Q.23

*nearly every time . .	1
More than half the time .	3
Less than half the time .	5
Once in a while . .	7
Never	9

(22b) When you drink wine, how often do you have three or four glasses?

*(SKIP TO Q.23

*Nearly every time . .	1
More than half the time	3
Less than half the time	5
Once in a while . .	7
Never	9

(22c) When you drink wine, how often do you have one or two glasses?

Nearly every time . .	1
More than half the time	3
Less than half the time	5
Once in a while . .	7
Never	9

BEER

(23)___(HAS BEER ABOUT ONCE A MONTH OR MORE OFTEN, ASK THE FOLLOWING. OTHERWISE SKIP TO Q.24)

(23a) Think of all the times you have had beer recently. When you drink beer, how often do you have as many as five or six glasses/cams?

*(SKIP TO

*Nearly every time . .	1
*More than half the time . .	3
Less than half the time . .	5
Once in a while	
Never	9

(23b) When you drink beer, how often do you have three or four glasses or cans?

*(SKIP TO Q.24)

*Nearly every time . .	1
More than half the time . .	3
Less than half the time. . .	5
Once in a while	7
Never	9

(23C) When you drink beer, how often do you have one or two glasses/cans?

Nearly every time	1
More than half the time. . .	3
Less than half the time . .	5
Once in a while.	7
Never	9

(CHECK ACCORDING TO Q.29 AND Q.30 ON PRECEDING PAGE.)

(24)____(HAS BOTH WINE AND BEER ABOUT ONCE A MONTH OR MORE OFTEN, ASK Q.24 - 24J ABOUT BOTH COMBINED.

____ HAS WINE ONLY ABOUT ONCE A MONTH OR MORE, ASK Q.24A - 24.J ABOUT WINE ONLY

____ HAS BEER ONLY ABOUT ONCE A MONTH OR MORE OFTEN, ASK Q.24 - 24 ABOUT BEER ONLY

____ HAS NEITHER WINE OR BEER ONCE A MONTH OR MORE OFTEN, SKIP TO Q. 25)

Less than half the time 5

Once in a while . . . 7

Never 9

(25b) When you have drinks containing <u>whiskey or liquor</u>, how often do you have three or four drinks?

*(SKIP TO Q26a) *nearly every time . . 1

*More than half the time 3

Less than half the time 5

Once in a while. . . 7

Never. 9

(25c) When you have drinks containing <u>whiskey or liquor</u>, how often do you have one or two drinks?

Nearly every time . . 1

More than half the time 3

Less than half the time 5

Once in a while . . . 7

Never . . . .

(26a) When you have drinks containing <u>whiskey or liquor</u>, where do you have them most often--at home, at friends' homes, or at restaurants and bars?

Your home 1

Friends' homes . . . 3

Restaurants/Bars . . 5

(26d) How often (do you have drinks containing whiskey or liquor) at <u>restaurants and bars</u>--fairly often once in a while, or almost never?

Fairly often 1

Once in a while . . . 3

Almost never 5

(26e) When you have drinks containing <u>whiskey or liquor</u>, with whom do you have them most often--with friends, with members of your family, or is it mostly when you are doint something by yourself?

With friends 1

With family members . . 3

by yourself 5

(26f) How often do you have drinks containing whiskey or liquor with <u>friends</u>--fairly often, once in a while, or almost never?

Fairly often 1

Once in a while . . . 3

Almost never 5

(26g) How often (do you have drinks containing whiskey or liquor) with <u>family members</u>--fairly often, once in a while, or almost never?

Fairly often 1

Once in a while . . . 3

Almost never . . . 5

(27) At the present time, do you consider yourself to be a very light drinker, a fairly light drinker, a fairly heavy drinker, or a heavy drinker?

Very light 1

Fairly light 3

Fairly heavy 5

Heavy 7

---------------(SKIP TO Q. 38a)---------------

(28) Have you ever had a close relative with a serious drinking problem?

No 1

Yes 3

(24a) When you have wine or beer, where do you have them most often--at your home, at friends' home, or at restaurants and bars?

Your home	1
Friends' home . . .	3
Restaurants/Bars . .	5

(24b) How often do you have wine or beer in your home--fairly often, once in a while, or almost never?

Fairly often . . .	1
Once in a while . .	3
Almost never . . .	5

(24c) How often (do you have wine or beer) at friends' homes--fairly often, once in a while, or almost never?

Fairly often . . .	1
Once in a while . .	3
Almost never . . .	5

(24D) How often (do you have wine or beer) at restaurants and bars--fairly often, once in a while, or almost never?

Fairly often . . .	1
Once in a while . .	3
Almost never . . .	5

(24e) When you have wine or beer, with whom do you have them most often-with friends, with members of your family, or is it mostly when you are doing something yourself?

With friends . . .	1
With family members .	3
By yourself . . .	5

(25)___(HAS WHISKEY OR LIQUOR ABOUT ONCE A MONTH OR MORE OFTEN, ASK THE FOLLOWING. OTHERWISE, SKIP TO Q.27)

(25a) (GIVE RESPONDENT CARD C)
Think of all the times you have had drinks containing whiskey or liquor recently. When you have them, how often do you have as many as five or six drinks?

*(SKIP TO Q.26a

*Nearly every time . .	1
*More than half the time	3

(24f) How often do you have wine or beer with friends--fairly often, once in a while, or almost never?

Fairly often	1
Once in a while . . .	3
Almost never	5

(24g) How often (do you have wine or beer with family members--fairly often, once in a while, or almost never?

Fairly often	1
Once in a while . . .	3
Almost never	5

(24h) How often (do you have wine or beer) by yourself--

Fairly often	1
Once in a while . . .	3
Almost never	5

(24i) How often do you have wine or beer on weekends--that is, Friday night through Sunday night--fairly often, once in a while, or almost never?

Fairly often	1
Once in a while . . .	3
Almost never	5

(24J) How often do you have wine or beer on weekdays--fairly often, once in a while, or almost never?

Fairly often	1
Once in a while . . .	3
Almost never	5

(26b) How often do you have drinks containing whiskey or liquor in YOUR home--fairly often, once in a while, or almost never?

Fairly often	1
Once in a while . . .	3
Almost never	5

(26c) How often (do you have drinks containing whiskey or liquor) at friends homes--Fairly often, once in a while, or almost never?

Fairly often	1
Once in a while . . .	3
Almost never	5

29. Have you ever had a breath test or blood test to find out your blood alcohol content?

Yes ____ No ____

30. If yes:
Do you happen to know what the results were?

BAC ____
Other ____

Driving Behavior

31. To the best of your recollection, how many moving violations have you had in the last year?

____

Last two years ____

Last Three years ____

32. How many non-moving violations?

Last year ____
Last two years ____
Last three years ____

33. How many non-traffic offenses, if any?

Last year ____
Last two years ____
Last three years ____

34. How many drivers license suspensions or revocations, if any?

Last year ____
Last two years ____
Last three years ____

35. How many points do you presently have, if any?

Last year ____
Last two years ____
Last three years ____

(If respondant is unsure, get information on violations and check for number of points.)

36. During the past year (12 months) have you been involved in any accidents while being the driver (whether or not you were responsible)?

____1. No.
____2. Yes

37. If yes, how many accidents altogether have you had in the past twelve months? (Include any accidents while you were in the driver's seat.)

____ Accidents in the past twelve months.

Describe the accidents, if any ______________________________

____

____

Attitude Survey - Read each of the following statements and check as it applies to you.

38. I feel that I have a number of good qualities.

_____1. Strongly agree
_____2. Somewhat agree
_____3. Somewhat disagree
_____4. Strongly disagree

39. I feel that I do not have much to be proud of.

_____1. Strongly agree
_____2. Somewhat agree
_____3. Somewhat disagree
_____4. Strongly disagree

40. All in all, I am inclined to feel that I am a failure.

_____1. Strongly agree
_____2. Somewhat agree
_____3. Somewhat disagree
_____4. Strongly disagree

41. On the whole, I am satisfied with myself.

_____1. Strongly agree
_____2. Somewhat agree
_____3. Somewhat disagree
_____4. Strongly disagree

42. At times I think I am no good at all.

_____1. Strongly agree
_____2. Somewhat agree
_____3. Somewhat disagree
_____4. Strongly disagree

43 I am able to do things as well as most other people.

_____1. Strongly agree
_____2. Somewhat agree
_____3. Somewhat disagree
_____4. Stongly disagree

44. How often do you feel that life is not worth living?

_____1. Always
_____2. Often
_____3. Sometimes
_____4. Seldom
_____5. Never

45. Have there been occasions where life seemed to you so bad that you felt like taking your life (committing suicide)?

_____1. On many occasions (often)
_____2. On several occasions
_____3. On a few occasions
_____4. Once only
_____5. Never

46. In the past year, have you thought of committing suicide?

_____1. Yes _____2. No

47. If YES, how seriously did you consider it?

_____1. Very seriously
_____2. Somewhat seriously
_____3. Not seriously

48. Have you ever attempted to commit suicide?

_____1. Yes _____2/ No

49. If Yes, was it during the past twelve months?

_____1. Yes _____2. No

50. How many times during the past year have you become so angry that you threw or broke things?

_____1. None
_____2. Once only
_____3. Twice only
_____4. Three times only
_____5. Four times or more

51. How many times diring the past year have you been involved in a fist fight?

_____1. None
_____2. Only once
_____3. Twice only
_____4. Three times only
_____5. Four times or more

The following questions are concerned with you and your feelings about the world about you.

52. How often are your disturbed by events that are suddenly developing like violent demonstrations, riots, rise in crime, increasing levels of noise and pollution, etc?

_____1. About every day or every other day
_____2. About once or twice a week
_____3. About once or three times a month
_____4. About once to several times a year
_____5. Never

53. How disturbing do you find it?

_____1. Extremely disturbing
_____2. Considerably disturbing
_____3. Moderately disturbing
_____4. A little disturbing
_____5. Not at all disturbing

54. How often do you feel that someone holds a grudge (resentment) against you?

_____1. Always
_____2. Often
_____3. Sometimes
_____4. Seldom
_____5. Never

55. How often do you feel that someone is trying to spoil things for you?

_____1. Always
_____2. Often
_____3. Sometimes
_____4. Seldom
_____5. Never

56. As compared to the tension and stress I had two years ago, now I feel . . . . .

_____1. Much more tension and stress
_____2. Somewhat more tension and stress
_____3. About the same tension and stress
_____4. Somewhat less tension and stress
_____5. Much less tension and stress

57. How often do you think that things are rigged (arranged) against you?

_____1. Always
_____2. Often
_____3. Sometimes
_____4. Seldom
_____5. Never

58. How often do you feel envious of other people?

_____1. Always
_____2. Often
_____3. Sometimes
_____4. Seldom
_____5. Never

59. How often do you feel that your life is full of unnecessary, annoying stress and tension?

_____1. About every day or every other day
_____2. About once ot twice a week
_____3. About once or three times a month
_____4. About once to several times a year
_____5. Never

60. How disturbing do you find it?

_____1. Extremely disturbing
_____2. Considerably disturbing
_____3. Moderately disturbing
_____4. A little disturbing
_____5. Not at all disturbing

Thank you for responding. Your cooperation is appreciated.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS-801 434		

4. Title and Subtitle	5. Report Date / 6. Performing Organization Code
ANALYSIS OF HIGH RISK GROUPS FOR ALCOHOL COUNTERMEASURES	5. Report Date: March 1975 6. Performing Organization Code:
7. Author(s) L. D. Filkins, C. P. Compton, R. L. Douglass, J. D. Flora	8. Performing Organization Report No. UM-HSRI-AL-74-8
9. Performing Organization Name and Address Highway Safety Research Institute The University of Michigan Huron Parkway and Baxter Road Ann Arbor, Michigan 48105	10. Work Unit No. 11. Contract or Grant No. DOT-HS-4-00990
12. Sponsoring Agency Name and Address Department of Transportation National Highway Traffic Safety Administration Office of Driver and Pedestrian Research Washington, D. C. 20590	13. Type of Report and Period Covered 6/1/74 to 12/31/74 Final Report on Phase I 14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract A 6-month (Phase-I) planning study was undertaken as the first step in a possible long-term, three-phase study. The overall study objectives are identification of groups of drivers at high risk to alcohol-related (A/R) crashes, development of predictive techniques for assigning risk factors to individuals within the groups, validation of the predictive techniques, and identification of countermeasures expected to reduce crash risks among identified drivers.

Phase-I objectives included identification of potential high-risk groups and the development of plans for their study. Relevant literature was reviewed and data from selected in-house files were analyzed. No variables were found that unequivocally identify drivers at high risk to A/R crashes, and such drivers were found to be widely distributed. However, several variables consistently correlated with A/R crashes were found. The low incidence of A/R crashees among the general driving population was shown to create a significant identification problem that will result in a high false-positive rate among those predicted to have an A/R crash. Countermeasure programs directed to target groups known to contain a large number of false positives will necessarily be of limited scope.

A carefully conceived and executed research program was recommended for the following target groups: A/R crashees; DWIs; blue-collar workers with high absenteeism rates; assigned-risk insureds; and divorcing persons.

17. Key Words	18. Distribution Statement
Alcohol, High Risk Driver, Traffic safety, Countermeasures	Document is available to the public through the National Technical Information Service, Springfield, Virginia 22151

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unlimited	Unlimited	117	

Form DOT F 1700.7 (8-69)

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

1.0 INTRODUCTION

Reported herein are the results of a six-month planning effort, identified as Phase I, undertaken in preparation for a potential long-term study entitled "Analysis of High-Risk Groups for Alcohol Countermeasures." The primary objective of the prospective long-term study is to identify individuals most likely to be involved in alcohol-related (A/R) crashes. A second objective is to identify countermeasure approaches that may be expected to reduce highway accidents among identified high-risk drivers so that effective preventive action can be taken prior to crash involvement.

The specific objectives of the Phase-I planning effort were to identify potential high-risk groups and generate a detailed plan of procedures for their study. Phase-II activities, if undertaken as originally conceived by NHTSA, would have included the collection of a variety of detailed data elements about drivers within the groups identified in Phase I, and formulation of a risk-prediction technique based on these data and their analyses. Phase III would consist of a validation study of the predictive techniques, using five years of driving record followup data. These requirements* were amplified in early discussions between technical principals from NHTSA and HSRI, and NHTSA personnel stressed the importance of addressing the pertinent benefit/cost considerations throughout the study.

The Phase-I objectives were approached by reviewing relevant literature, by analyzing various data available through

---

* RFP NHTSA-4-A611, dated 5/7/74, and Contract DOT-HS-4-00990

HSRI computerized data files, and by assembling pertinent information about Michigan's A/R crash experience. These activities have not produced any startling research results. However, the existing data, particularly when reviewed and interpreted from a benefit/cost and countermeasure-program perspective, clearly have important implications for the conduct of Phase II. The results to date and their interpretation together comprise Task 1 of Phase I and are given in Section 2 of this report.

Section 3--Phase I, Task II Planning Results--contains HSRI's recommendations regarding the conduct of Phase II. It will be seen subsequently that the activities and statement of work deriving from these recommendations are somewhat more modest in scope than those given in the original RFP for Phase II. The fundamental reason for this is that we believe it important to resolve several of the research issues uncovered during the Phase-I activities. In agreement with the RFP, we believe that considerable analytic work is called for during Phase II on the driving records of individuals within the experimental study groups. Unlike the RFP, we do not think it wise to plan for an extensive and expensive primary data collection effort on individual drivers at this time. The reasons for this position are developed in subsequent sections.

2.0 PHASE I, TASK I RESEARCH RESULTS

The present section contains a summary of the research findings--both those known heretofore and those newly generated--on which the recommendations contained in Section 3.0 are based. A limited review of the recent, pertinent literature was undertaken; a summary of this review follows and detailed information will be found in Appendix A. Key findings from certain analyses of in-house, computerized crash files are also given. Specific data about Michigan's A/R crash experience are presented, including costs of crashes by severity, geographic distribution, and the incidence of A/R crashes among Michigan drivers. The important issues of false positive and false negative test results--which necessarily result when imperfect predictive techniques are used for screening or diagnostic purposes--are also discussed and are related to the low incidence of A/R crashes among the driving population at large. Benefit/cost considerations are addressed briefly, and the findings are summarized in terms of the Phase II activities to be undertaken subsequently.

2.1 LITERATURE REVIEW

A detailed review of recent literature that provides significant background information for this study is presented in Appendix A. The literature review was organized in terms of biographical, demographic, socio-economic, and certain situational variables, and was oriented toward identifying target groups for which cost-effective A/R countermeasures could be postulated and applied.

Identifying operational target groups from the existing literature presented many problems. Studies generally are not comparable because of differing methodologies and data incompatibilities. Critical variables are often poorly measured, if at all, and comprehensive, multidisciplinary research using longitudinal analyses is uncommon. Analytic techniques have frequently been inadequate. The net result has been that useful, specific target groups with known, elevated risks to A/R crashes have not been uncovered by the literature review.

This result notwithstanding, the review has been productive, in that a number of variables were found to be correlated with A/R crashes consistently. These will prove useful both in helping to define potential countermeasure groups and for use in predictive models employed to generate risk factors for individuals within the groups. Further, methodological weaknesses characteristic of some of the studies are evident, and a discussion of these should prove useful to whatever organization undertakes Phase II.

The association of the basic demographic variables (age, sex, martial status, race) and accidents, particularly A/R accidents, has been demonstrated by the literature. The strength of this association varies from study to study, depending on the number of other variables included, the criterion variable(s), the study population, and the methodology used by the investigator. The young (16-29) male driver is consistently identified as being over-involved in accidents, while the older (30-50) male driver has been identified as the high BAC (Blood Alcohol Concentration) driver in both DWI (Driving While Intoxicated) and A/R crash populations. Divorced or separated males are over-represented in accident populations and tend to be drinking at the time of their accident. When used, socio-economic indicators have identified blue-collar workers as significant contributors to alcohol offenses and A/R crashes. Past driving and criminal records have not been shown to consistently and reliably predict future driving behavior. However, some competent studies have found that combinations of traffic and criminal offenses, including accidents, are associated with drinking and driving, while others have found no significant relationship.

Psychological tests or indexes of deviant behavior have met with mixed success when used to predict future driving behavior. Recent studies have indicated that long- or short-term stress, in conjunction with alcohol use, may precipitate behavior leading to accident involvement. Until correlations of psychological tests and personality profiles with driving behavior are shown to be stable and experimentally reproducible, the utility of psychological indexes for predicting driving behavior remains uncertain.

The many investigations reported in the literature employ a full range of research methods for ultimate triangulation on the same end result, e.g., to understand who it is that becomes involved in an alcohol-related highway crash. In the majority of selections reviewed here, the methodologies, in the abstract, were sound and internally valid (a large number of less-than-adequate sources were excluded because of methodological deficiencies). However, the many predictive models generated or variable correlations found were of little practical value for individual or group identification. This lack of utility was the result of inadequate analytic methodology, discipline-bound data sets, data restrictions or inclusion of intercorrelated variables, and/or the failure of the investigator to determine the practical accuracy of predictions or correlations for a general population.

Many of the studies reviewed display a level of statistical analysis that is patently inadequate to address complex and variable interactive problems. Typically these studies provided measured relationships of single independent variables to single measures of crash occurrences, for groups or individuals. The bi-variate analytical situation invites numerous inferential/methodological traps. Spurious relationships, for instance, often are produced in correlational studies. If inadequate control is achieved through introduction of "control" or intervening variables, a statistically significant but spurious correlation may persist. Thus, several statistically significant "predictors" have been found when, if those factors had been adequately controlled for, they would have been shown to be falsely or non-significantly associated with crashes. The need to predict high-risk target groups, in a way suitable for administrative use, requires that a complex and interactive phenomenon be analyzed at its own level of complexity. The relationship of one independent variable to a crash cannot logically be given high predictive weight unless it is viewed as being interactive with several other independent terms. For the most part, there is little emphasis on multivariate analyses in the literature--especially regarding the analysis of alcohol-related crashes.

Another characteristic of the literature is the variety of disciplines represented and a stubborn persistence of investigators to consider variables only within disciplinary boundaries. For example, there is no measured interaction between divided-attention task performance and acute risk-taking behavior, or socio-economic status and stressful life events, or other potentially useful correlations. The field of highway safety is far too inter- and multi-disciplinary to permit investigators the luxury of narrowly conceived research conducted according to strict disciplinary points of view.

Data restrictions identified throughout the literature review severely limited the adequacy of many investigations. This is particularly true of secondary analyses of crash, violation, and conviction data. The problem is that pre-crash behavioral measures are rarely obtained for official records. Therefore, critical analyses of crashes are inhibited by the lack of essential information, and the studies that do have adequate behavioral data are not adequately integrated with the crash records. Integration by inference is unsatisfactory for purposes of target-group identification. Another data restriction is the inability of many investigators to obtain comparable data over a long enough time period to facilitate tests of the stability of findings over time.

Some of the investigations reviewed are hampered by the inclusion of inter-correlated and/or multi-colinear variables within the same correlational analyses. The end results of such errors of methodology are statistically impressive prediction models with little practical value. Closely associated with such methodological shortcomings is the use of self-selected populations or case-study data to develop prediction models of high-risk groups. This sort of data set frequently raises the question of generalizability.

2.2 ANALYSIS OF SELECTED COMPUTER FILES

The initial literature review made it apparent that too few of the studies had specifically related driver variables to A/R accidents. To fill this void to the extent possible, in-house files were reviewed to identify data sets that contained both driver-specific variables and accident-specific variables. Of the four files selected, three contain information on specific drivers or specific accidents, and one contains roadside-survey information, including BACs.

Our initial goals in analyzing those files were to:

(1) Compare the A/R crash data in the files with the A/R variables reported in the literature;

(2) Identify additional A/R-crash variables that were not reported in the literature;

(3) Identify, to the extent possible, the involvement or over-involvement of target groups suggested by the literature; and

(4) Identify new target groups or unique populations exhibiting a high frequency of drinking and driving or A/R crashes.

2.2.1 Description of Data Sets

The four files used as data sources were:

(1) The Collision Performance and Injury Report (CPIR) file. This contains vehicle, occupant, and injury data for 6,060 accident cases collected by more than 30 multidisciplinary accident-investigation teams from around the country. Because the non-NHTSA teams did not report on such driver-specific variables as marital status, occupation, driving record, driver stress, alcohol usage or other driver impairment, CPIR cases missing those data were excluded from the analysis. In general, teams did not select cases for investigation based on the drinking state of the driver. Potential biases on other variables have been neglected in the

effort to associate alcohol, crash involvement, and driver characteristics. Specific biases are noted where they appear to influence the conclusions given.

(2) The Washtenaw County Alcohol Safety Action Program (ASAP) file. This contains driving records, criminal records, and program evaluation records on 3,539 alcohol offenders who participated in the program under the supervision of the Washtenaw County Courts. The driving records are complete for a 6 1/2-year period, and include an average of ten months' driving exposure after completion of the program.

(3) The Wayne County Fatality (WCF) file. This contains driving records and accident data, both precrash and crash, for 309 dead drivers involved in fatal accidents that occurred in Wayne County, Michigan, during the period July 15, 1967, through August 31, 1969.

(4) The National Roadside Survey (NRS) and National Roadside Survey Archive (RSA) files. These contain roadside survey data from all areas of the U.S. The NRS file, containing 3,698 interviews, represents a nationwide, random survey of nighttime drivers. The RSA file, a collection of Alcohol Safety Action Program roadside surveys, currently contains approximately 80,000 interviews obtained in 78 surveys from 28 ASAPs in as many states. After comparing the frequencies of variable responses to ascertain the generalizability of the NRS data, further bivariate analyses were conducted on the NRS file only.

2.2.2 Methods and Results

To maintain consistency and facilitate comparison with other sections of this report, the findings from the computer files are reported here first by variable and proposed target group and then summarized with respect to the literature review. The implications of the findings as they affect the remainder of the report are then discussed.

Sex. Male drivers, without exception, were over-involved in the A/R crash groups in our files. Consequently, most subsequent analyses were conducted only on male subsets. Males comprised 87.6% of the WCF population, 69.1% of the CPIR population, and 82.8% of the NRS population. Clearly, on a cost-effective basis, any countermeasure aimed at high-risk target groups should be directed at male drivers.

Race. The utility of this variable in connection with countermeasures is questionable. However, in the WCF file, 35.6% of white drivers and 23.7% of non-white drivers had not been drinking, while 53.0% of white and 64.4% of non-white drivers were above .10 BAC. This tends to support reports in the literature that non-white drivers in accident populations tend to have been drinking more often and more heavily.

Socio-Economic Level. Blue-collar workers comprised 57% of the NRS sample, 27.1% of the CPIR file*, and 48.2% of the WCF file. This occupational class was found to be more frequently associated with driving after drinking, and with higher BACs, than

*This figure is probably low, due to the selection of newer-model-year vehicles for the case studies.

any other occupational class. Variables associated with occupational class, such as income level and education, also show this trend. These findings are in agreement with the literature studies that used this type of variable.

Driving Record. Two files, the ASAP and WCF, had reliable driving record data. The analysis of the ASAP data is included later under the DWI target group. The WCF driving histories did not show any unique associations. The accident rate (computed by excluding the fatal accident) was slightly higher for the fatal sample than for the general driving public, but about half the rate of the ASAP sample. High-alcohol fatals (.15+ BAC) had a higher violation rate than those with lower BACs.

Age. Younger drivers (less than 25 years old) have consistently been reported in the scientific literature and in the popular press to be over-represented in crash populations. The common base populations from which such over-representations are measured are general population data and numbers of driving licenses. Even though the latter is the better of the two measures, its adequacy as an adequate measure of the exposed population has been challenged. Nonetheless, a finding that some group is over-represented in a crash population relative to its numbers in the licensed driving population is useful in the present context for identifying target groups. Furthermore, the more nearly ideal exposure measures, such as miles driven or nighttime miles driven, are not available.

The data sets analyzed here demonstrated, as did the literature review, that younger drivers are over-involved in the frequency of nighttime driving and in the frequency of their accidents. Drivers under 25 years old comprised 42.2% of the NRS population and 39.6% of the CPIR crash population. Of the drivers under age 25 in the NRS file data, 18.3% of them had been drinking. In the WCF file data, 35.6% of the drivers were under age 26, and 67.3% of those drivers had been drinking.

These data can be compared with the percentages of young drivers in the U.S. and in Michigan.* Of all U.S. male licensees in 1972, 21.8% were under age 25. (Irrespective of sex, 22.1% of all U.S. licensees were under age 25 in 1972.) In Michigan, male drivers under age 26 comprised 25.8% of all male licensees in 1972.

While the accident files are not strictly comparable, the data indicate the over-involvement of the younger driver. The CPIR data are probably not indicative of the general trend observable in the literature because of the selection criteria employed by the accident investigation teams, most of which were focussing on accidents involving new- and recent-model vehicles. Younger drivers, even when drinking, however, tend to have a lower BAC than older drivers. In the WCF fatality sample, 77.2% of drivers 26-45 years old were above 0.10% BAC, while 52.7% of the drivers under age 25 reached or exceeded that level. As suggested by both the literature and these data analyses, both the younger and older driver contribute to the A/R crash problem.

*Mundy, A.R., Drivers Licenses - 1972, U.S. Department of Transportation, Federal Highway Administration, Washington, D.C., 20590, 1973.

Marital Status. Data on marital status and BAC from the CPIR and NRS files are shown in Table 1. Marital status data for U.S. males 18 and older are also given.*

In the census data, divorced and separated males together comprise approximately 4.5% of the population, while in the NRS sample they comprise 6.1% of the sober, nighttime, weekend drivers and almost 14% of the drunk drivers. Clearly, divorced/separated drivers are over-represented in the at-risk driving population and heavily over-represented in the drinking-driving population, with respect to their numbers in the general population. Even though the CPIR crash file must be approached with caution due to the selection biases, it is apparent that the divorced/separated drivers are also heavily over-involved in A/R crashes with respect to their number in the general population, with 15.3% of drunk, crash-involved drivers either divorced or separated.

A comparison of the WCF file with census data for the Detroit Standard Metropolitan Statistical Area (SMSA) produces similar results for the distribution of fatal-accident drivers by marital status. Separated/divorced males over 18 years comprise a slightly higher percentage of the population of the Detroit SMSA than of the national population - 5.3% compared to 4.5%. However, divorced/separated drivers also comprised a larger total percentage--9,9%--of the fatal population than either the

*U.S. Bureau of the Census, Census of Population: 1970, Vol. 1, Characteristics of the Population, Part 24, Michigan, U.S. Government Printing Office, Washington, D.C., 1973.

TABLE 1. MARITAL STATUS VS. DRINKING STATUS: NRS AND CPIR FILES

	U.S. Population (Males 18 and Older)	NRS			CPIR		
		BAC .10%+	Not Drinking	Total	BAC .10%+	Not Drinking	Total
Divorced/ Separated	4.5%	13.9%	6.1%	7.8%	15.3%	5.6%	6.8%
Other	95.5	86.1	93.9	92.2	84.7	94.4	93.2
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

roadside sample or the crash group. Among high-BAC drivers the divorced/separated group comprised 13% of the fatal-accident drivers, or nearly 2.5 times their number in the general population.

The consistent finding that divorced/separated males are over-involved among drunk drivers and in A/R crashes, both in the literature reviewed and in the file analyses, indicates that this group offers a well-defined target group for A/R crash intervention. The high percentage of drunk, at-risk, and crash-involved drivers who are divorced or separated indicates that this group is contributing disproportionately to the A/R crash problem.

Drinking Involvement vs. Injury Severity. It has been known for some time that alcohol involvement in crashes increases as severity increases. A byproduct of the CPIR file analysis is that this result has been established with greater certainty than heretofore.

Figure 1 displays this result in terms of AIS (Abbreviated Injury Severity scale for Overall Occupant Injury Severity) and the percent within each AIS group meeting two codes for driver use of alcohol. The code values and their meaning follow.

The striking thing about these data is the positive and monotonic increase of the total Drunk- or Had-Been-Drinking curve as a function of increasing AIS. (The exception is AIS 10, "Details Unknown" for which there are only 11 drivers.) The increase is seen to hold even for the four AIS codes 6-9 for increasingly severe fatal accidents.

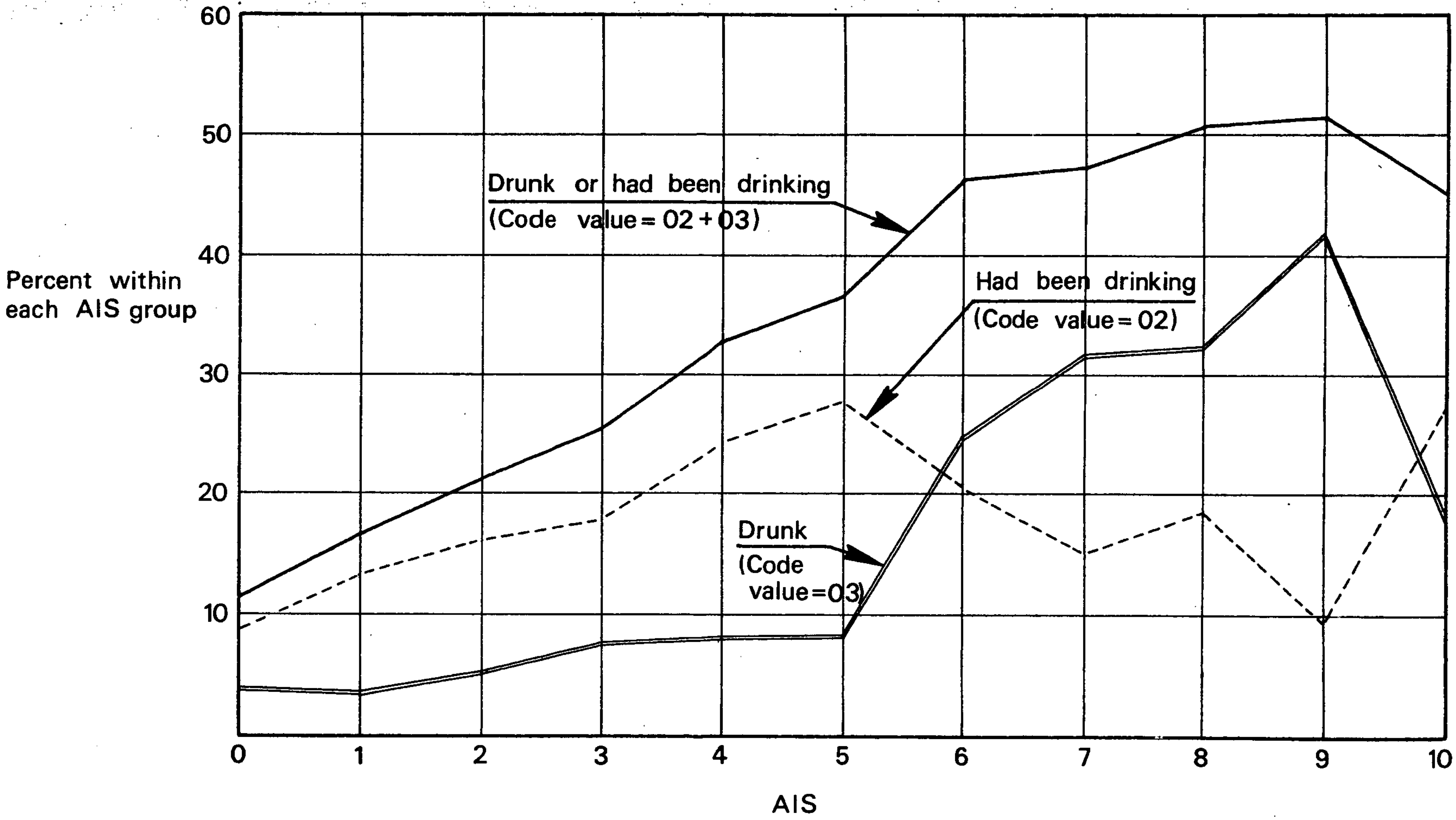


FIGURE 1. DRINKING INVOLVEMENT OF CPIR DRIVERS VS. INJURY SEVERITY

AIS	Meaning
00	None
01	Minor
02	Non-Dangerous, Moderate
03	Non-Dangerous, Severe
04	Dangerous, Serious
05	Dangerous, Critical
06	Fatal Lesions in 1 Region
07	Fatal Lesions in 1 Region + Serious Elsewhere
08	Fatal Lesions in 2 Regions
09	Fatal Lesions in 3 or More Regions
10	Fatal, Details Unknown
98	Injury Unknown
99	Injuried, Severity Unknown

Driver Use of Alcohol

1	Not drinking or missing data
2	Had Been Drinking
3	Drunk by Local Legal Standards (Either judgmental or by BAC $\geq$.10%)

AIS codes 0 and most AIS 1 injuries are equivalent to police agencies' property-damage-only crashes. There are 15.34% A/R drivers in these two categories. This is in reasonably good agreement with the 13.92% A/R drivers for the 1973 Michigan statewide property-damage experience. Similarly, 47.62% of the dead drivers were HBD or Drunk, again comparing favorably with the comparable 1973 Michigan figure of 49.10%. These findings suggest that the CPIR file, despite its known weaknesses, has no catastrophic biases with respect to alcohol involvement, and that A/R inferences are possible if made with due caution.

2.2.3 Target Group Identification

The by-variable findings from the computer files have confirmed the general findings reported by the literature. Our prime concern, however, is to identify groups, based on combinations of variables associated with an elevated A/R crash risk, with respect to the general driving population. Due to the differing sample populations in each computer file and the differing nature of the variables in the files, the target-group characteristics identifiable in each file are somewhat different.

CPIR File. The groups identifiable in the CPIR file are not exactly those we might desire on the basis of the literature review. However, some of the variables are the same. Following is a list of some candidate risk groups from the CPIR file, together with some measures of their over-involvement in alcohol-related crashes, injuries, and fatalities. Some important considerations to keep in mind are that this is a crash file, so these over-involvement rates are not the same as the incidence rates discussed subsequently. Further, the CPIR file has been filtered to become a driver file of males. Thus, the base group is already at an elevated risk relative to the general driving population. In the total file remaining, 1090/4186, or 26.0% of the crashes, were alcohol-related. Of the serious injuries, 491/1427, or 34.4%, were alcohol-related.

In the Table, P_1 stands for the proportion of alcohol-related crashes resulting in serious (AIS 2 or greater) injuries in that group. Thus P_1 equals the number of alcohol-related serious-injury crashes in the group, divided by the total number of serious injury crashes in the group. P_2 represents the proportion of alcohol crashes (all injury levels) to all crashes in the group. The columns headed by P_1 and P_2 thus represent a measure of over-involvement of alcohol in crashes for the particular group.

TABLE 2. OVER-INVOLVEMENT RATES FROM CPIR FILE

Potential Risk Group	P_1	P_2	Q_1	Q_2
1. Blue Collar with previous license suspension	.758	.655	.023	.013
2. Marital State other than Never Married or Currently Married	.530	.443	.058	.033
3. Blue Collar and Marital State other than Married or Single	.368	.485	.013	.008
4. Blue Collar with Previous Violation	.485	.349	.072	.057
5. Blue Collar with Previous Collision	.397	.311	.055	.044
6. Occupation other than White or Blue Collar	.313	.213	.157	.113
7. White Collar	.313	.240	.141	.110
8. Young (18-35) males in High Performance and/or Pony Cars and/or Speciality Cars	.439	.310	.150	.132
9. Blue Collar	.469	.324	.114	.089
10. Total CPIR Male Drivers	.344	.260	1.000	1.000

The columns headed by Q_1 and Q_2 are intended to indicate the contribution of the groups to the total crash problem. Q_1 is the proportion of serious injuries accounted for by that group, while Q_2 is the proportion of all crashes accounted for by that group. It should be noted that the groups are neither mutually exclusive nor exhaustive. Thus the proportions need not add to one; their sum may be either greater or less than one.

As the above table indicates, blue collar, divorced or separated, and previous violations or crashes all tend to subset groups with higher A/R crash experience than a general, male, crash population.

ASAP DATA. Driving history data from the ASAP client file are complete for 2,351 drivers arrested for either a drunk-driving violation or a Drunk and Disorderly violation. Of these drivers, 1,554 have no A/R crash on their record for the 6-1/2 years (including the program period) of driving records available, while 797 have an A/R crash on their record for this period. Thus the 6 1/2-year A/R-crash incidence is 33.9%.

The A/R-crash group has more multiple violators (13.7% with an A/R crash, 10.7% without), more blue-collar workers (76.5% with an A/R crash, 63.2% without), and more separated and divorced drivers (25.2% with an A/R crash, 23.4% without). This gives support to the use of these variables for prediction of A/R accident involvement for a DWI target group.

An interesting subgroup of the ASAP client population consists of those drivers who entered the program with a Drunk and Disorderly conviction. This conviction does not get recorded on the driving record. 1,601 drivers have an A/R traffic conviction, 866 have a D&D, and 116 have both on their records.

TABLE 3. A/R CRASHES DURING THE 6-1/2 YEAR DRIVING RECORD PERIOD

	INDIVIDUALS	CRASHES	CRASH RATE
D+D Violation Only	750 (31.9%)	353 (34.0%)	$\frac{353}{750} = .471$
A/R Violation Only	1485 (63.2%)	611 (58.9%)	$\frac{611}{1485} = .411$
Both	116 (4.9%)	73 (7.0%)	$\frac{73}{116} = .629$
Total	2351 (100.0%)	1037 (100.0%)	$\frac{1037}{2351} = .441$

Those individuals with only D+D convictions have a higher rate of A/R crashes than those with only A/R traffic convictions. Those with both D+D and A/R traffic convictions have a much higher rate than either those with only D+D or those with only A/R traffic convictions. These figures may be confounded by an occasional DUIL or D+D citation issued to a crash-involved driver, but the proportions are believed to be in error by less than 10%.

The most important point, however, is that D+D convictions do not appear on the driving record and do not involve a driving-related penalty. If the driving performance of the D+D group is similar to that of the A/R traffic group, a comparable level of intervention would seem to suggest itself, and the only means of identification of this group is the D+D conviction. Comparisons of the group with D+D convictions and the group with A/R traffic convictions show a larger percentage of blue collar and separated or divorced individuals among the D+D group.

The most interesting finding is that those individuals with D+D convictions seem to have a crash experience recorded on their driving records that is comparable to the crash experience of the individuals with an A/R traffic conviction. Since the D+D conviction is not recorded on the driving record and a driving-related penalty is not assessed, the only access to these people would seem to be through the D+D conviction on the criminal record.

<u>SUMMARY</u>. Support for the variables reported by the literature (social class, marital status, DWI conviction, previous accidents and violations, license suspensions, age, and sex) to be associated with crashes, and specifically alcohol-related crashes, was obtained. In addition, it was found that drivers with a Drunk and Disorderly conviction on their criminal record have an A/R-crash rate comparable to drivers with a DWI conviction on their driving record. It appears that for countermeasure inter-

vention, this group is potentially as important as the DWI drivers, especially when the Drunk and Disorderly conviction is the result of an accident or other driving violation.

2.3 MICHIGAN'S ALCOHOL-RELATED CRASH EXPERIENCE

Several factors pertaining to Michigan's recent alcohol-related crash experience have been examined as part of the planning effort. Michigan was selected not only because of convenience, but because it probably is as representative of the nation with respect to A/R crashes as any other single jurisdiction. Further, HSRI's experience has been that Michigan police agencies are attentive to possible alcohol involvement in crashes and that the state agencies satisfactorily record A/R crashes on accident reports and on official driving records.

2.3.1 Proportion and Costs of A/R Crashes by Accident Severity

Table 4 , compiled from Michigan State Police data for Michigan's 1973 crash experience,* shows the distribution of accidents by severity and drinking involvement; row and column percentages are also displayed. An "HBD" accident is one in which at least one crash-involved driver or pedestrian was noted by the investigating police officer to "Have Been Drinking"; neither accident responsibility nor drunkenness is necessarily implied. A "HNBD" accident is one in which the investigating police officer checked the "Had Not Been Drinking" block for all crash-involved drivers and pedestrians. "NKID"--Not Known If Drinking--results from missing data on both the HBD and HNBD blocks for all relevant drivers and pedestrians. Since "Hit and Run" and "NKID" crashes overlap considerably, it is a reasonable judgment that "HBD" crashes are under-reported

---

* Michigan Traffic Accident Facts: 1973, Department of State Police, Lansing, Michigan.

rather than over-reported.

Note the following: (1) 0.6% of all crashes are fatal crashes, but 1.6% of all HBD crashes are fatal crashes; (2) 31.4% of all crashes are personal-injury crashes, but 42.9% of all HBD crashes are personal-injury crashes; (3) as severity increases for the classes, the HBD percentage, excluding missing data on this variable, increases from 13.9 to 22.3 to 49.1; (4) 16.8% of all crashes, irrespective of severity and excluding missing data, are HBD crashes.

Table 4.

Distribution of Michigan's 1973 Crashes by Severity and Drinking Involvement

	HBD	NKID	HNBD	ALL
Fatal				
Frequency	789	342	818	1949
Row %	40.5	17.5	42.0	100
Column %	1.6	0.7	0.3	0.6
Row % excl. M.D.	49.1	---	50.9	---
Personal Injury				
Frequency	21,525	13,762	74,998	110,285
Row %	19.5	12.5	68.0	100
Column %	42.9	26.2	30.2	31.4
Row % excl. M.D.	22.3	---	77.7	---
Property Damage				
Frequency	27,868	38,493	172,269	238,630
Row %	11.7	16.1	72.2	100
Column %	55.5	73.2	69.4	68.0
Row % excl. M.D.	13.9	---	86.1	---
Total				
Frequency	50,182	52,597	248,085	350,864
Row %	14.3	15.0	70.7	100
Column %	100	100	100	100
Row % excl. M.D.	16.8	---	83.2	---

Similar data for Michigan 1972 experience reveal exactly the same pattern, with the significant percentages varying less than 3% from year to year.

The costs of Michigan's 1973 HBD crashes are shown in Table 5 for varying estimates of the average cost of fatal, injury, and property-damage crashes.* The striking fact to observe from this table is the percentage of HBD crash costs accounted for by fatal and injury crashes. Using NHTSA figures, 97.4% of HBD crash costs are incurred in fatal and injury crashes; the comparable figure for the National Safety Council dollar estimates is 89.8%; the RECAT committee estimates produce a 97.1% figure. Irrespective of which set of figures is used, it is clear that property-damage crashes, which make up 56% of the number of A/R crashes, account for only from 3% to 10% of the costs associated with A/R crashes. The balance of the study, therefore, should place considerably more emphasis on fatal and personal-injury crashes.

The argument above does not take into account judgments about the value of human life lost in fatal crashes nor the pain and suffering connected with personal-injury crashes. It is clear, however, that consideration of these non-economic issues would argue even more strongly for emphasis on the more severe crashes, so these issues will not be considered further.

---

* Cost data are taken from <u>Need to Improve Benefit-Cost Analyses in Setting Motor Vehicle Safety Standards</u>, B-164497(3), Report to the Committee on Commerce, U. S. Senate, by the Comptroller to the U. S., Washington, D. C. 20548, July, 1974.

TABLE 5. COSTS OF MICHIGAN'S 1973 A/R CRASHES BY ACCIDENT SEVERITY

	Crash Severity			
	Fatal	Injury	Property Damage	Total
Number A/R Crashes	789	21,525	27,868	50,182
% A/R Crashes	1.6	42.9	55.5	100
NHTSA				
$/Crash	200,700	7,300	300	---
Millions of Dollars	158.4	157.1	8.4	323.9
%	48.9	48.5	2.6	100
NSC				
$/Crash	52,000	3,100	440	---
Millions of Dollars	41.0	66.7	12.3	120.0
%	34.2	55.6	10.2	100
RECAT				
$/Crash	140,000	2,750	178	---
Millions of Dollars	110.5	59.2	5.0	174.7
%	63.2	33.9	2.9	100

2.3.2 Geographic Distribution of A/R Crashes and Related Data

The geographic distribution of A/R crashes in Michigan was investigated to determine whether regional differences exist which might have countermeasure implications.* Population data (1970)** and motor vehicle registration data (1972)*** were tabulated as well to determine whether particular types of accidents are grossly overrepresented in certain areas of the state.

A summary of the pertinent data is displayed in Table 6. The data have been grouped by three regions: the 15 counties of Michigan's Upper Peninsula; Wayne County (Detroit and environs) and its four surrounding counties (Macomb, Monroe, Oakland, and Washtenaw) in southeastern Michigan; and the rest of the state. The column percents have been tabulated for each of the variables in question.

The table reveals that the population, motor vehicle registration, and crash data are highly correlated. For example, the Upper Peninsula--rural and sparsely populated--

---

* Crash data consisted of a 15% random sample of 1972 Michigan crash data drawn from data supplied to HSRI by the Michigan Department of State Police.

** U.S. Bureau of the Census, Census of Population: 1970, Vol. 1, Characteristics of the Population, Part 24, Michigan, U.S. Government Printing Office, Washington, D. C., 1973.

*** Michigan Traffic Accident Facts: 1972, Department of State Police, Lansing, Michigan.

TABLE 6. MICHIGAN POPULATION, MOTOR VEHICLE REGISTRATION, AND CRASH DATA: PERCENT BY REGION

Region	1970 Population	1972 Motor Vehicle Registrations	15% Sample - 1972 Michigan Crashes							
			All Crashes				HBD Crashes			
			Fatal	Injury	Damage	Total	Fatal	Injury	Damage	Total
Upper Peninsula	3.43	3.41	4.35	3.00	3.67	3.47	3.48	4.13	5.10	4.67
Five Southeastern Counties	51.34	47.32	33.78	55.44	47.09	49.58	33.91	52.45	46.72	48.97
All Other	45.23	49.27	61.87	41.56	49.24	46.96	62.61	43.42	48.18	46.36

contained 3.43% of the 1970 population, had 3.41% of the motor vehicle registrations in 1972, had 3.47% of the total statewide 1972 crash experience, and had 4.67% of the HBD crash experience. Somewhat larger, although still small, differences are noted in comparing particular classes of accident severity percentages with the population and motor vehicle registration percentages. These differences might result from sampling variations or from police investigation and reporting practices, or they may reflect genuine differences in the phenomenon between the three regions. Irrespective of the source, however, it is important to note that the differences are small and that the similarities in distributions are pronounced.

The observations imply that countermeasures should be targeted on areas of high density population. This is particularly true if the cost of a countermeasure is primarily a function of the area covered and not of the number of persons exposed to it, such as mass media campaigns or increased police patrol activity. For person-oriented countermeasures, such as rehabilitation of problem drinking drivers, concentration on high population areas might also prove differentially worthwhile if the countermeasure cost per person can be reduced through administrative economies.

The lack of disproportionately high concentrations of A/R crashes in particular areas also places limitations on locally oriented countermeasures from a policy perspective. Even though such programs might have favorable benefit/cost ratios, or theoretically even be 100% effective in reducing A/R crashes among the target group, nonetheless they can be expected to reduce a jurisdiction's A/R crash problem by no more than the proration of the exposed population.

2.3.3 Incidence of A/R Crashes Among Michigan Drivers

The frequencies of prior alcohol use and associated BACs among crash-involved drivers are quite well known. However, characteristics of the general driving population experiencing A/R crashes, including its size, are much less studied. Incidence data of this type are important in this study for several reasons: to serve as a baseline against which the relative risk of high-risk groups can be measured; to assist in estimating the number of false predictions resulting when screening techniques are applied (see Section 2.5); and to assist in selecting sample sizes of subsequent study groups. Collection of additional incidence data is subsequently recommended as an integral part of Phase II.

Available incidence data have been collected to assist in Phase-II planning. These were taken directly or derived from a series of publications and informal reports generated by the Driver and Vehicle Administration of the Michigan Department of State.* Key findings follow regarding yearly incidence of A/R crashes.

(a) Of 5,436,121 studied male and female Drivers of Record, 0.906% had at least one "Accident-With Alcohol" during 1972. The "Accident-With Alcohol" is equivalent to a positive

---

*See, for example, Michigan Driver Statistics, Report No. 6, September 1973, Michigan Department of State, Lansing, Michigan.

response on the HBD (Had Been Drinking) variable.*

(b) Males had a 1.498% incidence of a least one A/R crash during 1972, compared to 0.213% for females, a 7:1 ratio. This fact obviously suggests that heavy if not exclusive emphasis should be placed on male study groups.

(c) The age-specific incidence of A/R crashes in 1971 peaked at 1.92% among both 22-and 23-year-old male drivers, and decreased, approximately linearly, to 0.15% among 61-year-old male drivers, increasing slightly thereafter. This clearly supports an emphasis on young male drivers.

(d) Male drivers aged 30 and under comprised 44.306% of the population of male drivers having one or more A/R crashes during 1971. This again suggests an emphasis on young, male drivers. Obviously, however, exclusive attention to the 30-and-under male drivers would have missed about 56% of the male drivers having A/R crashes during 1971. At face value, exclusive attention to the 30-and-under drivers does not seem warranted.

---

*Michigan's Official Traffic Accident Report Form, in use throughout the state, contains a Had Been Drinking (HBD), Had Not Been Drinking (HNBD) binary variable. Officers investigating crashes are charged with estimating crash-involved drivers' drinking conditions and recording their estimates, irrespective of whether a DWI citation is issued. Data derived from this variable provide the most reliable estimate of the incidence of A/R crashes currently available. The Michigan Department of State Police process all accident reports for the state and transmit selected data, including the HBD variable, to the Department of State for inclusion in the driving record of Michigan drivers.

(e) All 5-year age groups from 21-25 through 46-50 are overrepresented in A/R crashes with respect to the percentage of licensed drivers in their 5-year age group. The 21-25 group is highest at 1.461; that is, 20.208% of the A/R driver-involvements were produced by 13.834% of the studied drivers of record. This lends further support to identifying "young" and "male" as two of the stratification criteria.

Driver-involvement data for longer time periods are less detailed and subject to differing interpretations. The following table presents the percentage of males and females involved in one or more A/R crashes during the given time periods for about 100,000 sampled drivers having driving records during the 1966-1972 period.

Percentage A/R Driver Involvements Over Time

	Period Years	1972 1	1971-72 2	1970-72 3	1968-72 5	1966-72 7
Males		1.5%	2.5%	3.0%	3.1%	3.5%
Females		0.2%	0.4%	0.4%	0.5%	0.5%
Males: Yearly Mean		1.5%	1.2%	1.0%	0.6%	0.5%

The decreasing yearly average driver-involvement percentage (last line) is interesting, but it raises more questions than it resolves. Several explanations are possible:

1. Sampling procedures may have resulted in a larger population of 1972 drivers than for earlier years. So far as known, this is not the case.

2. Increased attention to A/R crash investigation and reporting from 1966 to 1972 may have resulted in increases of the reported phenomenon without a real increase in the phenomenon itself. This possibility cannot be ruled out.

3. The occurrence of an A/R crash in earlier years may have lowered the probability of a subsequent A/R crash for the same drivers below that of the general driving population. In other words, the probability of a second A/R crash among drivers having experienced one A/R crash may be less than that of the first A/R crash among drivers not yet having had one.

4. Since drivers in A/R crashes--not A/R crashes themselves--are being enumerated, it is possible that a significant number are recidivists. A driver with two or more A/R crashes would be counted only once during any given period, so that the longer time periods would exhibit artifactually lower percentages of average A/R driver involvements.

Items 3 and 4 are clearly important research issues with significant countermeasure implications, and their investigation is recommended during Phase II. Irrespective of their resolution, it is important to observe that the incidence of driver involvements in all A/R crashes, even among males and over extended periods of several years, is low.

2.4 INCIDENCE, PREDICTIVE CAPABILITY AND FALSE PREDICTIONS

Incidence, in the present context, is the proportion of drivers experiencing an A/R crash per unit time; it is a "given" and not subject to the control of the investigator. Predictive capability refers to the identification of potential A/R crashes in a group by applying a screening tool or diagnostic technique to the members of the group. False predictions are the inevitable result of imperfect predictive devices and are of two kinds: false positives, incorrectly predicting that an A/R crash will occur when it in fact will not, and false negatives, failing to predict that an A/R crash will occur when it will. These three concepts are central to this study and they are highly interrelated, both mathematically and in an operational, countermeasure sense.

The basic concept of this program is that groups and individuals within groups who have high risks of becoming involved in A/R crashes can be identified. If this is so, then specific countermeasures could be applied to identified high-risk individuals to lower their risk or prevent them from being involved in the A/R crashes.

The basic steps in achieving this goal are conceived of as:

1. Identify groups with high risk to A/R crash involvement.

2. Use a predictive model on each group to identify individuals with a high risk. This involves collecting additional data on all individuals in the target groups for input to the predictive model.

3. Develop appropriate countermeasures for the high-risk

individuals within each group. This will include trial applications and development of measures of effectiveness for evaluating each proposed countermeasure.

4. Determine the cost and the effectiveness of the proposed countermeasures.

5. If appropriate, apply the countermeasures to the selected individuals in the target groups.

Decisions must be made at several stages in such a program. In particular the ultimate decision of whether to institute the countermeasure program in a particular group is of paramount importance. The following model provides a method for a type of cost-benefit analysis to measure the utility of implementing a particular countermeasure. The implications of the model are also useful in determining feasibilities of target groups.

For clarity of notation and discussion, attention is restricted to one target group. In practice, each potential target group would be considered individually, so this results in no loss of generality. The various parameters, such as incidence, selectivity, efficacy, and total number of individuals will, of course, vary from group to group.

The following notation will be used:

I = incidence of A/R crashes in the target group per unit time,

M = number of drivers in the target group,

Y = predictive test indicates at least one A/R crash per unit time,

N = predictive test indicates no A/R crashes,

T = the subject in question will in fact have at least one A/R crash, and

F = the subject will in fact not have any A/R crashes.

Two parameters of the predictive test to be applied to the target group in question can be defined: the sensitivity and the selectivity.

The sensitivity of a predictive test is the probability that the test will correctly identify individuals who will have at least one A/R crash during some specified period. In symbols,

$$\text{Sensitivity} = P(Y|T),$$

or the probability that the test correctly predicts the A/R crash, given that the individual will in fact have an A/R crash. Similarly, the selectivity of a predictive test is the probability that the test will correctly identify those individuals who will not have any A/R crashes in the specified period. In symbols,

$$\text{Selectivity} = P\ (N|F),$$

or the probability that the test correctly predicts no A/R crashes, given that the individual will have no such crashes in the specified period. Sensitivity and selectivity are related. In general it is possible to improve either at the expense of the other. However, in order to improve both simultaneously, a new procedure must be found.

When a predictive test is applied to a group, it is important to be able to estimate the false positive rate. This is more clearly explained by the following table.

		Actual Occurrence (future)		
		T	F	
Test Result (now)	Y	a	b	a+b
	N	c	d	c+d
		a+c	b+d	M

A false positive is an individual who is predicted to have an A/R crash, but who in fact does not. The number of these indicated in the table is b. A false negative is an individual who is predicted to have no A/R crashes, but who in fact has one or more. The number of these indicated in the table is c. Then the false-positive rate is b/(a+b) and the false-negative rate is c/(c+d). In symbols, the probability of a false positive is

$$\text{False positive} = P(F|N),$$

or the probability that the individual does not have an A/R crash, given that the test was positive for that individual. The symbol for a false negative is

$$\text{False negative} = P(T|N),$$

or the probability that the individual does have an A/R crash given that his test result was negative.

The false-positive and false-negative rates can be calculated from the selectivity, sensitivity, and incidence in the target group according to the following formulas which follow from Baye's theorem.

$$P(F|Y) = \frac{P(Y|F) \cdot (1.0 - I)}{P(Y|F) \cdot (1.0 - I) + P(Y|T) \cdot I}$$

and

$$P(T|N) = \frac{P(N|T) \cdot I}{P(N|T) \cdot I + P(N|F) \cdot (1.0 - I)}$$

The false-positive rate is plotted as a function of the incidence in Figures 2, 3, and 4 for various values of the sensitivity (R_1) and the selectivity (R_2) of the predictive procedures to be developed. Both the false-positive rate and the false-negative rate are shown in Table 7 for selected values of the same parameters.

The figures and table reveal a number of important characteristics. First it should be noted that relatively optimistic values of the sensitivity and selectivity have been used, ranging for illustrative purposes from 0.5 to 0.995. For the higher values of these two parameters--say 0.9 and higher, equivalent to exceptionally good predictive devices--the false-positive rate is highly non-linear as a function of the incidence of A/R crashes among the group under investigation. As the incidence decreases and approaches zero, the false-positive rate approaches unity, even for sensitivity and selectivity values of 0.995. Intuitively this is clear because, if the incidence is zero--that is, there are no A/R crashes among some particular group--then any prediction of the occurrence of an A/R crash must be false, and the false-positive rate must be one.

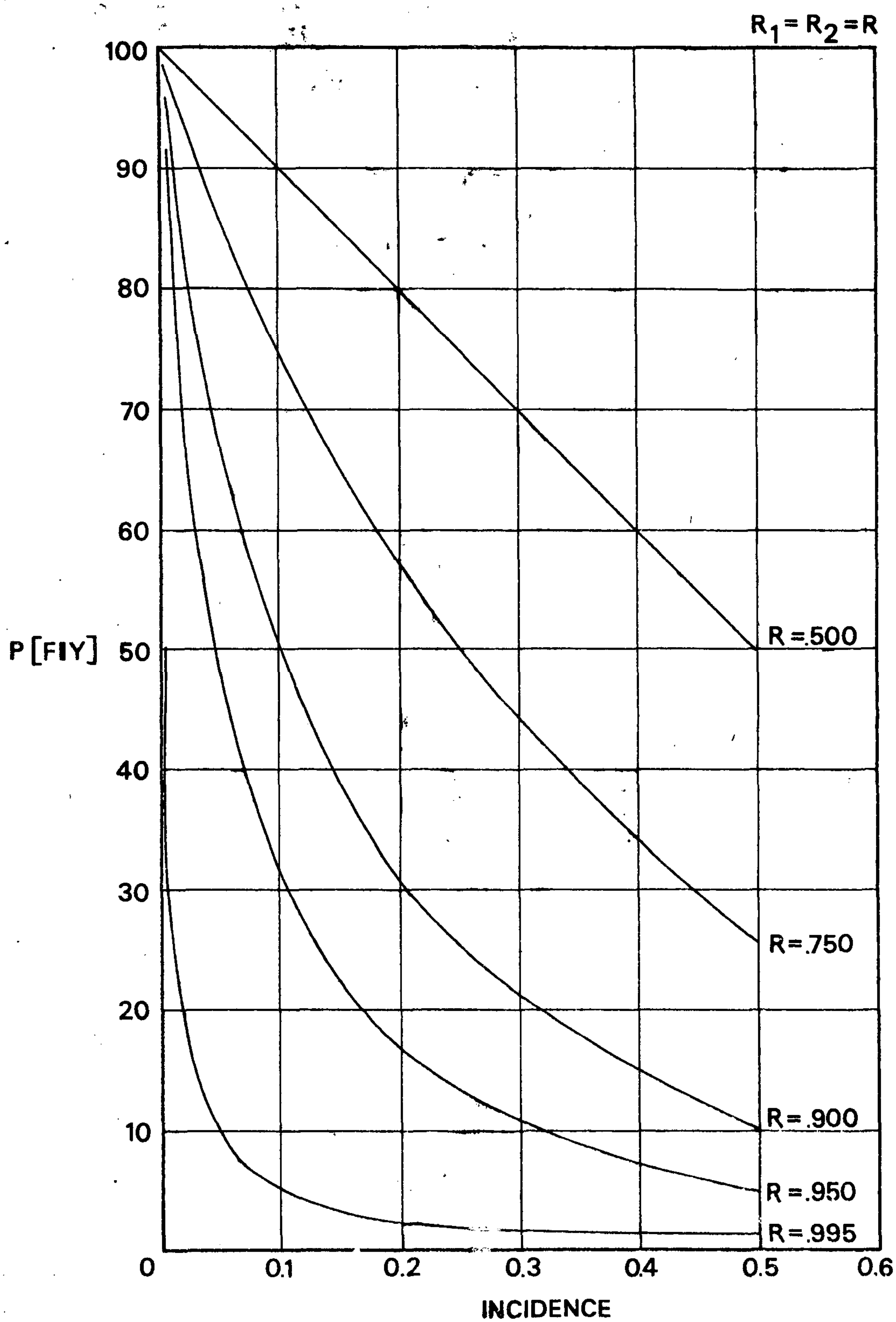


Figure 2. FALSE-POSITIVE RATE VS. INCIDENCE FOR EQUAL AND VARYING SENSITIVITY AND SELECTIVITY VALUES

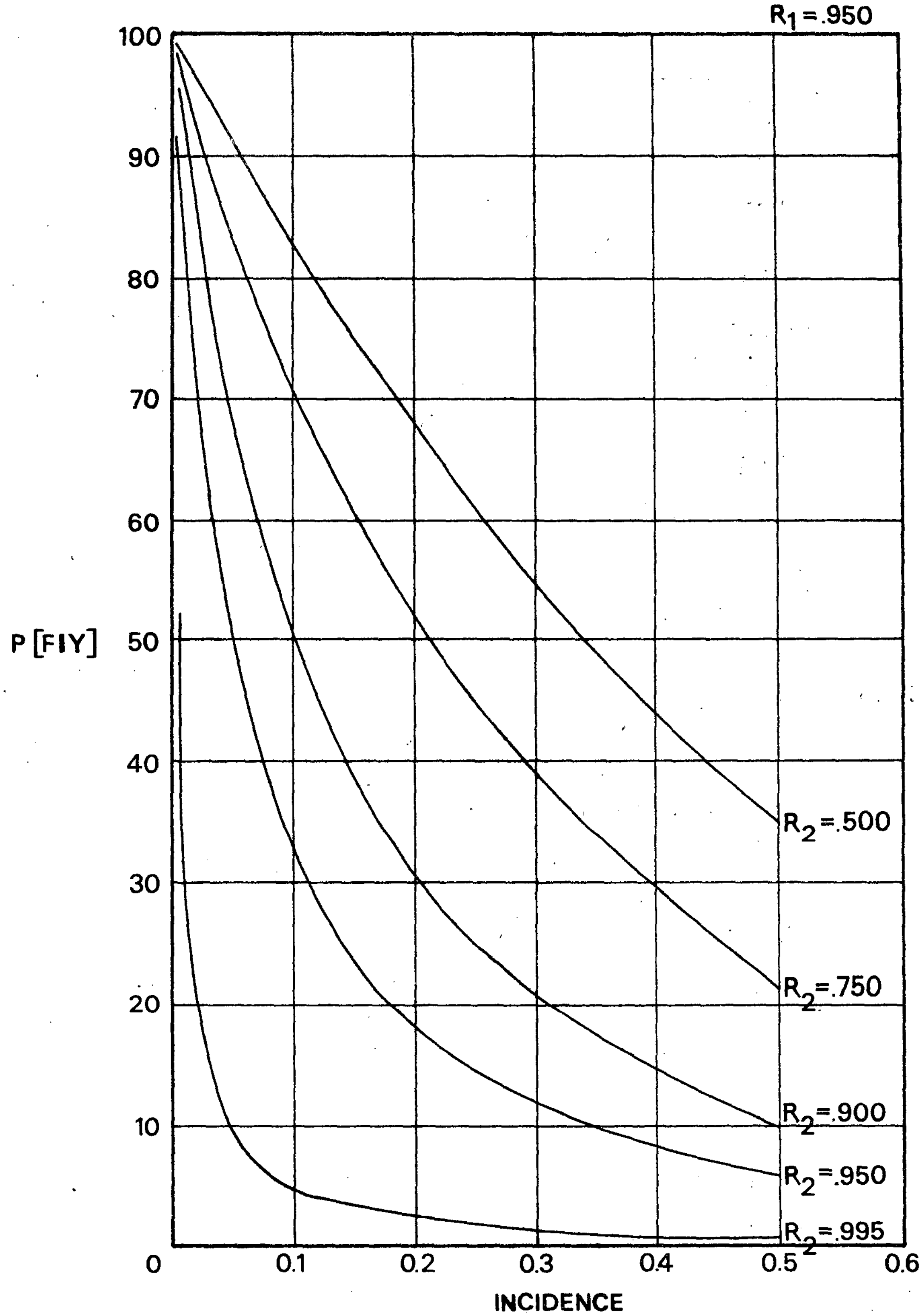


Figure 3. FALSE-POSITIVE RATE VS. INCIDENCE FOR SENSITIVITY = 0.95, VARYING SELECTIVITIES

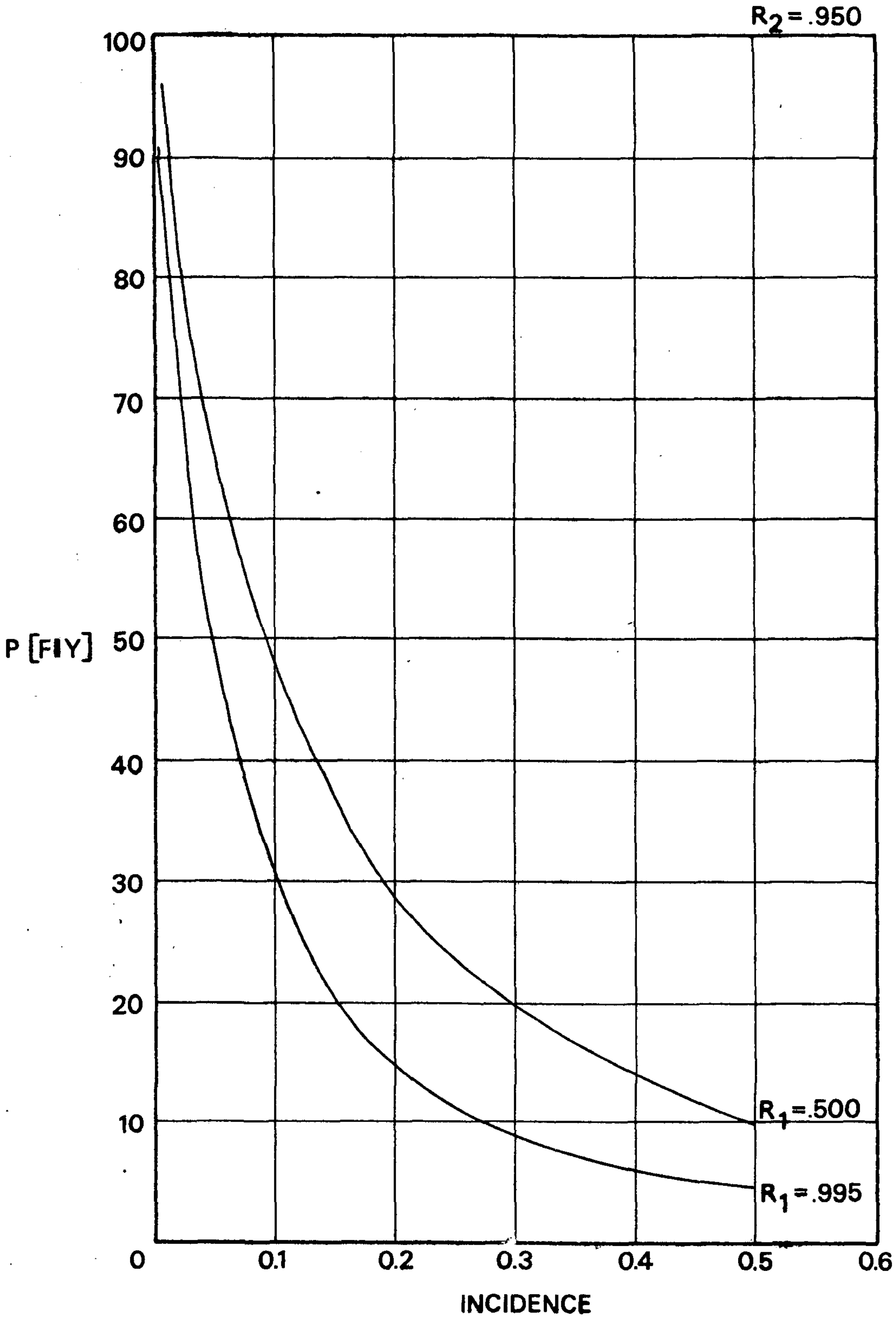


Figure 4. FALSE-POSITIVE RATE VS. INCIDENCE FOR SELECTIVITY = 0.95, VARYING SENSITIVITIES

TABLE 7. FALSE-PREDICTION RATES FOR SELECTED PARAMETRIC VALUES

Incidence	Sensitivity and Selectivity	False Positive Rate (%)	False Negative Rate (%)
.005	.995	50	.002
	.95	91	.03
	.9	96	.06
	.75	98	.2
.02	.995	20	.01
	.95	72	.1
	.9	84	.2
	.75	94	.7
.05	.995	9	.03
	.95	50	.3
	.9	68	.6
	.75	83	2
.1	.995	4	.06
	.95	32	.6
	.9	50	1
	.75	75	4
.25	.995	1	.2
	.95	14	2
	.9	25	4
	.75	50	10
.5	.995	.5	.5
	.95	5	5
	.9	10	10
	.75	25	25

2.5 FALSE PREDICTIONS: GENERAL IMPLICATIONS

False predictions are important in considering countermeasure programs from several perspectives. In a philosophic vein, it should be noted that false positives imply that some individuals who would not experience an A/R crash would presumably be subjected to a countermeasure program. Such a program, with few exceptions, typically involves at least some inconvenience or loss of time to the targeted drivers. Either of these would be perceived by some as infringement, however slight, of their civil liberties. This objection would seem to be particularly important when it is remembered that countermeasure intervention before the fact of an A/R crash is under consideration, with the target group almost certainly defined because of its statistical association with A/R crashes. Further, there can be no deterministic "proof" that an A/R crash will occur in the future even for true positives. (The occurrence of an A/R crash to a false positive is a contradiction in terms.) Further, Professor J. W. Little raised, over six years ago, a fundamental question about society's legal stance in precisely this situation:

> From a legal point of view the task of creating new countermeasures for an old problem, however difficult that may prove, is a less profound problem than that implied by an attempt to impose a legal restriction on a class of individuals defined solely in terms of some probability that, unrestricted, they may do some social harm in the future.*

---

* Little, J. W., "Control of the Drinking Driver: Science Challenges Legal Creativity," American Bar Association Journal, Vol. 54, June, 1968, p. 558.

The issue remains unresolved. From still a different perspective, the expenditure of countermeasure resources on false positives is at best wasteful, and at worst it can lead to a false sense of security that the A/R-crash problem is being "solved."

On the other hand, the effect of a false negative is to exclude from countermeasure attention a person who will have an A/R crash some time in the future, a crash that might have been preventable. Clearly this situation is to be avoided if possible.

The trade-off between the false-positive and false-negative rates depends on what seriousness is assigned to the crash event and on the stringency of the proposed countermeasure. The more serious the consequences of failing to apply a countermeasure to an individual and thus failing to prevent an accident, the smaller the false-negative rate should be. The more stringent the countermeasure (for example, revocation of driving privileges or vehicle registration) the lower the false-positive rate must be. The false-negative rate is closely related to the incidence of crashes. If the incidence of A/R crashes remains quite low in the target group, the more serious concern will be the false-positive rate. Table 7 shows that the false-negative rate remains below 5% unless the incidence of A/R crashes becomes greater than 10% in the target group. Currently we feel that the incidence of A/R crashes in the target groups will remain relatively low, and consequently the false-positive rate will be the more important. This need not be the case, however, and the consequences of a false negative would be viewed by some as more serious than the consequences of a false positive.

The quantitative implications of these facts for the problem at hand are also significant. From material presented earlier it will be recalled that the yearly incidence of at least one A/R crash among Michigan males is about 1.5%, and that the seven-year incidence among Michigan males is about 3.5%. Further, fatal and personal-injury A/R crashes--of prime concern because they account for over 90% of the costs associated with A/R crashes--comprise less than half the A/R crashes which occur. Therefore, the incidence of the crashes of concern among Michigan males is something less than 2%.

Table 7 shows that the false-positive rate for an incidence of 0.02 ranges from a minimum of 20% for prediction rates of 0.995 to 94% for prediction rates of 0.75. The first combination is not reasonable because the scientific community cannot realistically aspire to predictive techniques that are so close to perfection. The second situation is not much better, in that the false-positive rate of 94%--that is, 94 of 100 drivers predicted to have an A/R crash would not experience one--would create a most complex operational situation. It would indeed be difficult to postulate and implement countermeasures that would be cost-effective. The costs would be elevated simply because the 94% false positives would be indistinguishable from the 6% true positives, and they would have to be treated the same from a countermeasure perspective. One would also estimate that the benefits would be low, largely because the range of countermeasures to be applied to a group known beforehand to contain a large number of false positives would necessarily be restricted.

This somewhat gloomy outlook is modified extensively, however, if the initial incidence among the target groups is increased. For example, an incidence of 0.25 and a sensitivity of 0.9 produce a false-positive rate of 25%, the same as for an incidence of 0.5 and a sensitivity of 0.75. Such a false-positive rate might be acceptable for at least some countermeasures, such as mandatory driver-education courses or enforced attendance at didactic alcohol-education lectures; however, it would clearly be too high for more stringent countermeasures, such as revocation of driving privileges.

The final result of these considerations is that the initial incidence of A/R crashes among the target groups must be as high as possible, perhaps with risk factors of ten times that of the driving population at large. This, of course, is the fundamental thrust behind the whole study and is not a new concept. However, the preceding and following work provide a quantitative framework, heretofore lacking. This need for high and known incidence among the target groups is the primary reason why we believe that the initial thrust of the Phase-II activities must be strongly oriented to establishing, as accurately as possible and much more definitively than has been possible during Phase I, the risk factors of all candidate groups under consideration.

2.6 FALSE PREDICTIONS AND BENEFIT/COST CONSIDERATIONS

The implementation of any proposed countermeasure involves certain costs. Let C_o denote the overhead cost of formulating, implementing, and administering; let C_1 denote the cost per individual of applying the countermeasure; and let C_2 denote the cost of inconvenience to those individuals for whom the countermeasure was unnecessary. Then the total cost of implementing a countermeasure in a target group of size M is given by

$$CC = C_o + MC_1[P(Y|T)\ I + P(Y|F)(1.0 - I) +$$
$$+ MC_2P[Y|F](1.0 - I)\ .$$

If the cost per alcohol-related crash is assumed to be K, then the cost to society if no countermeasure were implemented would be

$$CD = K \cdot M \cdot I$$

that is, the product of the cost per crash times the expected number of crashes. The expected number of crashes is the number of drivers times the incidence (crashes per driver). The cost per crash, K, can be taken to be the cost per fatal crash, the cost per injury crash, the cost per property-damage crash, or some weighted combination of all of these. The different severities of crashes could also be assigned different costs, K_i, and the incidence, selectivities, and sensitivities could be determined separately for each type of crash. This would lead to a rather more complicated but tractable model. As discussed before, the major costs are incurred in injury and fatal accidents. Since there are relatively few fatal accidents, the most practical procedure is to choose a single K to represent these accidents.

If the proposed countermeasure were perfectly effective, the comparison of the two costs above would provide the rationale for implementing, not implementing, changing the countermeasure, or improving the predictive test. However, countermeasures are not perfect, and they can be expected to prevent only some portion of the alcohol-related crashes which would otherwise occur.

Let e denote the efficacy of a proposed countermeasure. By this we mean that if the particular countermeasure were applied to n individuals who would otherwise have an alcohol-related crash in the period, $e \cdot n$ accidents would be prevented by applying the countermeasure. If a proposed countermeasure has efficacy e, then if it is applied to those individuals in a target group of size M for whom the predictive test indicates "Y", the expected benefit will be

$$B = K \cdot M \cdot e \cdot P(Y|T) \cdot I$$

and this is the amount which must be balanced against the cost of the countermeasure, CC.

It should be emphasized that many of the parameters to make a useful benefit/cost comparison are presently unknown. The efficacy of any given countermeasure can at present only be guessed at. Estimation of the efficiacy would require a carefully controlled evaluation study. The costs of implementing various countermeasures are imperfectly known; restriction of the countermeasures to predicted individuals in target groups is one attempt to reduce the cost by limiting the number of individuals. Restriction of countermeasure efforts to areas of high population density might be a means of reducing C_o. The incidence in the target groups and the selectivity and sensitivity of predictive models have yet to be determined. Consequently the false-positive and false-negative rates are also unknown.

Certain generalizations can be made from the formulas. The larger the cost of an accident, K, the more attractive a countermeasure intervention is. Also, the larger K is, the more serious the false-negative cases area, since these cases are excluded from receiving the countermeasure by the application of the predictive model. The better the predictive model that can be developed, the better any type of countermeasure program would be, both in terms of preventing A/R crashes and in terms of avoiding application of an unnecessary countermeasure to a large group of persons. The larger the cost, C_2, of applying a countermeasure unnecessarily becomes, the smaller the false-positive rate must be. For any proposed countermeasure, K and C_2 can be balanced in conjunction with the predictive model to set the cutoff score for application of the countermeasure. Reduction of any of the costs, C_o, C_1, or C_2, will obviously improve the utility of a countermeasure. Finally, the more effective the countermeasure, the better it will appear in a benefit/cost analysis.

One of the difficulties in utilizing a predictive model for the selective application of a countermeasure program is that the predictions of the model apply properly to groups, not to individuals. If a target group can be identified which has a 25% incidence of A/R crashes per year, then this means that on the average, 25% of the individuals in that group would have an A/R crash in the subsequent year. Not all individuals in the group have the same 25% chance of experiencing an A/R crash, but it is not possible with the information at hand to distinguish which individuals in the group have relatively higher and which relatively lower chances. Consequently, they are all assumed to have an equal chance, and as a result, the particular 25% who will experience an A/R crash are regarded as a random quarter of the original group.

Further, no countermeasure program is perfect. The countermeasure can be expected to prevent only some fraction of the A/R crashes in the group. Thus a successful countermeasure might reduce the incidence in a predicted target group from 25% to 10% per year. However, the 10% of the group which would be expected to experience an A/R crash would still be regarded as a random 10% subset of the group. It cannot be claimed that the countermeasure prevented any particular A/R crash from occurring, only that it reduced the group incidence, and, as a result, the average individual risk for persons in that group.

Once a target group is identified, a predictive model would be used to select individuals from the group for the application of a countermeasure. The *group incidence and the selectivity and* sensitivity of the predictive model determine the rates of false positives and false negatives. The selectivity and sensitivity of the model can be adjusted somewhat. Either can be improved at the expense of the other, so the false-positive and false-negative rates can be balanced against each other.

It is instructive to consider an example. Suppose that a target group with an incidence of 25% A/R crashes per year has been identified. Suppose further that a countermeasure for this group has been developed which is 60% effective. That is, it would reduce the incidence from 25% to 10% per year if applied to the entire target group. This may not be desirable or feasible because of cost or legal considerations, however, and it may be desired to use the predictive model to identify individuals in the group and apply the countermeasure to a subset of these identified individuals. Suppose that one possible criterion for application of the countermeasure results is a sensitivity and a selectivity that are both estimated to be 75%. According to Table 7 this would result in a false-positive rate of 50% and a false-negative rate of 10%.

The countermeasure is applied to those individuals whose score generated by the predictive model is above a specified value. This is 75% of the "true positives" and 25% of the "true negatives", on the average. Thus the countermeasure will be applied to 3/8 of the original target group, this being the number expected to score positive on the prediction. Among those predicted as positive by the model, the incidence would be 50%, which is reduced to 20% by the application of the countermeasure. Among the rest of the initial target group, the incidence is 10% and remains at 10%, since no countermeasure is applied. Combining these results, it will be seen that the new, overall incidence of A/R crashes in the target group is 13.75%. This is to be compared to 25% if no countermeasure were introduced and 10% if the countermeasure were applied to the entire group instead of only 3/8 of it.

The advantage of using the predictive model as described was to avoid applying the countermeasure to 5/8 of the target group. The disadvantage was that the resulting incidence of A/R crashes was 13.75% instead of the 10% which could have been achieved by applying the countermeasure to the entire group. Whether the procedure was beneficial or not depends on the relative costs of applying the countermeasure unnecessarily and of failing to prevent A/R crashes. Of course, it may have been that the costs associated with applying the countermeasure to the entire group were prohibitive. In this case the effect of the predictive model was to enable the countermeasure to be applied at all.

Inspection of Table 7 indicates that the false-positive rates are much larger than the false-negative rates (if the sensitivity and selectivity of the model are taken equal) unless the incidence in the target group becomes quite high. It should be noted that with any model, the false positives can be completely eliminated by ignoring the results of the test and not applying the countermeasure at all. In this case, the false-negative rate is the incidence in the group. Similarly the false negatives may be eliminated by regarding all individuals as positive. The false-positive rate then becomes one minus the incidence. For stringent countermeasures, the false-positive rate may well be the more important. On the other hand, the example illustrates that the effect of false negatives could still be important.

The estimation of the incidence rates for the various target groups is of crucial importance. This is emphasized in the suggested approach to Phase II. The determination of the predictive model follows in importance. It is anticipated that this model will take the form of assigning a score to each individual. This score will be determined by some combination of the various predictive variables which will be measured on the individuals in the target groups. From this score a prediction criterion would be determined for prediction of risk and subsequent application of a countermeasure. For example, large scores might correspond with high risk, and the decision would then be to apply the countermeasure to all individuals in the target group whose score exceeded a selected value. The choice of this value would affect the sensitivity and the selectivity of the predictive process and would be made after consideration of the effects on the false-positive and false-negative rates in conjunction with the stringency of the countermeasure and the assigned seriousness of an A/R crash. After the predictive model has been developed, various efficacies for countermeasures may be postulated--or estimated for specific countermeasures. The administrative and other costs of a proposed countermeasure could be estimated and the preliminary benefit/cost analysis performed.

2.7 OVERVIEW AND SUMMARY OF PERTINENT FINDINGS

The role of alcohol as a contributing factor to crashes of all severities--particularly fatal crashes and to a lesser extent personal-injury and property-damage crashes--is well established. It is so pervasive that it would seem a straightforward task to identify a reasonably high proportion of the drivers who will become involved in A/R crashes and take before-the-fact, preventive action.

The data in the preceding sections suggest, however, that the task confronting the research and operational communities is not a simple one by any standard. A/R crashes and "crashees" are everywhere; geographically, they are distributed throughout Michigan in about the same proportion as the general population. Sex is by far the most distinguishing feature of A/R crashees; we are concerned primarily, but not quite exclusively, with male drivers. Age is also a distinguishing characteristic; we should be concerned with young drivers for a number of reasons, but certainly not to the exclusion of older drivers. Marital status is also a distinguishing feature; divorced and separated persons are significantly over-represented among A/R-crash populations with respect to their number in the general population, but they comprise a relatively small part of the A/R-crash problem. Blue-collar workers--clearly a large part of the general population--are somewhat over-represented among A/R crashees; their over-representation is not so preponderant, however, that they should be the exclusive target of future countermeasure efforts. Driving-record variables, such as prior DWIs, can help to identify A/R crashees, and their use is surely called for in the risk-prediction models to be developed subsequently. Like other variables under consideration, however, they are not adequate if used alone, and they should be coupled with other variables in multivariate predictive models. In summary, it is probably true that A/R crashees are more easily characterized by their heterogeneity than by their homogeneity, and that their similarities to the non-A/R-crash group are more pronounced than their differences.

The pervasiveness of alcohol as a primary contributing factor to crashes might also lead to the conclusion that a large percentage of drivers will experience an A/R crash in any given year. Based on Michigan's experience this is far from true. Only about 1% of Michigan drivers will have an A/R crash (of any severity) that is reported as such by an investigating police agency and subsequently recorded on their driving records. This already low incidence of drivers-of-interest is further cut in half because fatal and personal-injury crashes, whose costs comprise over 90% of the costs of all A/R crashes, comprise only about 45% of the number of A/R crashes.

These two summary facts together--the lack of highly distinguishing characteristics of A/R crashees and their low incidence among the driving population--pose a formidable identification problem. The first implies that risk-prediction techniques are likely to be considerably less accurate than desired. The second implies that, even with very good risk-prediction instruments on hand, the false-positive rate can easily approach 50% or so.

In moving from the research to the operational realm, a high false-positive rate suggests that cost-effective countermeasures directed to identified, high-risk drivers may not be easily formulated. The potentially large number of false positives, indistinguishable from the true positives, will require that more drivers be "treated" than necessary, and this will increase countermeasure costs. A known, high false-positive rate also suggests that a very limited range of countermeasure options will be open to policy makers and program planners to alter the undesired behavior leading to A/R crashes. It is reasonable to conclude, therefore, that low countermeasure effectiveness is likely to result. If these conjectures are realistic then benefit/cost ratios will be low.

This overview, while reconfirming the common-sense conclusion that panaceas to the problem at hand will not be forthcoming, in no way implies that the research and operational directions implicit in the study are unsound. An inability to solve the A/R-crash problem in one fell swoop simply does not establish that cost-effective approaches for dealing with a portion of it also do not exist. Distinguishing variables of A/R crashees do exist, even on a univariate basis, and it is likely that combinations of interactive variables also exist which even more sharply distinguish high-risk (to A/R crashes) drivers from others. Multivariate analytical procedures continue to become more powerful, and with them is the promise that risk-prediction models, operating on key distinguishing variables drawn from a variety of disciplines, can identify drivers with elevated risks to A/R crashes.

The costs of not solving the A/R-crash problem continue to be exceptionally high. Our judgment is that a carefully planned and executed program along the overall lines identified in the original RFP, seen not as a panacea but as a cost-effective approach to a part of it, continues to be a sound research investment Our approach to the next step in such a program is spelled out in the next section.

3.0 PHASE-I, TASK-II PLANNING RESULTS

The preceding section has reported the research findings and their interpretation which form the basis for our recommendations regarding the content and conduct of Phase II. The current section reports these recommendations directly in the form of a proposed Phase-II work statement and discussion of the work statement.

In the introductory section it was observed that HSRI was recommending a somewhat more modest set of Phase-II activities than those originally included by NHTSA in the RFP for guidance in the preparation of the Phase-I proposal. The basic thrust of our recommendations coincides with those contained in the RFP with respect to the gathering and analysis of driving record data for individuals among the high-risk groups. However, the risk factors of the candidate target groups should be established with much more confidence than is currently known, both in quantifying the risks and in establishing the quantitative estimates with acceptable statistical precision. Until this is done, therefore, we believe that it is unnecessary, and potentially inefficient, to plan for primary, detailed data collection on individual members of the high-risk groups.

3.1 PROPOSED STATEMENT OF WORK: PHASE II

3.1.1 Task I: Analysis of Random Sample of Michigan Drivers

a. Obtain, in cooperation with the Michigan Department of State, a one-percent (1%) random sample of Michigan driving records. Include for each sampled driver all data in the Department's Master Driving Record.

b. Build the sample of driving records into computerized data files consistent with the HSRI data analytic system.

c. Determine the 1-year, 3-year, 5-year, and 7-year incidence of alcohol-related events (alcohol-related crashes by injury severity, Driving Under the Influence of Liquor convictions, and Driving While Visibly Impaired convictions), among male and female drivers and by selected demographic variables.

3.1.2 Task II: Analysis of Driving Records of Drivers with Alcohol-Related Crashes

a. Obtain, in cooperation with the Michigan Department of State, a census (or a random sample of size 2,000, whichever is smaller) of driving records containing at least one alcohol-related crash on the Master Driving Record.

b. Build computerized data files and analyze the driving records, including but not limited to the following topics: recidivism rate among alcohol-related crashees; incidence of drivers having a second alcohol-related crash on their driving record; relationship between alcohol-related crashes and other variables contained in the driving record, such as age, sex, other crashes, alcohol-related convictions, and other convictions on the driving record.

3.1.3 Task III: Analysis of Driving Records of DWI Drivers

a. Repeat the procedures and analyses of Task II above for a sample of drivers convicted of DUIL or DWVI.

b. Correlate and compare the findings from Task II and this task, so that the relationships between persons with A/R crashes and those with A/R convictions is thoroughly understood.

3.1.4 Task IV: Analysis of Driving Records of Blue-Collar Workers

a. In cooperation with a large industrial firm in southeastern Michigan, obtain a random sample of at least 1,000 male, blue-collar workers and sufficient identifying data so that their driving records may be retrieved from the Michigan Department of State.

b. From the same firm, obtain either a census or a random sample of 1,000 male, blue-collar workers with high rates of absenteeism.

c. Obtain the driving records of the subjects in (a) and (b) above and determine the incidence of both alcohol-related crashes and alcohol-related convictions.

d. Compute risk factors for the groups in (a) and (b) above, relative to each other and to the random sample of Michigan drivers analyzed in Task I.

3.1.5 Task V: Analysis of Driving Records of Assigned-Risk Insureds

a. In connection with an insurance underwriting firm, and with the approval of the State of Michigan Insurance Commissioner, obtain a random sample of 1,000 drivers from the assigned-risk insurance pool of the State of Michigan.

b. Obtain the driving records of the subjects, determine the incidence of A/R crashes and convictions, and compute risk factors.

3.1.6 Task VI: Analysis of Marital Stress and Alcohol-Related Crashes

a. Identify Michigan residents filing for divorce in Wayne, Oakland, and Washtenaw Counties during a time period sufficient for the population of filees to approach 1,000 individuals (approximately 10 months). The Wayne County sample selection will be in cooperation with the Marital Health Study of the Program for Urban Health Research, The University of Michigan. Filee population sizes would be (approximately):

Wayne County	N = 400
Oakland County	N = 300 - 350
Washtenaw County	N = 200 - 250

b. Collect available descriptive information about each filee from available public records of the intent to divorce, and initiate preparation of subject files by county. The Wayne County data files will be prepared by the Marital Health Study.

c. Secure the driver record (with complete and current data) for each filee six to eight months subsequent to the dissolution of each marriage.

d. Merge Wayne County subjects' driver record data with survey data on each filee collected by the Marital Health Study.

e. Conduct correlational and multivariate analyses of crash, violation, and survey data for Wayne County filees.

f. Conduct time-series analyses of crash and violation histories vis-a-vis acute episodic stress during the divorce process, for Wayne County filees.

g. Formulate and test hypotheses relating the time periods most proximal to the dissolution of marriage to increased frequency of crashes, violations, alcohol-related crashes, and alcohol-related violations.

3.2 WORK STATEMENT DISCUSSION

The preceding work statement summarizes the research work we recommend be undertaken in Phase II. Tasks I-III are seen as a minimum research effort needed to answer some fundamental research questions regarding the incidence of A/R crashees among the general driving population and about the similarities and differences between A/R crashees and A/R convictees.

Tasks IV-VI deal with the collection and analysis of driving records of target groups believed to be at high risk to A/R crashes. To those given could be added a group of

Drunk & Disorderly convictees, shown in Section 2.2 to have a six-and-one-half year incidence to an A/R crash of about 0.441. On the assumption that the majority of the D & D convictees are males, the risk factor for this group can be estimated at 0.441/0.035 = 12.6. This is certainly an acceptably high risk factor for the group to warrant further attention, but it has not been included at the present time for two reasons. First, there is a need to limit the scope of work proposed to something that is manageable. Second, no new and innovative countermeasures have surfaced for dealing with a D & D population at high risk to an A/R crash. The two reasons together have led to the omission of this group at the present time, but it could, of course, be added subsequently.

All study groups would be drawn from within the State of Michigan. Michigan is not claimed to be a superior study site over several others that could be named, but neither does it lack the attributes needed. As noted earlier, the investigation, reporting, and file maintenance of crashes in general, and A/R crashes in particular, by the state and local police agencies is satisfactory. Furthermore, The Michigan Department of State receives pertinent crash data, including accident severity and alcohol involvement, on each crash processed by the Department of State Police, and transcribes the data onto the driving records of Michigan drivers. HSRI has for many years been able to retrieve driving records on magnetic tape on any number of drivers for subsequent re-formatting and analysis.

d. Merge Wayne County subjects' driver record data with survey data on each filee collected by the Marital Health Study.

e. Conduct correlational and multivariate analyses of crash, violation, and survey data for Wayne County filees.

f. Conduct time-series analyses of crash and violation histories vis-a-vis acute episodic stress during the divorce process, for Wayne County filees.

g. Formulate and test hypotheses relating the time periods most proximal to the dissolution of marriage to increased frequency of crashes, violations, alcohol-related crashes, and alcohol-related violations.

3.2 WORK STATEMENT DISCUSSION

The preceding work statement summarizes the research work we recommend be undertaken in Phase II. Tasks I-III are seen as a minimum research effort needed to answer some fundamental research questions regarding the incidence of A/R crashees among the general driving population and about the similarities and differences between A/R crashees and A/R convictees.

Tasks IV-VI deal with the collection and analysis of driving records of target groups believed to be at high risk to A/R crashes. To those given could be added a group of

Drunk & Disorderly convictees, shown in Section 2.2 to have a six-and-one-half year incidence to an A/R crash of about 0.441. On the assumption that the majority of the D & D convictees are males, the risk factor for this group can be estimated at 0.441/0.035 = 12.6. This is certainly an acceptably high risk factor for the group to warrant further attention, but it has not been included at the present time for two reasons. First, there is a need to limit the scope of work proposed to something that is manageable. Second, no new and innovative countermeasures have surfaced for dealing with a D & D population at high risk to an A/R crash. The two reasons together have led to the omission of this group at the present time, but it could, of course, be added subsequently.

All study groups would be drawn from within the State of Michigan. Michigan is not claimed to be a superior study site over several others that could be named, but neither does it lack the attributes needed. As noted earlier, the investigation, reporting, and file maintenance of crashes in general, and A/R crashes in particular, by the state and local police agencies is satisfactory. Furthermore, The Michigan Department of State receives pertinent crash data, including accident severity and alcohol involvement, on each crash processed by the Department of State Police, and transcribes the data onto the driving records of Michigan drivers. HSRI has for many years been able to retrieve driving records on magnetic tape on any number of drivers for subsequent re-formatting and analysis.

These capabilities on the parts of all agencies concerned are central to the proposed research.

The proposed period of performance is fourteen months, from January 1, 1975, to February 29, 1976. Cost data are being supplied under separate cover.

3.2.1 Task I: Analysis of Random Sample of Michigan Drivers

This task is of central concern in the proposed research program. The objective is to establish a baseline of data regarding the incidence of drivers-of-record in A/R crashes. As noted in Section 2, some data on this subject do exist, but they are far too sparse to serve the required purposes. In particular the long-term incidence--say, up to seven years--is not known acceptably. Without this information there is no common base population from which to compute relative risk to A/R crashes, and comparisons among high-risk groups are hampered.

HSRI is currently negotiating with the Michigan Department of State to obtain a one-percent (1%) random sample of Michigan drivers. These data are expected to be in hand during the first quarter of FY-75, and the proposed analytical work could commence during the second quarter. The base costs of obtaining the random sample and building the data into an HSRI analytic file will probably be absorbed by the Department of State, judging from past experience. The costs of building the data into HSRI analytic files would be shared, and the project-specific analyses would be supported under the proposed research program.

3.2.2 Task II: Analysis of A/R Crashees

The material presented in Sections 2.2 and 2.3 raises a number of questions about the probability of experiencing a second A/R crash, given the occurrence of the first one. Resolution of this issue is considered important because of the countermeasure implications.

If A/R crashees are repeaters, then this suggests a well-defined target group worthy of special countermeasure attention. The data in Section 2.2 showed that, for a sample of DWI and D & D arrestees, 797 drivers experienced 1,037 A/R crashes in six-and-one-half years. Unfortunately, the distribution of the crashes by driver is not known. Nonetheless, the data show either that 797 drivers had one A/R crash and 240 drivers had two A/R crashes or that 797 drivers had one A/R crash and something less than 240 drivers had two or more A/R crashes. If the first is true, then we can conclude that the six-and-one-half year incidence to a second A/R crash, given the occurrence of the first, is 240/797 = 0.301. If the second proposition is true, then the incidence of an even smaller group of drivers having a second A/R crash is even greater than 0.301. In either case, on the assumption that the samples from which the above inferences were drawn are representative and not pathologic, an important target group for A/R countermeasures would have been identified. The purpose of this task, then, is to explore fully the recidivism of A/R crashees.

Although it might seem reasonable to address this issue on the basis of the data obtained on the random sample of drivers in Task I above, such a procedure is not adequate. The incidence of A/R crashees having one A/R crash is so low--on the order of one percent (1%) per year--that the incidence of drivers having two or more A/R crashes is probably on the order of 0.01%. Even with an original sample of 55,000-60,000 drivers, we might find only five or six drivers per year with multiple A/R crashes on their records, clearly too small a number of drivers for in-depth analysis and statistical inferences.

Therefore we will attempt, in cooperation with the Department of State, to obtain a census of all Michigan drivers having at least one A/R event on their driving record. An A/R event is defined to include an A/R crash, an arrest and conviction for Driving Under the Influence of Liquor (DUIL), and an arrest and conviction for the lesser included offense of Driving While Visibly Impaired (DWVI). These data will be used both for the present task and for the next task. There is no question regarding the technical feasibility of this approach, and preliminary discussions with officials of the Department of State suggest that it is administratively feasible as well.

3.2.3 Task III: Analysis of Driving Records of DWI Drivers

The contract required the inclusion, as one of the study groups, of drivers arrested for DWI in an ASAP community.

Preliminary data for the Washtenaw ASAP DWI (including both DUIL and DWVI) drivers were given in Section 2.2. Those data show a six-and-one-half year incidence of A/R crashes of 0.411, equivalent to a risk factor of about 12.

This demonstrated high risk to A/R crashes of a group of DWI drivers in Washtenaw County strongly argues that they will continue to be of concern to the traffic safety community. We believe, however, that the analysis should be extended to cover other DWI drivers in Michigan so that findings are not regionally biased. Further, the analysis of the A/R crashees (Task II above) complements the analysis of the DWI drivers, both logically and procedurally, and it is recommended that both be undertaken concurrently in the same jurisdiction.

3.2.4 Task IV: Analysis of Driving Records of Blue-Collar Workers

The data throughout Section 2 consistently show that blue-collar workers are over-represented in A/R crashes among various populations of crash-involved drivers. The same data suggest, therefore, that blue-collar workers have elevated risks to A/R crashes with respect to the average driver.

The latter point cannot be established by sampling crash populations, however. It is necessary to sample the population of interest, blue-collar workers in this case, and determine the crash experience rather than to sample a population of crashees and determine the occupational status.

The purpose of this task is to begin a systematic evaluation of the risk factors of blue-collar workers generally, and of young, male, blue-collar workers with high rates of absenteeism specifically. "Young," "male," and "blue-collar" are all stratification criteria previously shown to be associated with A/R crashes on the age, sex, and occupational status variables. "With high rates of absenteeism" has been added as an additional stratification criterion because absenteeism is an indication of behavior problems and is one of the means by which early drinking problems are spotted in the labor force. Applying the four criteria simultaneously should define a target group with a high risk factor.

The purpose of this task is to confirm or refute that this group is at high risk to A/R crashes. In the meantime it is assumed that it is a high-risk group worthy of countermeasure attention. We have not been successful in Phase I in identifying any really new or innovative countermeasures to apply to the blue-collar group, or to any other high-risk group. Fortunately, however, there has been considerable success in recent years in dealing with problem drinkers through company-based rehabilitation programs, and possibly cost-effective countermeasures could be piggy-backed onto on-going rehabilitation programs.

HSRI has not yet obtained the necessary and extensive cooperation of a large industrial firm that will be needed to carry out the required analytic investigation. And of course we have not investigated the legal or ethical issues inherent in injecting traffic safety considerations into an employee-employer relationship from a research perspective, much less a countermeasure perspective. However, contacts had been established earlier with the Medical Director of a firm with adequate numbers of blue-collar workers, and we are prepared to follow up with the medical and personnel departments of this firm to determine whether the proposed research is feasible.

3.2.5 Analysis of Driving Records of Assigned-Risk Insureds

In addition to the groups discussed earlier, we are also recommending the systematic study of drivers in the assigned risk insurance plans operated under the authority of insurance commissions in the individual states. DOT, in its Automobile Insurance and Compensation Study, analyzed many aspects of the plans, including the driving performance of assigned-risk insureds, but the results do not lend themselves to specification of risk factors to A/R crashes. The results do, however, suggest that subsets of the group, if not the whole group, will subsequently be found to contain many high-risk drivers. The following excerpts from various publications from the parent study are offerred in support of this recommendation.

In 1967 there were 2.7 million vehicles insured through the assigned-risk mechanism, representing 2.8% of all registered vehicles and 3.3% of all insured vehicles. Males comprised over 70% of the insured in each of the several states that were studied. Driving under the influence of alcohol or drugs was found to be the third most common offense on the driving records of the insureds, and the Ohio plan had the largest proportion of DUILs among its applicants, 36.4%. Insureds generally were found, as well, to have poorer driving records as reflected by the number of other violations and recorded accidents. Claims were more numerous and costly for assigned-risk drivers than for others. Young drivers were more common, as were occupations from the lower part of the socio-economic scale. In short, the assigned-risk insureds matched the crash-involved populations of Section 2 on a number of variables that identify A/R crashees.

The assigned-risk insureds would seem to offer possibilities from a countermeasure perspective as well. The insurers claim that they lose money on the assigned-risk plan because of numerous and costly claims, and they should welcome any research and operational efforts to improve the driving performance of the insureds. The insureds, on the other hand pay insurance premium surcharges that can range up to several hundred dollars per year, and a countermeasure approach based primarily on economic factors might prove attractive.

The proposed research would probably require the approval of the State Insurance Commissioner, and it would certainly require extensive cooperation from an underwriting company that handles a significant percentage of Michigan's assigned-risk drivers. Neither of these has been obtained to date, and we cannot guarantee that the research is feasible. This issue would be resolved early in the research program if there is interest on the part of the Government.

3.2.6 Task VI: Analysis of Marital Stress and Alcohol-Related Crashes

Proposed herein is a quasi-experimental analysis of the effect of the process of divorce on alcohol-related crash involvements among adults filing for divorce in three Southeastern Michigan counties. HSRI is fortunate to have established a relationship with a currently active study of marital disruption and, therefore, the present proposal incorporates the anticipated survey data of that study in addition to official driver records from the Michigan Secretary of State.

Several investigations of stress, alcoholism, and crash involvement have identified marital problems as being a common denominator among drinking drivers involved in fatal or other serious traffic accidents. Among others, Evenson[1] isolated marital disharmony as being generally associated with problem drinking and alcoholism. Kephart [2] related drinking and marital disruption in a study of 1,434 divorces in Philadelphia between 1937 and 1950. He found that excessive drinking was alleged in more than twenty percent (20%) of the cases and was listed as a

---

[1] Evenson, R. C., et al. "Factors in the Description and Grouping of Alcoholics." American Journal of Psychiatry, 130:1, January, 1973. pp. 49-54.

[2] Kephart, W. M. "Drinking and Marital Disruption: a Research Note." Quarterly Journal of Studies on Alcohol, 15, March, 1954. pp. 63-73.

complaint more frequently than any other single factor except desertion and other legal grounds for divorce. The charge of excessive drinking was listed more times than cruelty, adultery bigamy, fraud, and sexual complaints combined.

Borkenstein[1] and Filkins[2] in separate investigations identified divorced and separated persons as being over-involved in alcohol-related traffic accidents. Brown[3] reported that in a population of fatal driver involvements the operators were subjected to multiple stresses and serious personal problems, and had often been drinking excessively at the time of the crash. Selzer and associates[4] have provided

---

[1]Borkenstein, et al. The Role of the Drinking Driver in Traffic Accidents, Department of Police Administration, Indiana University, Bloomington, February, 1964.

[2]Filkins, L. D., et al., Alcohol Abuse and Traffic Safety: A Study of Fatalities, DWI Offenders, Alcoholics, and Court-Related Treatment Approaches, Final Report, Contract FH-11-6555 and FH-11-7129, Highway Safety Research Institute, The University of Michigan, June, 1970.

[3]Brown, S. L., et al., Alcohol Safety Study "Drivers Who Die," Final Report, Baylor University College of Medicine, 1968.

[4]Selzer, M. L., Rogers, J. E. and Kern, S., "Fatal Accidents: The Role of Psychopathology, Social Stress and Acute Disturbance," American Journal of Psychiatry, Vol. 124, No. 8, February, 1968, pp. 46-54.

Brenner, B. and Selzer, M. L., "Risk of Causing a Fatal Accident Associated with Alcoholism, Psychopathology, and Stress: Further Analysis of Previous Data," Behavioral Science, Vol. 14, No. 6, November, 1969, pp. 490-495.

Selzer, M. L. and Vinokur, A., "Life Events, Subjective Stress, and Traffic Accidents," America Journal of Psychiatry, Vol. 131, No. 8, August, 1974, pp. 903-906.

Selzer, M. L. and Vinokur, A., Detecting the High Risk Driver: The Development of a Risk Questionnaire, Final Report, Report No. DOT-HS-801-099, Highway Safety Research Institute, The University of Michigan, Ann Arbor, January, 1974.

documentation regarding the interrelationships of stress, problems with alcohol, and problems with driving. Waller and Flowers[1] stated that individuals who were single, divorced, or separated had higher traffic offense rates during license suspension than did those who were married or widowed.

In one of the few studies specifically dealing with the effects of divorce on driving performance, McMurray[2] related the emotional stress of the divorce process to impaired driving performance, higher violation rates, and higher accident rates for both men and women during the year of their divorce proceedings. This study demonstrated the effect on driving behavior of the act of filing for divorce, as a stressful event. The McMurray study took place in Washington State and incorporated into the analysis data covering seven years prior to and the year of the divorce proceedings for 410 persons filing for divorce.

HSRI proposes to replicate the design and intent of the McMurray study in three counties in Southeastern Michigan: Wayne, Washtenaw, and Oakland Counties. Selection of these counties was based on previous HSRI experience and research in

---

[1] Waller, J. A. and Flowers, L. Previous Police Contacts, and Recidivism among Drivers with Arrests for Driving while Under the Influence of Alcohol in Vermont--Baseline Data. CRASH Report V-1, August, 1972, Waterbury, Vermont.

[2] McMurray, L. "Emotional Stress and Driving Performance: The Effect of Divorce." Behavioral Research in Highway Safety, 1, Summer, 1970. pp. 100-114.

these populations and the availability of a major concurrent investigation of persons filing for divorce in Wayne County. The Program for Urban Health Research, also at The University of Michigan, is conducting a study of marital health in Wayne County.

The Marital Health Study investigates the impact of marital separation and divorce on physical and mental health. The sample consists of over 400 men and women in the Detroit area who have contacted the Wayne County Circuit Court Marriage Counseling Service, either as a result of filing for divorce or because of serious marital problems. The subjects are interviewed at the initial contact with the Marriage Counseling Service and four months later. The sample is restricted to people who have at least one child under the age of eighteen. About one half of the interviews are with husband and wife of the same couple. The sample is about forty percent (40%) black and sixty percent (60%) white and represents all economic strata.

The major focus of this study is on the mediating effects of coping on the relationship between marital stress and health. The health outcomes include blood pressure, major health problems, drinking and drug-taking patterns, health habits and more common symptoms of illness, as well as measures of mental health and of mood such as depression, anxiety, and general psychological well-being. Coping is operationalized in a number of ways: handling anger and guilt; involvement in a network of supportive social relationships; setting and reaching realistic goals in relationships with people of the opposite sex, with one's children, and in terms of work and career. Data are also collected on driving habits and exposure; experiences with other recent stressful events; the use and effectiveness of professional services from counselors, lawyers, clergy, etc.; socio-locus of control and a variety of attitudinal measures.

The particular strong points of the Marital Health Study are its focus on respondents in the midst of a stressful life change rather than ex post facto analysis of such an event, its relatively large and socioeconomically diverse sample, the panel design, and the multidisciplinary approach in collecting a variety of types of data.

In cooperation with the Marital Health Study, HSRI proposes to secure the driver records for respondents among the Wayne County respondents and perform analyses of traffic offenses and accidents concurrent with the divorce-related stressful period. Primary attention will be given to alcohol-related incidents noted on the driver records.

To expand the data base for broader inferences and more reliability, HSRI proposes to identify persons filing for divorce in Washtenaw and Oakland Counties (also in Southeastern Michigan) and to secure the driver records of these persons from the Michigan Secretary of State. Analyses of the effect of the divorce process in terms of accident and violation occurrences will be identical for all three populations of divorce filees.

Inferences that appear to be stable from the analyses of the Wayne County survey responses and driving records will be made to the Oakland and Washtenaw County populations.

A final total of approximately 1,000 driver records will be secured from the Secretary of State and subjected to a variety of statistical analyses. To identify the differences between divorce-filee driving performances and other drivers, comparisons will be made against identical analyses of a one percent (1%) random sample of Michigan drivers (proposed elsewhere in this report).

There are a variety of potential implications of the proposed study of the effect of divorce on alcohol-related crash involvement. The act of filing for divorce is a public one and, therefore, provides an unobstrusive means of identifying a target group for alcohol-highway safety countermeasures, should the proposed investigation support a need for such action. Because filees for divorce are often participating in counseling services, the introduction of traffic-safety content in that counseling would provide the opportunity to create an unanticipated cognitive awareness of elevated risk in the divorcing individual. Divorce counseling services are established and operational, and an alcohol-countermeasure activity can easily be added to those services.

APPENDIX A

LITERATURE REVIEW

A1. INTRODUCTION

The concept of target groups in highway safety is a basic element in analyses of the epidemiology of accidents, including traffic accidents. One underlying assumption in the search for target groups to which countermeasures might be applied is that there is a causal chain of events leading to a crash. In other words, accidents are not assumed to simply "happen," but are caused by the intentional or unintentional behaviors of people. If this assumption were incorrect, then there would be no operational target groups, because accidents would be entirely random, unpredictable phenomena. We believe that alcohol-related crashes, as a specific subset of all traffic incidents, are predictable on the basis of interactive and complex combinations of factors. Our review of the literature has demonstrated few unanticipated findings, but has strengthened our conviction that the eventual predictability of alcohol-related accidents on the road will be a function of research brought up to date by future investigations of the precrash behavioral determinants of crash causation.

In 1961 McFarland and Moore (1) summarized an epidemiology of accidents. The basic concepts detailed by these authors related the field of medical epidemiology to traffic safety and concluded with a "host" orientation that has since been termed social or behavioral epidemiology. Dealing with traffic accidents, McFarland and Moore surveyed the range of theories of accident causation. Three basic levels of causal explanation emerged: (1) Unusual Individual Susceptibility, (2) Personal and Social Maladjustments, (3) Temporary Factors Influencing Driving Performance. The first explanation is best exemplified by the various theories of "accident proneness," a concept that McFarland and Moore challenged on the basis of inconsistent and unconvincing research. The second concept was treated as having significantly more value than the psychiatric "proneness" theories. Several objective studies were cited as having demonstrated that persons who have been involved with one social agency (the police, a venereal disease clinic, a juvenile court, etc.), or involved in an alcohol-related highway accident, are quite likely to have been involved with another social agency. Thus, it seems that a small proportion of the human population repeatedly appears in the social statistics on which these studies are based. There is seductive appeal to the idea that a designated target group for one social problem is also a suitable target for one or more other problem-oriented countermeasures. The validity of the data, however, must be carefully assessed, in that social statistics relating to welfare, disease, accidents, and driving violations are subject to known and predictable biases. In short, the concept of a problem-producing minority in the population could be a self-fulfilling prophecy generated by interwoven and consistently biased data. There are certain findings in this area that, on the basis of tested external validity and generalizability, can be taken as social facts. These findings, which have been reviewed in depth, include the factors of youth, socioeconomic status, and driving-exposure time. These factors, however, are quite inadequate in terms of specificity vis a vis target-group identification.

The third area that has received theoretical and practical attention is the area of temporary factors influencing performance. This includes such topics as fatigue, physical defects, illnesses, drugs and medications, and temporary emotional states. That last factor is seen to interact with drinking and lead to temporary impairment and decrements in driving performance. McFarland and Moore (1) state:

> Some accidents on the highway have been traced to preoccupation with anxieties, or to carrying over emotional states into the manner of driving; but the usual investigation of accidents does not include evaluation of such factors... It is well known that when people are emotionally upset or preoccupied some disorganization of behavior is likely to occur. Under such circumstances, one may misinterpret the meaning of a situation or ignore important stimuli and make inappropriate responses. (p. 30)

That quotation raises two important points. First, it is suspected (though often from less than satisfactory evidence) that under conditions of anxiety and stress, some persons are more likely to undertake episodic drinking, and consequently exhibit drinking and driving patterns, that are hypothesized to increase their likelihood of being crash-involved. Secondly, although this quotation was taken from a 1961 source, it remains true that accident investigations rarely attend to temporary emotional or behavioral factors of the involved driver (or dwell on other variables of potential importance). Consequently, the role of such factors, in combination with other factors, in causation of alcohol-related crashes remains unclear.

The following literature review is not intended to document the state of the art completely, but to exemplify the bases on which key decisions in the present study were made. The reviewed literature is presented according to the focus of research interest and the type and scope of the published information being described. For each variable category a methodological overview precedes a review of the critical studies and a summary of findings, facts, and issues raised by the research. The literature review concludes with a summary and a statement of the implications of the literature regarding our current ability to identify target groups in the driving population.

Before proceeding to the literature review proper, it is important to define the limits and purposes of the review. This review is not a comprehensive "state of the art" statement on the drinking driver, nor is it intended to cover the variety and magnitude of the available literature in definite detail. On the other hand, this literature review is intended to provide sufficient, representative, multidisciplinary evidence to explain the directions taken in the developmental and empirical components of the study. Others (2,3) have provided comprehensive, general literature reviews. It was not the purpose of the present review to duplicate those efforts. This literature review was based on the need to determine the feasibility of identifying suitable target groups for alcohol-highway safety countermeasures. To the extent possible, the literature surveyed was limited to post-1969 publications and often to much more recent material. The literature review was oriented toward specific independent variables that have been researched to a degree sufficient for confidence and generalizability. Such variables include biographical, demographic, socio-economic, and certain situational measures. Whenever possible, existing literature reviews were searched to provide more efficient coverage of the field. This was always supported by examinations of primary sources to offset any potential biases introduced in secondary sources.

This literature review had a specific purpose based on the requirements of theoretically and practically valid countermeasures for target groups in the epidemiologic tradition. McGuire (4) identified such requirements as well as anyone. His criteria follow:

> Target groups should be based on an individual variable or a combination of predictor variables that meet the following criteria:
>
> (1) It must be easy to obtain.
>
> (2) It must be highly reliable (for example, sex and age are very reliable, while a psychological test score may vary widely).
>
> (3) It must be a 'true' predictor--that is, capable of being gathered before the fact. Mileage, for example, is by definition an after-the-fact predictor.* Pre-

*While true mileage is post-facto, estimated mileage is an appropriate "before-the-fact predictor."

ferably, this variable must be capable of being gathered retroactively and still retain its 'true' predictor label. For example, age and sex would qualify, since they may be accurately measured retroactively.

(4) It must not be parochial--that is, peculiar to one region of the country, or peculiar to only a small subgroup of drivers.

(5) It must not be controversial, politically sensitive, or objected to by subjects on grounds of being too personal, an invasion of privacy, etc. (pp. 104-105)

Thus, the present literature review sought to determine whether the current level of knowledge about the accident-involved drinking driver was adequate to justify the definition of target groups based on predictor(s) meeting the above criteria.

A2. AGE AND YOUTH

The analysis of age and youth as predictors of alcohol-related crashes represents one of the most universal of all variable categories in the field. This is, of course, true of most social and epidemiological research. Joscelyn and co-workers (2) concluded in their review of the literature that, with conflicting findings of studies of fatalities, roadside surveys, interview and driving records, convictions and arrests, the basic and solitary conclusion was that problem-drinking drivers were under the age of 45. These authors, however, did not review numerous publications available to them at the time of their review, nor did they have available to them the findings of a large volume of literature that has since been generated.

The current research findings reviewed showed fairly clearly that young drivers are significantly more often involved than older drivers in crashes, fatal and injury-producing crashes, and alcohol-related crashes. Specifically, drivers under age 30 (particularly between 15 and 24) are more often crash-involved than other age groups.

Some efforts have been made to explain away this over-involvement of young drivers on the basis of exposure (5). However, the possibility of explaining away a causal relationship with one source of crash causation over another does not "explain away" the problem. Taken as a group, young drivers have been substantially shown to be of singular importance as a subset of the total driving population with unusually high probabilities of alcohol-related crash involvement.

A study of fatal case histories in Wayne County, Michigan, by Filkins, et al. (6) showed that 16- to 25-year-old drivers had a higher proportion of driver fatalities than their proportion of the total driver population. Goldstein (7) summarized the evidence supporting the thesis that youthful drivers are a special highway safety concern, although his review did not address the role of drinking. Harrington (8), in a longitudinal study of young California drivers, determined that the high rates of accident involvement decreased somewhat during the first four years of driving experience. However, even after four years of experience, the rates of accident involvement were higher than for adults.

On the premise that young drivers are an important research topic, Pelz, Schuman, and co-workers (9-13) conducted a series of studies. Those investigations, while not centrally focused on the interaction of drinking and driving, indicate that there might be certain characteristics of being young that discriminate between young and old drivers in terms of accident liabilities. The Pelz and Schuman studies determined that young drivers, especially males, drive more for emotional or recreational purposes and have higher rates of exposure than older drivers.

Since the advent of the Alcohol Safety Action Programs, the early roadside survey research findings (14) have been generalized to numerous other populations and places. From these studies it is consistently found that young drivers, and young males in particular, are most likely to be driving with elevated blood alcohol concentrations (15-18).

Douglass (19), O'Day (20, 21), and Carlson (16), in independent analyses of state accident data covering seven states for the time period from 1965 to 1973, have consistently indicated that reported alcohol-involved crashes, single-vehicle driver involvements with a male driver, and alcohol-related fatal crashes all exhibit maximum age-specific frequencies within the 18- to 24-year-old age range. Studies of the problem in Ontario and other jurisdictions in the United States corroborate the Michigan findings (22, 23).

The literature on drinking patterns and practices indicates that with few exceptions young people begin to drink at approximately the same time that they learn to drive (24, 25). Several investigations have contended that a maturation process involving the "learning to drink" and "learning to drive" behaviors is a factor responsible for creating the over-involvement of young drivers in alcohol-related crashes (20, 26). Douglass, et al. (27) found that in seven states--Michigan, New York, Vermont, Maine, Louisiana, Texas, and Pennsylvania--maximum age-specific alcohol-related crash involvement for the 1968 to 1973 period was consistently predicted by the minimum legal drinking age or legal beverage alcohol availability (socio-cultural or geographic). When the legal drinking age was lowered, the maximum age-specific alcohol-related crash involvement changed accordingly.

Rosenberg, et al. (28) in a study of alcohol, age, and fatal traffic accidents, stated that blood alcohol concentrations were found to be higher among drivers under age 30 and also in one-car rather than two-car accidents, in nighttime rather than day-time accidents, and in weekend rather than weekday accidents. Peak occurrence of single-car crashes was found at a younger age than the peak blood alcohol concentration, suggesting to the authors that age interacts with drinking in accident causation (29).

These and many other investigations (30-34) have determined that age is of critical concern in the prediction of target groups for alcohol-highway safety countermeasures. Age, however, is far too imprecise a parameter for purposes of prediction.

The extent to which the predictability of alcohol-related crashes is now an operational practicality will be revealed in the following reviews of other variables.

A3. SEX

As Joscelyn, et al. (2) correctly noted in their review of the literature:

> No other variable's importance in the characterization of the problem drinking driver has been as conclusively demonstrated as has that of the sex of the individual. The populations in every study are predominately male, and the incidence rate of problem drinking drivers among males is greater than among females. (p 12)

McGuire (4) in an analysis of accident-producing behavior stated:

> Two variables in particular stood out--age and sex. So important was this relationship found to be, that we no longer gather and analyze accident-related data without separating according to sex and age whenever possible. So far, we have discovered (or rediscovered) that there are few or no psychological variables in the real world which do not differ among age and sex groups. Accident rates are different, violation rates are different, mileage, night driving, rural driving, and many of the correlates thereof are different. In fact, strange as it may seem, I have come to the conclusion that sex differences are one of the most neglected areas of research in all of the behavioral sciences. (p. 105)

These conclusions and insights are valid for alcohol-related crashes, arrests, and convictions. Most of the documentation supporting the importance of age as a predictor also support the role of sex. Although generalizations into the future must be made with adequate consideration for social changes, the male drinking driver appears to define the primary population at risk of an alcohol-related crash. In combination with the age variable, the prediction of one target group can now be somewhat defined as young males--a definition still far too general for an operational target group.

A4. OTHER DEMOGRAPHIC VARIABLES

Of all the variables associated with alcohol and driving, demographic variables (age, sex, marital status, race) are the most routinely collected, the most consistently reported on accident forms, driving records, license applications, work records, etc., and the most reliable to use to define subgroups of the general population. We have discussed age and sex in relation to the alcohol crash population. In this section we will discuss marital status and race, and their association with alcohol-related crash populations.

Demographic variables are generally used in two ways in the study of accident occurrence in populations:

(1) The demographic variables are used as definers of the population to be studied, such as young drivers (see previous section) or divorced drivers.

(2) Demographic variables are also used as predictive variables to delimit a population of over-involved drivers, when the study population is chosen at random.

A difficulty encountered in the literature is the variety of methods of measuring marital status. While some studies were found to measure all levels of marital status (6, 14, 35), others tend to dichotomize the variable into married (including widowed) or single (including divorced) (36-38). This difference in measurement or operational definition makes it difficult to compare the interactive effects of such variables as age on marital status.

In an early study of the at-risk drinking-driving population it was found that while separated and divorced drivers made up a very small proportion of the driving population, they comprised a significant proportion of the drinking-driving population (14). In analyses of fatal drinking and non-drinking drivers, several authors have shown that separated and divorced drivers comprise a much higher percentage of the fatal accident population than of the general driving population (6, 35, 38, 39). In analyses of drinking driver populations as defined by DWI arrests, it has also been demonstrated that the divorced and separated driver is overrepresented (6, 39). A case-history study of fatal-accident drivers examined the causes of stress in drivers and found that a significant number of drivers were adversely affected by family problems, as reflected by the number of divorced or separated in the population (35).

Race, when included in the study, is usually divided into white and non-white categories. This variable is not included in a number of studies due to the controversial issue of using this variable. One of the prerequisites for the use of any variable in accident research is that the variable not be one that would cause concern in the community if used to define groups (4). Some studies have measured this variable and have found non-white groups to be overrepresented in accidents (6) and drunk driving populations (39).

When marital status is included in more sophisticated analytic techniques, conflicting results are reported. In a study to predict negligent operators it was found that marital status was significantly associated with the negligent operator classification (this study used a dichotomous classification) (37). In a comparative study of a DWI population and a fatal drinking-driver population, marital status was not a factor in predicting alcohol involvement (36).

Marital status and race, as variables to define subgroups of over-involved accident drivers, appear to have some value, as reported by the literature. Race as a variable has inherent problems which tend to discourage its use in the studies reviewed. In areas of the country where a significant proportion of the population is non-white, the issue of its use must rest with the investigator. Marital status, however, has been consistently shown to be significantly related to drinking, both in the population at risk and in subgroups of drinking and accident-involved drivers.

A5. SOCIO-ECONOMIC VARIABLES

The socio-economic classification of drivers has taken many forms in the literature. The variables included in this category range from income level and type of job to social class, and include such behavioral indices as the number of jobs held in a previous time period. Also, generally included as socio-economic indicators are educational background and parental occupation and education. Clearly these variables all attempt to measure an orientation toward a specific social position. It would be expected that there would be a strong correlation between such variables as education and occupation.

An analysis of driving records of an alcoholic driving population indicated that semi-skilled and unskilled workers had fewer crashes, while skilled manual workers were over-represented among those with crashes on their driving record (6). Similar results were obtained when the relationship of occupation to DWI conviction was examined. However, it was found that unskilled workers tended to have more DWI convictions than skilled workers (39). Other studies have also indicated that lower occupational levels tend to be over-represented in problem-drinking, DWI, or crash populations (14, 30, 35, 38, 40, 41). The number of jobs held in a previous time period, a variable which includes behavioral and social-class aspects, has also been demonstrated to correlate with drunk driving and accidents (38, 42). Credit ratings were also examined as an indicator of driving behavior. A poor credit rating was also found to correlate with a poor accident and violation history (43). Educational level tends to parallel occupational-level results; the highest grade completed tends to be lower as drunk-driving convictions or accident occurrence increase (4, 14, 30, 44). Parental occupation and education also appear to be related to accident occurrence, principally for younger drivers, where it was found that the higher the parental occupation and education level, the higher the accident rate (4).

As demonstrated by the literature, socio-economic indicators appear to be consistently related to alcohol and driving behavior. There is a tendency for lower social and economic levels to be over-represented in accident-involved driver populations.

A6. PREDICTION FROM VIOLATION AND CONVICTION DATA

Driving records, as compiled by states, and criminal records offer an attractive and easily accessible source of data for identifying high-risk drivers. Assuming that these public records have an acceptable level of accuracy and completeness for the type of violations or convictions to be used, two points must still be proven. First, it must be demonstrated that some types of convictions are significantly associated with accidents. Second, it must be demonstrated that a violation or sum of violations in one time period predicts accident occurrence in a subsequent time period. If it is a true assumption that public records are sufficiently accurate and complete and the two above criteria are met, it would then be possible to generate a predictive model based on past violations and/or convictions.

Few studies have used criminal records in an attempt to predict driving behavior, and none of the studies reviewed used alcohol-related accidents alone as a prediction criteria. While one study developed a prediction model for drunk-driving arrests (44) and another used a population of alcoholics (45), most studies reviewed used reported crashes as the prediction criterion.

Two main approaches have been used to study the relationship between accidents and violations: (1) an analysis of driving records and, in some studies, criminal-record data for a given time period, comparing accident history and violation history of the same time period; or (2) a compilation of violation data for one time period and accident data for a second time period (usually a consecutive period). While it is much easier to collect data from one time period on both violations and accidents, the second method offers more insight into the actual predictive value of violation data and the effects of other variables.

The first method of analysis has been used by a number of investigators (39, 45, 46, 47). The attraction of this method is the ease of data collection, length of time necessary for data collection, and consistency of data in public records in one time period. It is fairly easy and less costly to collect the total driving record for a given period and analyze the violations for the period against accidents for the period. It is also easier to identify high-accident drivers at the end of a period than to try to follow a much larger sample of drivers over a period to find a few high-accident drivers for analysis. However, it has not been demonstrated that a truly predictive model can be devised from concurrent accident and violation data.

Another method (4, 42, 48, 49) consisted of collecting the violation and accident history for time-period one (t_1) and comparing it to the accident history in time-period two (t_2). Some studies (4, 42) also administered primary data collection in the form of questionnaires or tests at the end of time-period one.

When violations were compared to accidents for the same time period, it was found that the total number of violations was the best predictor of accidents in some studies (45, 47), or there was a significant relationship between some selected types of violations and accidents (46). Another study found no significant relationships (39). Studies which have attempted to find predictive types of violations in one time period for accidents in a second have met with mixed results. A study of high-accident drivers in one year showed that a prediction for following years should be based on the total number of accidents in the first year, but that most drivers improve their driving in subsequent years (48). In a study of all drivers in one state, it was found that accidents in the first time period were the best predictors of accidents in the second period, but that most accidents occurring in any time period involve drivers with no accidents or violations in the previous period (49).

If other variables are entered into the analysis, the predictive strength of past driving violations is altered. It has been demonstrated that attitude scales combined with past driving record increase the correlation of both with future accidents (42), that younger drivers have less-predictable driving records (49), and that inclusion of a larger number of variables reduces the amount of variance explained by past violation records (4, 39). The use of more advanced analytic techniques provides us with little more information. If all items of driving and criminal records are entered into analysis by type, it is found that some types of violations are more significant than others (39, 46) but more often the total number of convictions is the most significant predictor of accidents (42, 45, 47-49).

It was consistently found in these studies that accidents were much better predictors of accidents than were violations (46, 48, 49). While some studies indicated that high-accident drivers are characterized by a high violation rate (39, 48), it was found that most drivers involved in accidents had no accidents or violations in the past (49), or that most high-accident drivers in one time period were accident-free, or had a greatly reduced rate, in the following time period (48). One study which dealt primarily with DWI prediction found that many traffic and criminal offenses did correlate to a significant degree with drunk driving (39). Since it has been shown that accidents can, to some extent, predict accidents, and that violations are associated with drunk driving, these variables should be considered in any attempt to develop a prediction model based on available data sources.

A7. PREDICTION VIA PSYCHIATRIC, PERSONALITY, AND PSYCHOLOGICAL TESTING

Substantial efforts have been made by numerous investigators to correlate and predict accident-prone or high-risk drivers with personality indices and psychiatric or psychological measures. The evidence, however, fails to support the use of such devices for purposes of identifying target groups for countermeasure implementation.

Regarding the use of the McGuire Safe Driver Scale, the author states:

> In prediction, we found that once a suitable number of biographical variables are considered, the use of personality test items are of very little significance, especially when sex and age are involved. As mentioned earlier, of additional importance is the fact that biographical variables are statistically more reliable (that is, each time the measure is taken the result, or "score," is likely to be the same), less controversial (many people resent and reject psychological testing), and much easier to gather. (4, pp. 115-116)

Other investigators have arrived at similar conclusions. Hanen (51) reported an insurance firm's experience in the use of an attitude-personality inventory for determination of auto insurance rates. Although the author defended the use of the instrument for a self-selection population of young, male applicants, there was no evidence that the validity of the predictions was tested in a normal driving population.

Kleinknealt (43) reviewed efforts regarding Washington State's Driver Improvement Interview as a prediction of problem drivers. The interview was based on an attitudinal personality-formatted questionnaire. It was concluded that the high failure rate of the thirty-minute interview to predict poor drivers negated the value of the procedure.

Kraus and co-workers (52) found that in a study of 205 drivers under age 21 in Ontario, certain psychological measures failed to discriminate between good and bad drivers. Self-ratings of degree of aggressiveness, irresponsibility, social conformity, and difficulty in tolerating frustration failed to show a statistically significant difference between a control group and an accident-involved group of young drivers.

Harano, et al. (30) sought to determine the predictability of traffic accidents by the use of biographic data and psychological tests. The investigators collected data on a sample of 950 drivers who had been driving for at least three years and who were under the age of 65.

Data included standard biographical and demographic measures plus a battery of psychological tests, which included:

(1) Interview (with the exception of the driving record selection).
(2) Vocabulary test.
(3) Embedded Figure Test.
(4) Gordon Personal Profile and Inventory.
(5) Parent-Child Inventory.
(6) Eye-Hand Coordination Task.

(7) California Inventory of Driver Attitudes and Opinions (CIDAO).
(8) Physical check list and vision test.
(9) Reaction time measurements.
(10) Simulator performance.
(11) Interview (driving record portion only).
(12) Rating of subject by experimenter. (p. 13)

Dependent variables and predictors of driving performance were taken from official driving records.

Multivariate analyses, including cluster analyses and multiple linear stepwise regression analyses, were performed on the full data set, which included the following components:

(1) Biographical data.
(2) Life-style variables (satisfaction indices, smoking and drinking habits, etc.).
(3) Automobile description and driving-related activities
(4) Attitudes.
(5) Parental relationships.
(6) Personality and cognitive tests.
(7) Attitude and interest tests.
(8) Criminal arrest record.
(9) Perceptual-motor skills and physical checklist.
(10) Mileage and convictions.
(11) Simulator summary scores.
(12) Cluster scores.
(13) Simulator event scores and reaction-time standard deviations. (p. 15)

This study represents the most satisfactory attempt to predict accidents with a multi-dimensional set of predictor variables and indices. It was concluded that accidents could be predicted.

However, because the investigators combined accidents and traffic convictions into a single dependent variable criterion, the results cannot be generalized to the problem of predicting accidents independent of traffic convictions (p. 52). In addition, the unique contribution of non-biographical and demographic variables to the accident-conviction variance explained in the analyses, i.e., the psychological and attitudinal measures, was uniformly small when compared to the independent contributions of standard independent variables. It was only in combination with biographical variables that psychological tests were statistically predictive of problem drivers. In addition the use of, or accident-involvement-with, alcohol (except for minor attention to general drinking habits) was not included in the research. Therefore, the results are less than satisfactory regarding the prediction of alcohol-related accidents.

Lisansky (53), in a chapter directed to clinical research in alcoholism and the use of psychological tests, provided a final conclusion that psychological procedures were far from satisfactory. In her discussion the author stated:

> Having once again reviewed the research reports of psychological test results of alcoholics, and having once again found its contribution so minimal, we find that there remain several issues to be raised.
>
> If indeed the research reports involving psychological tests have failed to demonstrate the existence of "the alcoholic personality" or a single "type," do psychologists then withdraw all claim to the terrain of etiology? There is a position held by some that

addictive behavior can be explained in terms of availability of the addicting substance and/or group membership, the social milieu, and within these limits almost anyone qualifies as a potential alcoholic or addict. But the failure of psychologists and psychiatrists to demonstrate "the alcoholic personality" in no way negates the importance of personality factors as playing a major role in etiology. We have stopped looking for the vague, amorphous, ill-defined whole and started looking for the more specific, more precisely defined parts, i.e., for those personality factors which are necessary (although not sufficient) to explain the adoption of an addictive psychopathology.

Shotgun methods of studying "the alcoholic personality" have failed here as they have failed wherever applied....Psychological tests seem to have been over-used and over-extended generally but the unwise use of a tool only proves the user's lack of wisdom. It seems likely that psychological tests in research will find maximal usefulness in combination with other information-gathering techniques. Occasionally, a specific test may be used to answer a specific question.

Certainly it is true that the test literature has not yielded evidence for "the alcoholic personality," but it is also true that we cannot reject the idea that personality factors play a very significant role in determining who will become an alcoholic and who will not. The great study of alcoholism, a longitudinal, self-evaluating, flexible and comprehensive research plan, will need to include all the psychological and sociological variables we now think relevant and those we have yet to learn about. (42, pp. 11-13)

There have been few indicators in the present reading of the alcohol-highway safety literature that the state-of-the-art of predicting alcohol-related accidents with psychological tests is at all different from Lisansky's observations.

McFarland (1) p. 26, dispenses with the concept of "accident proneness" as being too general a term to be useful for epidemiologic utilization or for intervention-prevention programs. Campbell and Levine (54) similarly discounted the utility of accident proneness as a basis for screening out problem drivers. Although Shaw & Sickel (55, 56) have provided an impressive collection of research findings specifically dealing with the concept of accident proneness and highway safety, it is our conclusion that (1) most investigations cited were inadequate in terms of design or analysis, (2) results were non-generalizable to normal populations, (3) the international flavor of the collected research findings on accident proneness fails to provide sufficient specificity for any single population, as a whole, or precision for target group identification. It is our firm belief that, in agreement with Campbell, Levine, McFarland, and others, accident proneness is but a subset of the full range of psychological testing and prediction of problem drivers; these methods, by themselves, are inadequate for pre-crash identification of drivers at high risk of accident involvement and/or alcohol-related accident involvement.

A8. STRESS, DRINKING, AND DIVIDED ATTENTION; PREDICTORS OF THE PRECRASH PHASE

A number of investigators in recent years have focused on the precrash determinants of alcohol-related accidents. These investigators have proceeded on the basic premise that, while on occasion most adults drink and drive, only a minority become crash-involved. The precrash-phase research has sought to identify the processes that discriminate between crash-involved and non-crash-involved drinking drivers.

Several studies have determined that crash-involved drinking drivers were drinking greater quantities of alcohol prior to the crash and had higher BACs than other drinking drivers in the driving population (6, 14, 35). Precrash investigators have, in recent years, focused on the perplexing question of why the crash-involved drinking driver was drinking so much prior to the crash, and what other determinants of the crash can be identified.

Brown, et al. (35) in a study of fatalities, stated:

> The victims-to-be on the highway seem to be shouldering a much greater burden of stresses than were the controls; 80% of the victims had serious problems at the time of their collision while only 12% of the controls were similarly afflicted. This gap was actually even greater, since many of the traffic victims had multiple stress, while the controls seldom had more than one significant worry.

The authors identified interpersonal and marital, financial, and vocational stresses as being paramount among the victims, and a serious interpersonal conflict in the 24 hours immediately preceding the collision was experienced by 56% of the victims. Marital discord and the emotional and financial burdens subsequent to a marital dissolution were identified as a most common factor among the victims' "generally disorganized, chaotic life."

Causal, rather than correlational, relationships between stress, drinking problems, and crash involvement have never been adequately researched. Alcoholics and alcohol-related crash victims are frequently reported to have numerous social and personal problems. Resolution regarding the time-ordering of drinking-driving problems and others in the social-personal areas has not been forthcoming. However, the concomitance of stress and drinking-driving problems is generally accepted.

Selzer and associates (41, 57-59) have provided further evidence that stressful life events contribute to drinking problems, alcoholism and alcohol-related highway accidents. In a series of investigations of driving populations, psychiatric patients, alcoholics, and crash-involved drivers, the interwoven roles of stress, acute episodic drinking problems, and periodic levels of impaired driving performance have provided some insights into the causal determinants of crashes related to alcohol.

Closely associated with the research described above, on a theoretical level, are investigations of the role of driving as a divided-attention task that interacts with alcohol-impairment in crash causation. Moskowitz, in Perrine (60), summarized recent findings in this area:

> It was concluded that alcohol affects the ability to process appreciable quantities of information when these arrive from more than one source simultaneously, as is typical of the requirements for driving.

Specifically the author concluded that:

> What is clear from all of these studies is that tasks measuring time for complex information-processing show a greater alcohol-induced performance decrement than simpler processing situations. Whether this is the result of interference with some processing of the potential range of stimuli and responses--as implied by an information theoretic view--or whether it is due to the number of central processes involved in the task, is of less immediate concern than the unanimous agreement that alcohol causes greater response impairment when the response requires complex information-processing than when only simple motor-reaction times are involved.

Voas (31) and Moskowitz (60) offered further evidence of the importance of viewing driving as a divided-attention task especially subject to performance decrement under the influence of alcohol.

The relationship between the literatures on stress and divided-attention performance is found when the cause of an individual's stress is viewed as an overwhelming focus of cognitive attention competing with the multiplicity of other stimuli while driving. If driving is normally a complex information-processing task, then the introduction of an acute stressful problem further complicates the situation. If the stressful situation itself becomes the central focus of a drinking driver's attention (a cognitive requirement set), then the level of impairment affecting all multiple stimuli specific to the driving task will be exaggerated. Thus acute stress, interacting with alcohol, would be expected to greatly increase the likelihood of driving performance decrement and crash occurrence. This could be a discrimination between crash-involved and non-crash-involved drinking drivers. However, the definitive research remains to be performed.

McMurray (62) investigated the effect of divorce as an emotional, stressful state on driving performance. An analysis of the driving records of 410 persons involved in divorce proceedings indicated that all persons in the divorce-process sample had more accidents and violation citations than the average driver in the State of Washington over a seven-year period. Proximity in time to the year of divorce was related to the frequency of traffic incidents, and men experienced more incidents throughout the study period than women.

APPENDIX A REFERENCES

1. McFarland, R. A. and Moore, R. C., "The Epidemiology of Accidents," Accident Prevention, ed. by M. N. Halsey, McGraw-Hill, 1961, pp. 17-45.

2. Joscelyn, K. B., Maickel, R. P. and Goldenbaum, D.M., The Drinking Driver: A Survey of the Literature (Court Procedures Survey; Reference Volume I,) Final Report, Report No. DOT-HS-800-608, Institute for Research in Public Safety, Indiana University, Bloomington, October, 1971.

3. Arthur D. Little, Inc., The State of the Art of Traffic Safety, for the Automobile Manufacturers Association, Inc., June, 1960, pp. 231-273.

4. McGuire, F. L., "The Understanding and Prediction of Accident-Producing Behavior," Highway Safety: Anatomy of a Problem, North Carolina Symposium on Highway Safety, Vol. I, Chapel Hill, Fall, 1969, pp. 101-124.

5. Zylman, R., "Age is More Important Than Alcohol in the Collision-Involvement of Young and Old Drivers," Journal of Traffic Safety Education, Vol. 20, No. 1, October, 1972, pp. 7-8, 34.

6. Filkins, L. D., et. al., Alcohol Abuse and Traffic Safety: A Study of Fatalities, DWI Offenders, Alcoholics, and Court-Related Treatment Approaches, Final Report, Contract FH-11-6555 and FH-11-7129, Highway Safety Research Institute, The University of Michigan, June, 1970.

7. Goldstein, L.G., "Youthful Drivers as a Special Safety Problem," The Young Driver: reckless or unprepared?, North Carolina Symposium on Highway Safety, Chapel Hill, Vol.5, Fall, 1971, pp. 37-93.

8. Harrington, D. M., The Young Driver Follow-Up Study: An Evaluation of the Role of Human Factors in the First Four Years of Driving, Final Report, No. 38, California Department of Motor Vehicles, September, 1971.

9. Schuman, S. H., Pelz, D. C., Ehrlich, N. J. and Selzer, M. L., "Young Male Drivers Impulse Expression, Accidents, and Violations," Journal of the American Medical Association, Vol. 200, July 1967 1026-1030.

10. Pelz, D. C. and Schuman, S. H., "Dangerous Young Drivers," HSRI Research, Highway Safety Research Institute, The University of Michigan, Ann Arbor, No. 2, June 1968.

11. Pelz, D. C. and Schuman, S. H., Young Drivers: Road Behavior and Motivations, presented at the Third Traffic Accident Congress, New York City, May, 1969.

12. Pelz, D. C. and Schuman, S. H., Exposure Factors in Accidents and Violations of Young Drivers, Highway Safety Research Institute, The University of Michigan, Ann Arbor, 1971.

13. Pelz, D. C. and Schuman, S. H., Motivational Factors in Crashes and Violations of Young Drivers, Highway Safety Research Institute, The University of Michigan, Ann Arbor, 1971.

14. Borkenstein, et. al., The Role of the Drinking Driver in Traffic Accidents, Department of Police Administration, Indiana University, Bloomington, February, 1964.

15. Research Triangle Institute, Mecklenburg County Drinking/Driving Roadside Interview Survey, 1970, Project SU-582-4, Statistics Research Division, Research Triangle Park, January, 1971.

16. Carlson, W. L., "Alcohol Usage of the Nighttime Driver," Journal of Safety Research, Vol. 4, No. 1, March, 1972, pp. 12-25.

17. Clark, C. D., Compton, M. J., Douglass, R. L. and Filkins, L. D., "A Three Year Comparison of Alcohol Related Driving Behavior in Washtenaw County, Michigan," Hit Lab Reports, Highway Safety Research Institute, The University of Michigan, Vol. 4, No. 2, October, 1973.

18. Waller, J.A., Worden, J.K., and Maranville, I.W., Baseline Data for Public Education About Alcohol and Highway Safety in Vermont, CRASH Report I-1, Vermont Department of Mental Health, Waterbury, February, 1972.

19. Douglass, R. L. and Filkins, L. D., "Empirical Development of A Surrogate Measure of Alcohol Involvement in Official Accident Data," Hit Lab Reports, Highway Safety Research Institute, The University of Michigan, Vol. 4, No. 9, May, 1974, pp. 7-11.

20. O'Day, J., "Characteristics of Alcohol Involvement in Michigan Fatalities 1966-1969," Hit Lab Reports, Highway Safety Research Institute, The University of Michigan, October, 1970, pp. 4-8.

21. O'Day, J., "Drinking Involvement and Age of Young Drivers in Fatal Accidents," Hit Lab Reports, Highway Safety Research Institute, The University of Michigan, October, 1970, pp. 13-14.

22. Schmidt, W. and Kornaczewski, A., "The Effect of Lowering the Legal Drinking Age in Ontario on Alcohol-Related Motor Accidents," paper presented at the 6th International Conference on Alcohol, Drugs and Traffic Safety, Toronto, September, 1974.

23. Williams, A. F., et al., The Legal Minimum Drinking Age and Fatality in Motor Vehicle Accidents. Insurance Institute for Highway Safety, Washington, D. C., 1974.

24. Johnston, L., Drugs and American Youth, Report from the Youth in Transition Project, Institute for Social Research, The University of Michigan, Ann Arbor, 1973.

25. National Commission on Marihuana and Drug Abuse, Drug Use in America: Problem in Perspective, Second Report, U.S. Government Printing Office, Washington, D. C., March, 1973.

26. Pelz, D. C., McDole, T. L. and Schuman, S. H., Drinking-Driving Behavior of Young Men in Relation to Accidents, paper prepared for September, 1974 APA meetings, New Orleans, January, 1974.

27. Douglass, R. L., Filkins, L. D. and Clark, F. A., The Effect of Lower Legal Drinking Ages on Youth Crash Involvement, Final Report, DOT-HS-031-3-754, Highway Safety Research Institute, The University of Michigan, Ann Arbor, June, 1974.

28. Rosenberg, N., Laessig, R. H. and Rawlings, R. R., "Alcohol, Age and Fatal Traffic Accidents," Quarterly Journal of Studies in Alcoholism, Vol. 35, 1974, pp. 473-489.

29. Ingersoll, R. L., Trow, J. E. and Clarke, D. W., The High Risk Driver a Descriptive Study, Program on Alcohol & Drug Abuse, New Hampshire Division of Public Health, Concord, September, 1970.

30. Harano, R. M. McBride, R. S. and Peck, R. C., The Prediction of Accident Liability Through Biographical Data and Psychometric Tests, Final Report, Research and Statistics Section, Department of Motor Vehicles, California Division of Highways, Sacramento, March, 1973.

31. Voas, R. B., "Alcohol as an Underlying Factor in Behavior Leading to Fatal Highway Crashes," Proceedings of the First Annual Alcoholism Conference of the National Institute on Alcohol Abuse and Alcoholism, ed. by M. E. Chafetz, National Institute on Alcohol Abuse and Alcoholism, June, 1971, pp. 324-331.

32. Klein, D., "Adolescent Driving as Deviant Behavior," The Young Driver: reckless or unprepared?, North Carolina Symposium on Highway Safety, Chapel Hill, Vol. 5, Fall, 1971, pp. 3-19.

33. Schuster, D.H., "The Young Problem Driver," The Young Driver: reckless or unprepared?, North Carolina Symposium on Highway Safety, Chapel Hill, Vol.5, Fall, 1971, pp. 111-131.

34. Klein, D. and Waller, J. A., Causation, Culpability and Deterrence in Highway Crashes, Report of Automobile Insurance and Compensation Study, Department of Transportation, Washington, July, 1970.

35. Brown, S. L., et al., Alcohol Safety Study "Drivers Who Die," Final Report, Baylor University College of Medicine, 1968.

36. Pollack, S., et al., Drinking Driver and Traffic Safety Project, Annual Report, Public Systems Research Institute, University of Southern California, Los Angeles, July, 1970.

37. Levonian, E., "Prediction of Accidents and Convictions," Traffic Safety Research Review, Vol. II, 1967, pp. 75-79.

38. Perrine, M. W., Waller, J. A. and Harris, L. S., Alcohol and Highway Safety: Behavioral and Medical Aspects, Final Report, DOT-HS-800-599, Department of Psychology, University of Vermont, Burlington, September, 1971.

39. Pollack, S., et al., The Drinking Driver and Traffic Safety Project, Annual Report, Public Systems Research Institute, University of Southern California, Los Angeles, Vol. I., July, 1969.

40. Cahalan, D. and Room, R., Problem Drinking Among American Men Aged 21-59, presented at American Public Health Association Meeting, Minneapolis, October, 1971.

41. Selzer, M. L. and Vinokur, A., Detecting the High Risk Driver: The Development of a Risk Questionaire, Final Report, Report No. DOT-HS-801-099, Highway Safety Research Institute, The University of Michigan, Ann Arbor, January, 1974.

42. Schuster, D. H., "Prediction of Follow-Up Driving Accidents and Violations," Traffic Safety Research Review, Vol. 12, No. 1, March, 1968, pp. 17-21.

43. Kleinknecht, R. A., An Analysis of Washington's Driver Improvement Interview: A Study In Prediction and Control of Problem Drivers, Report 017, Division of Research, Administrative Services, State of Washington, Department of Motor Vehicles, August, 1968.

44. Didenko, O. R., McEachern, A. W. and Berger, R. M., Drinking Driver and Traffic Safety Project, Final Report, DOT-HS-800-699, Public Systems Research Institute, University of Southern California, Los Angeles, Vol. I, May, 1972.

45. Clay, M. L., Which Drunks Shall We Dodge?, presented at the Twenty Third Annual Meeting, Alcohol and Drug Problems Association of North America, Atlanta, September, 1972.

46. Peck, R. C. and Coppin, R. S., "The Prediction of Accident Involvement Using Concurrent Driver Record Data," Traffic Safety Research Review, Vol. II, No. 2, June, 1967, pp. 34-41.

47. Carlson, W. L., "Identifying The Problem Driver From State Driving Records," HSRI Research, Highway Safety Research Institute, The University of Michigan, Ann Arbor, No. 1, May, 1968.

48. Goodson, J. E., Changing Characteristics of High Accident Drivers Over A Five Year Period, No. 29, Engineering Experiment Station, Purdue University, West Lafayette, September, 1972.

49. Stewart, J. R. and Campbell, B. J., The Statistical Association Between Past and Future Accidents and Violations, Highway Safety Research Center, University of North Carolina, Chapel Hill, December, 1972.

50. McGuire, F. L., A Study of Methodological and Psychosocial Variables in Accident Research, Public Health Service Bureau of Community Environmental Management, U.S. Department of Health, Education and Welfare, March, 1971.

51. Haner, C. F., "Prediction of Automobile Claims by Psychological Methods--A Case Study in Automobile Insurance," Journal of Risk and Insurance, March, 1968.

52. Kraus, A. S., Steele, R., Ghent, W. R. and Thompson, M. G., "Pre-Driving Identification of Young Drivers With a High Risk of Accidents," Journal of Safety Research, Vol. 2, No. 2, June, 1970, pp. 55-66.

53. Lisansky, E. S., "Clinical Research in Alcoholism and the Use of Psychological Tests: A Reevaluation," Alcoholism, Behavior Research, Therapeutic Approaches, ed. by Ruth Fox, Springer, New York, 1967.

54. Campbell, B. J. and Levine, D., Accident Proneness and Driver License Programs, presented at the International Conference on Driver Behavior, Zurich, October, 1973.

55. Shaw, L. and Sichel, H., Accident Proneness, Pergamon Press, Oxford, 1971.

56. Shaw, L., "The Practical Use of Projective Personality Tests As Accident Predictors," Traffic Safety Research Review, Vol. 9, No. 2, June, 1965, pp. 34-72.

57. Selzer, M. L., Rogers, J. E. and Kern, S., "Fatal Accidents: The Role of Psychopathology, Social Stress and Acute Disturbance," American Journal of Psychiatry, Vol. 124, No. 8, February, 1968, pp. 46-54.

58. Brenner, B. and Selzer, M. L., "Risk of Causing a Fatal Accident Associated with Alcoholism, Psychopathology, and Stress: Further Analysis of Previous Data," Behavioral Science, Vol. 14, No. 6, November, 1969, pp. 490-495.

59. Selzer, M. L. and Vinokur, A., "Life Events, Subjective Stress, and Traffic Accidents," American Journal of Psychiatry, Vol. 131, No. 8, August, 1974, pp. 903-906.

60. Moskowitz, H., "Alcohol Influences Upon Sensory Motor Function, Visual Perception, and Attention," Alcohol, Drugs, and Driving, ed. by M. W. Perrine, Report No. DOT-HS-801-096, Psychological Research Foundation of Vt., Inc., March, 1974, pp. 58-61.

61. Moskowitz, H., "A Behavioral Mechanism of Alcohol-Related Accidents," Proceedings of the First Annual Alcoholism Conference of the National Institute on Alcohol Abuse and Alcoholism, ed. by M. E. Chafetz, National Institute on Alcohol Abuse and Alcoholism, June, 1971, pp. 311-323.

62. McMurray, L., Emotional Stress and Driving Performance: The Effect of Divorce, Report 016, Division of Research, Administrative Services, State of Washington, Department of Motor Vehicles, August, 1968.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS-801 435		

4. Title and Subtitle

ANALYSIS OF HIGH RISK DRIVERS FOR ALCOHOL COUNTERMEASURES

Final Report

5. Report Date

March 1975

6. Performing Organization Code

7. Author(s)

R.E.Hagen, D.H.Harris, A.Burg

8. Performing Organization Report No.

9. Performing Organization Name and Address

Anacapa Sciences Inc. 2034 De La Vina Str.
Santa Barbara, Cal. 93102

10. Work Unit No. (TRAIS)

11. Contract or Grant No.

DOT-HS-4-00991

12. Sponsoring Agency Name and Address

National Highway Traffic Safety Administration
400 SW 7th Str. Washington, D.C. 20590

13. Type of Report and Period Covered

6/1/74 to 12/31/74
Final Report

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

An approach was developed to enhance the precision of predicting alcohol-related accidents. The approach assumed that there were small,identifiable high risk groups and that prediction models could be devloped to identify individuals with a high probability of crash involvement. The selection criteria were constrained by the consideration of countermeasure application. Plans were prepared for developing and validating the predictor model.

17. Key Words

Alcohol, Drinking Driver, Predictor Model, Accident Prediction

18. Distribution Statement

Document is available to the public through the National Technical Information Service, Springfield, Virginia 22151

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	94	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

SUMMARY

An approach was developed to enhance the precision of predicting alcohol-related crash-involvement and to facilitate the application of appropriate pre-crash countermeasures. The approach assumed the existence of high-risk driver groups--relatively small, identifiable segments of the driver population found to be over-represented in alcohol-related crashes. It assumed further that, within each high-risk group, a prediction model could be developed to identify individuals with the highest probability of crash-involvement. The individuals thus identified would be the primary targets for pre-crash countermeasures.

The development of selection criteria for the high-risk groups was carefully constrained by the practical considerations of countermeasure application. In anticipation of the various problems that might develop from identifying a sub-population of drivers for special treatment, constraints of both legality and social acceptability were applied to candidate selection criteria. In addition, consideration was given to the availability and cost of the data required for an ongoing program of target selection and pre-crash countermeasures.

Five high-risk driver groups were identified through a systematic review of previous research on alcohol-related crash-involvement. For reasons explained in this report, each group was made up of male drivers only. Each group was further defined by one or more of the following primary variables: age, recent change in marital status, hazardous-moving-violation record, and ASAP-DWI record. The estimated size of the resulting target groups ranged from less than one percent to about seven percent of the male driver population.

Detailed plans and specifications were prepared for developing and validating a model for predicting crash-involvement among group members. The first phase of this effort will include: prediction model development,

concurrent validation of the model, assessment of the predictive efficiency of the model when applied in different high-risk groups, and identification of key predictor variables upon which pre-crash countermeasures can be developed. The second phase of this effort will be a five-year longitudinal study of the effectiveness of the entire approach to predicting crash-involvement. The predictive validity of the approach will be determined; the efficiency of the approach will be assessed; the dynamics and life-span of the predictive model will be determined; the potential long-term benefits of the approach will be estimated; and assessments of the potential impact of applying alternative pre-crash countermeasures will be made.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

A primary objective of driver licensing, driver improvement, law enforcement, and traffic court programs is to control drivers who have a high probability of becoming involved in a crash. Fatal crashes in particular are of major concern, not only because of the pain and grief they cause, but also because of their high societal cost. Therefore, when it was determined that alcohol consumption played a role in approximately 50 percent of the nation's fatal crashes, public agencies directed pre-crash countermeasures toward the drinking driver. Unfortunately, these initial efforts were not particularly successful, because they were directed toward a population of drivers which was too large and heterogeneous (over 77 percent of the total driving population are drinkers, *20*). Expenditure of resources on pre-crash countermeasures produced little or no reduction in accident rates. Furthermore, the public backlash against the countermeasures employed forced the discontinuance or reduction of many efforts.

As a result of this experience, an attempt was made to define more precisely the role of the drinking driver in fatal crashes. One immediate finding was that two-thirds of the alcohol-related fatal crashes involved a sub-group of drinking drivers who could be described as problem drinkers. The problem drinker-driver group became the target of 35 federally funded Alcohol Safety Action Projects (ASAP) and numerous other NHTSA-sponsored "mini-ASAP's." Since the pre-crash countermeasure efforts were attempting to control a smaller, better-defined sub-group of the driver population (21 percent of the total driving population rather than 77 percent, *20*), they proved more effective. Even so, on the basis of initial ASAP results, success has been less than universal. Although reductions or increases in numbers of fatal crashes are typically attributed to the success or failure of the program, it may be that the definition of the problem drinker-driver group is still too broad to adequately develop effective pre-crash countermeasures. Thus, further refinement of the definition of high-risk drivers may still be necessary.

More restricted definitions of high-risk driver groups might lead to smaller, more homogeneous target groups and, in turn, to more specific countermeasure applications as well as more effective allocation of countermeasure resources. An important means to this end will be the development of crash prediction techniques. Although crash prediction techniques could be developed for any driver group, they would be expected to have greater predictive power for groups which are otherwise relatively homogeneous.

The development of valid prediction equations will provide pre-crash countermeasure efforts the capability of determining, for any member of a high-risk group, his *probability of future crash-involvement*. Appropriate methods of control or restriction could then be prescribed. Since the pre-crash countermeasure efforts could then be targeted toward smaller, well-defined, high-risk driver groups, overall results would be expected to be more successful.

This report is part of a three-phase project. The ultimate purpose of the project is to develop and validate crash prediction techniques which will serve as a component of effective pre-crash countermeasure efforts. In this report of the first phase of the project, we discuss the development of both the design characteristics for high-risk driver selection criteria and sets of high-risk driver selection criteria. Further, we have prepared a Phase II detailed study plan which will allow for the development of crash prediction equations which will relate for each high-risk driver group, predictor variables (driving records, etc.), and criterion variables (involvement in fatal and injury crashes or nighttime crashes). Finally, we have developed a five-year study plan (Phase III) designed to assess the predictive validity of the equations developed during Phase II.

SETS OF HIGH-RISK DRIVER SELECTION CRITERIA

The criteria for identifying high-risk drivers might be developed by applying cluster analytic or factor analytic techniques to data developed from the driver history, accident investigation reports, and person-centered variables associated with crash-involved drivers. But, this approach was determined at the outset to be too costly and time-consuming for this project. As an alternative, published and unpublished data were thoroughly examined to determine the characteristics of crash-involved and alcohol-related crash-involved drivers, and to assess unique relationships that exist between relevant predictor and criterion variables.

The initial result of the review of published and unpublished data was a list of relevant predictor variables that had been used in or determined through prior analyses. The relationships among these variables and pertinent criterion variables were noted. Further, the availability of data on the predictor variables was assessed. This was done to ensure that Phases II and III could be completed, and that any prediction techniques developed as a result of Phases II and III would be usable as components of pre-crash countermeasure efforts. Using these data, five sets of driver selection criteria were developed. Each set of selection criteria satisfied the following design specifications considered necessary for the development of selection criteria which would identify drivers having a disproportionately high probability of becoming crash-involved.

DESIGN CHARACTERISTICS FOR SETS OF SELECTION CRITERIA

The high-risk driver selection criteria were designed to identify drivers having a high risk of becoming involved in an alcohol-related crash (A/R crash). Specifically, the selection criteria were designed to identify drivers who evidenced all of the following:

- High exposure to A/R crashes--likely to be driving when and where such crashes occur
- High crash liability--likely to be in a crash
- High potential for aberrant drinking and/or driving after drinking

To ensure that the resultant driver groups were also suitable pre-crash countermeasure targets, the following were also required:

- The resultant driver group was small enough to serve as a pre-crash countermeasure target

- The selection criteria were legal and socially acceptable
- The resultant driver group was in a meaningfully large number of crashes

LIMITATION TO MALES

Because of the drastic over-representation of male drivers in nighttime fatal crashes and alcohol-related crashes, all of the sets of high-risk driver selection criteria, and thus the Phase II and III analyses, were limited to male drivers (*10, 15, 16, 20, 23, 30*). Their over-representation appears related to driving exposure, since the accident-vulnerability ratio, which holds the driving exposure factor constant, was actually slightly higher for females than for males. As female drivers' crash-involvement becomes greater, development of similar prediction equations for them may become appropriate. Because of potential differences between the two driver groups, they will not be combined, nor will any of the prediction equations developed using data on males be applied or generalized to female drivers (*12, 22*).

"DRINKER" AS A VARIABLE

Since the primary objective is to reduce the frequency of alcohol-related crashes, it would appear necessary to select only drivers who drink. But the inclusion of this variable would make the application of any set of selection criteria very difficult. For example, no agency involved in driving improvement efforts is now recording whether subject drivers drink, and such data, even if collected, would have questionable validity. Further, since a potential for aberrant patterns of drinking and/or driving after drinking was a major design specification for all of the sets of high-risk driver selection criteria, to use "drinker" as a selection criterion would merely limit the practical application of the selection criteria without significantly enhancing the homogeneity of the resultant target groups. The drinker variable would instead be used as a predictor; that is, after drivers have been pre-selected by means of the selection criteria, we will determine whether they drink and, if so, in what manner. Thus, the relationship between this variable and the crash-criterion variables would be explored.

HIGH-RISK DRIVER SELECTION CRITERIA: YOUNG DRIVERS

Alcohol-related crashes are concentrated in the nighttime hours, reaching their highest levels around midnight (*13, 30, 31*). The absolute number of A/R crashes is higher on the weekend, but their frequency relative to non-A/R crashes remains about the same for all days of the week. The concentration of A/R crashes in the nighttime hours has special implications for determining what types of drivers have high exposure to such crashes. Table 1 uses roadside survey data collection from seven ASAP sites (*20*). The data were collected from 7 p.m. to 3 a.m., and include samples from each day of the week. From the data in Table 1, one can determine an age profile of non-crash involved drivers who are using the roadway during the times in which A/R crashes were concentrated. Drivers under the age of 30 were over-represented in the nighttime driving population in comparison with their proportional representation in the licensed driver population; drivers 30 years of age or older were under-represented. These data indicated that the male driver 29 or younger has a high exposure to A/R crashes.

TABLE 1

Nighttime Non-Crash Involved Driver Distribution--1971-72[30]

Driver Group	Percentage Using Roadway From 7 PM - 3 AM	Percentage Of Licensed Driver Population
Under 20	18.8	8.7
20-29	38.8	25.2
30-39	16.8	18.2
40 & Over	25.5	47.9
Male	81.8	55.7

CRASH LIABILITY

Analysis of fatal crash data determined that male drivers under the age of 20 were involved in twice as many day and nighttime fatal crashes as one would expect based on their proportional representation in the licensed driver population (see Table 2). Further, males age 20 through 24 were involved in the expected number of daytime fatal crashes, but almost twice as many nighttime fatal crashes. The proportionate day or nighttime fatal crash-involvement of all other age groups was similar to or less than that expected based on their proportional representation in the licensed population. The only exception to this trend was the high involvement of males over the age of 64 in daytime fatal crashes.

TABLE 2

Age Distribution of Male Drivers Involved in Fatal Crashes--1970[30]

Age Group	Percentage of Daytime Fatal Crashes	Percentage of Nighttime Fatal Crashes	Percentage of Driver License Population
Under 20	19.5	19.0	8.7
20-24	13.9	24.7	13.2
25-34	15.7	21.2	20.5
35-64	34.6	29.0	47.0
Over 64	15.6	5.0	10.6
Unknown	0.8	1.0	----

The over-representation of any age group in nighttime fatal crashes is of particular interest, since a large proportion of such crashes are alcohol-related (*20*). Thus, male drivers under the age of 25 had both a high exposure rate to A/R crashes and a high involvement rate in nighttime fatal crashes. Because of anticipated group differences, young male drivers were separated into two groups: those under the age of 20 and 20-24.

The elevated level of A/R crash-involvement of the 20-24 year old driver group was further supported by a study of A/R driver fatalities. The highest percentage of Detroit A/R driver fatalities (blood alcohol concentration of at least 0.05) was among the 20-24 year old group (*6*). The involvement of other age groups was considerably less.

The overall accident liability of males under the age of 20 and 20-24 is further exemplified in Table 3, which shows age distribution of accident vulnerability ratios (A-VR). Accident vulnerability ratios, first developed by Hyman (*14*) in an attempt to hold driving exposure factors constant, relate the percentage of drivers of interest in an accident population to their representation in an at-risk control group. The at-risk control group consists of a random sample of drivers using the roadway in the vicinity of an accident at about the same time that the accident occurred. For example, 80 percent of accident group and 40 percent of the at-risk group were male, the accident-vulnerability ratio for male drivers is 2.0--they are having twice as many crashes as their presence in the at-risk driver population would account for. If equal percentages were found in both groups, the ratio would be 1.0. The A-V ratios reported in Table 3 were calculated by Hyman based on data collected in the Grand Rapids' study (*2*).

TABLE 3

Accident-Vulnerability Ratios for Male Drivers[14]

Age Group	Blood Alcohol Concentration 0.0	.01-.04	.05-.09	Above .09
Under 18	2.4	7.3	---	---
18-19	1.5	2.3	4.2	---
20-24	1.1	1.1	1.8	9.4
25-69	.6-.8	.7-1.0	.6-.9	4.5-13.0
70-74	1.9	2.5	2.3	---
Over 74	1.9	5.0	---	---
TOTAL	.91	.8	1.4	6.9

--- Impossible to calculate.

As reported in Table 3, the A-V ratios at a 0.0 blood alcohol concentration (BAC) for drivers under the age of 20 and from 20-24 exceeded 1.0, thus reflecting their over-representation in the general accident population. When alcohol was involved, the A-V ratios for these age groups increased. The increases were extremely large when compared with the largest segment of the driving population, ages 25 through 69. Further, the A-VR increased at a higher rate relative to the BAC level for male drivers under the age of 20 than for those 20-24.

ABERRANT DRINKING AND DRIVING AFTER DRINKING

The final element considered in designing high-risk driver selection criteria was the potential for exhibiting aberrant patterns of drinking and/or driving after drinking. The incidence of alcohol use reported in Table 4 was high among young people, with its peak occurring in the 22 to 25 year age bracket. From that point on, it tended to stabilize, and was significantly decreased by age 50 (*19*). Thus, the age group with the largest percentage reporting that they do drink was essentially identical to that exhibiting high rates of exposure to A/R crashes as well as involvement in nighttime fatal crashes.

TABLE 4

Incidence of Alcohol Use in Various Age Groups[19]

Age Group	Percentage
14-15	21
16-17	35
18-21	65
22-25	66
26-34	62
35-49	57
Over 49	39

Though alcohol use in itself is not indicative of a drinking problem, a survey of problem drinking suggested that of all age groups the 21-24 year old group had the largest proportion of its members evidencing alcohol-related problems (*5*).

The incidence of A/R problems would diminish in the later 20's and remain stable until age 50. Thus, alcohol-related crash-involvement, as evidenced in the Carlson and Clark study (*6*), and drinking problems peak together in the 21-24 age bracket (*30*).

A high incidence of drinking problems was not expected in the group of drivers under the age of 20. But, because of constraints on their drinking when it did occur, we did expect a high incidence of driving after drinking. In most states it is illegal for a driver in this age group to drink, thus suggesting the need to do so in seclusion. Where it is legal, it would also be novel, suggesting that most drinking activities would take place in public. Thus, a high incidence of driving after drinking can be expected in either situation.

TARGET SIZE

Based on 1972 statistics, selecting male drivers ages 20-24 would result in identifying about 13 percent of the male licensed driver population, or 8.7 million drivers. Further, there are another 5.7 million male drivers under the age of 20. Since another selection criterion was that the resultant driver group be small enough to serve as a target group of pre-crash countermeasure efforts, it would seem neither group is as yet small enough. To reduce the size of the group and to increase the homogeneity of the target group, other selection criteria were reviewed.

One aspect of fatal crash and alcohol-related crash occurrence involving these types of drivers is the over-representation of excessive speed. This would follow from the observation of when young drivers use alcohol, they typically increase their risk taking behavior as evidenced by the reckless manner in which they drive. Thus, a conviction for a hazardous moving violation (HMV) on a young driver's record indicates at least a higher level of risk taking, and possibly even evidence of driving after drinking. Because of this, one or more HMV's in the last three years was considered an appropriate criterion for selecting high-risk drivers especially when coupled with the age specifications of under 20 and 20-24. Since only about 30 percent of all male drivers have HMV's within the past year, implementation of this selection criterion should reduce the target groups by about 70 percent. The proportional size of the resultant target group is indicated by the shaded area in Figure 1.

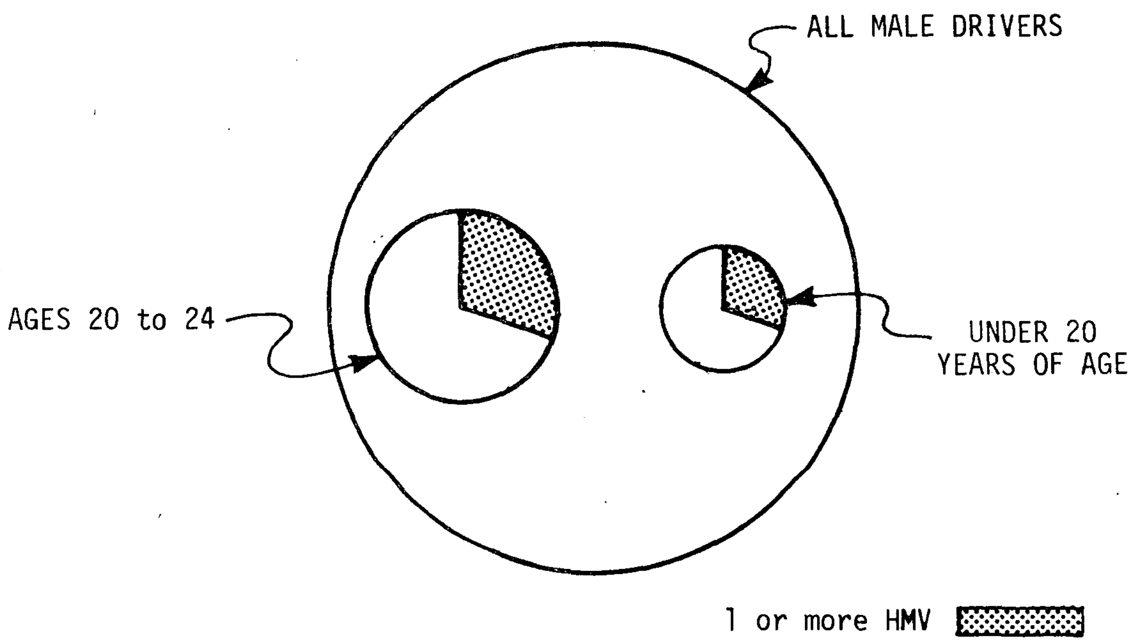


Figure 1. Proportional size of target groups resulting from high-risk driver selection criteria: Sets A & B.

Based on the data in Table 5, the two target groups would involve something less than 7 percent of the male licensed driver population. More importantly, by attempting to control this small group of drivers by implementing tailor-made pre-crash countermeasures it may be possible to impact 44 percent of the nighttime fatal crashes or 39 percent of all fatal crashes involving male drivers.

TABLE 5

Fatal Crash-Involvement of Male Drivers[30]

Age Group	Licensed Drivers (Mill.) - 1972		Daytime Fatal Crashes - 1970		Nighttime Fatal Crashes - 1970		Fatal Crashes 1970	
	Number	Percentage**	Number	Percentage*	Number	Percentage*	Number	Percentage*
Under 20	5.7	8.7	2514	19.5	2862	19.0	5376	19
20-24	8.7	13.2	1800	13.9	3731	24./	5531	20

*Percentage of total crashes involving male drivers.
**Percentage of male licensed driver population.

The relative magnitude of fatal crash-involvement of drivers under the age of 24 is best shown in Figure 2. The shaded areas represent the roles of the two age groups in both day and nighttime fatal crashes. The figure shows the involvement of all drivers of such age, regardless of citation records. The role of drivers under the age of 24 with one or more HMV's would be somewhat less, but probably not substantially different.

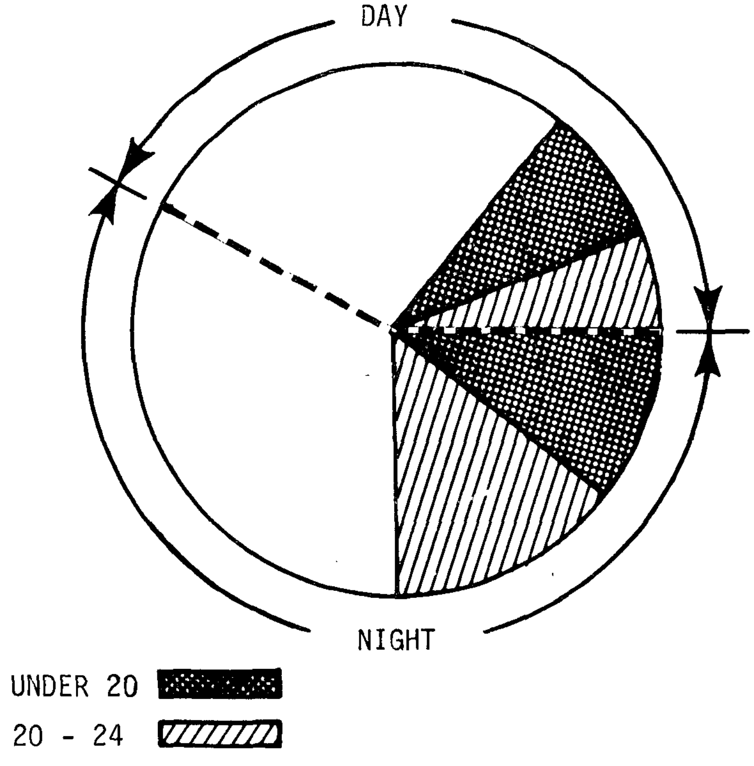


Figure 2. Proportion of fatal crash-involvement of more drivers under the age of 24.

We conclude that the following two sets of selection criteria will identify high-risk driver groups which are appropriate targets for pre-crash countermeasures. Though the age criterion could have been simply "24 and under," it is desirable to separate the two groups, since the two age groups do differ in drinking, driving after drinking, and fatal crash-involvement.

Set A	Set B
• Male	• Male
• Under 20 years of age	• 20-24 years of age
• One or more HMV in last 3 years	• One or more HMV in last 3 years

HIGH-RISK DRIVER SELECTION CRITERIA: CRISIS

A driver's risk level or potential for crash-involvement is not likely to remain constant. With the occurrence of a crisis of highly stressful event, the risk level of a driver can be expected to radically increase. Events such as financial disaster, death of spouse, or a divorce involving children can be expected to cause such an increase. The risk level will remain high until the individual adapts to the situation and learns to cope with the new conditions of his life. The risk level can be assumed to increase because of changes in behavior generally associated with reactions to major stressful events--such as increased frequency and quantity of drinking as well as increased drinking in public. Further, personality changes involving despondency feelings of persecution and possibly suicidal wishes can be expected.

CRASH LIABILITY

The high-risk level or crash liability of such drivers is supported by a number of background studies of fatally injured drivers (*3, 18, 26*). The results generally verify the similarity between the personality and situational variables associated with fatally injured drivers and those expected in individuals reacting to a major stressful event or crisis.

If we assume the incidence of suicidal wishes increases when an individual encounters major stress events, then further support of elevated crash liability is available from a background study of individuals who had been hospitalized for suicidal gestures. The overall accident rate for this group was 81 percent higher than that for the general licensed population (*9*).

DRIVER SELECTION CRITERIA

A set of selection criteria was designed to identify drivers who, because of a major stress situation in their life, were assumed to become high-risk drivers. Events involving unforeseen financial losses or death of spouse were not included as selection criteria. These events occur too randomly, and pre-crash countermeasure efforts for drivers selected through their use would almost certainly not be acceptable to the public. A divorce, especially involving children, might be an appropriate selection criterion. Such an event was considered not random, and development of socially acceptable pre-crash countermeasures might be feasible.

To maximize the amount of stress, the divorces were stipulated to have involved children whose custody was awarded to the other spouse. From such events one might expect radical, but probably temporary changes in drinking, driving after drinking, and personality characteristics. Because of these, the risk level or probability of crash-involvement would also be expected to temporarily increase. Divorced within the past year was included as a time frame in the selection criteria, since most individuals eventually adapt or learn to effectively cope with the situation. Thus, the high level or risk was expected to return to normal as the length of time from the divorce occurrence increased. In summary, the final set of high-risk driver selection criteria resulting from transient effects of high stress is as follows.

Set C

- Male
- Divorced within the last year
- Spouse awarded custody of the children

TARGET SIZE

A relatively small number of drivers will be selected by implementation of these criteria. The number of divorced or separated licensed drivers is small in itself. One study found that only 5 percent of 1400 DMV license applicants were in this marital status category (*25*). With the additional selection criteria, the size of the resultant driver group is estimated to be less than 1 percent of the licensed male driving population.

The number of crashes that will be impacted by using this driver group as a target of pre-crash countermeasure efforts cannot be directly estimated from existing data. Since A-V ratios greater than one were reported for the general group of divorced or separated drivers, the resultant target group is expected to be over-represented in the crash population (*14*). Also, the A-V ratio does increase relative to the BAC at a much greater rate for divorced or separated drivers than for married drivers. If the divorced or separated category were further broken down into one resembling the proposed target group, the A-V ratios can be expected to be even higher.

HIGH-RISK DRIVER SELECTION CRITERIA: OLDER DRIVERS

A high crash liability for drivers age 65 and over was evidenced in prior analyses (*10, 13, 14, 30*). Though only 10.6 percent of the male drivers licensed as of 1972 were in this age bracket, they were involved in 15.6 percent of the daytime and 5 percent of the nighttime fatal crashes (*30*). Thus, their over-representation in the fatal crash population is concentrated in the daytime hours, hours during which alcohol is not usually involved. But, because of the life-style of a driver of this age, nighttime drinking, thus nighttime driving after drinking, was not expected. We can expect the incidence of alcohol use by drivers in this age bracket to be at its highest during the afternoon or early evening.

Crash-involvement estimates for this group are extremely conservative since their proportionate role in the licensed driver population was used as a comparison group. A large number of drivers in this age bracket maintain a driver's license primarily for identification instead of driving. The 10.6 percent figure is inflated because the actual number of licensed drivers in this age bracket who still drive is much smaller. Therefore, if this figure were adjusted to reflect the actual number of licensed drivers still driving, the relative representation of this age group in both day and nighttime fatal crashes would increase.

Since driving exposure is controlled in developing accident vulnerability ratios, they offer a more accurate assessment of the crash liability of male drivers 65 and over. The ratios reported in Table 6 typically exceed 1.0, thus evidencing the over-representation of this driver group in all crashes (*14*). The significant increases in the A-V ratios at even relatively low BAC's supports the importance of considering this driver group as a high-risk group, especially when alcohol is involved. The accident vulnerability for this driver group is initially high, and, with even a small amount of alcohol use, any age-related impairment is significantly accentuated.

TABLE 6

A-V Ratios for Older Male Drivers at Different BAC Levels[14]

Age Group	Blood Alcohol Concentration			
	0.0	.01-.04	.05-.09	.10+
65-69	.83	.56	1.25	13.0
70-74	1.88	2.5	2.33	---
75 & Older	1.88	5.0	---	---

In summing, the following is considered an appropriate set of high-risk driver selection criteria:

Set D

- Male
- 65 years of age or older
- Drive at least one day per week

TARGET SIZE

Approximately 7 million drivers' licenses were issued to males 65 years old or older in 1972 (*30*). The size of this group would be reduced by eliminating licensees who do not actually drive.

The number of crashes involving drivers selected through this set of criteria is impossible to estimate. Based on the fatal crash-involvement of all licensed male drivers in the 65 and over age bracket, about 16 percent of the daytime and 5 percent of the nighttime fatal crashes potentially would be impacted by using this set of selection criteria.

HIGH-RISK DRIVER SELECTION CRITERIA: ASAP-DWI

The value of using a driving-while-intoxicated (DWI) arrest or conviction as a high-risk driver selection criterion is minimal according to analysis of pre- or non-Alcohol Safety Action Project data. For example, it was reported that only two in ten drivers involved in fatal crashes had previously been arrested for DWI (*29*). Further, the average age for the DWI population was reported as 44, while those for the fatal crash and A/R fatal crash populations were reported as 39 and 35, respectively, The data suggest that the drivers arrested for DWI were not the same type of driver as those involved in fatal crashes.

In light of this, Alcohol Safety Action Project (ASAP) special enforcement efforts were developed and targeted toward characteristics of A/R crashes or offenses. This involved concentrating enforcement efforts on the hours-of-the-day, days-of-the-week, and locations where the incidence of A/R crashes or violations are concentrated. For example, 81 percent of the special enforcement manpower allocation and 93 percent of the arrests made through ASAP occurred between the hours of 8 p.m. and 4 a.m. (*20*). In comparison, 74 percent of the alcohol-related fatal crashes occurring in the ASAP surveyed locations also occurred in this time block. Initial composite project data suggested that the ASAP-DWI population is much more similar to the fatal crash population than prior DWI populations have been.

A composite profile was developed for an "average" driver who had been arrested for driving-while-intoxicated in the ASAP program:

- Male
- 25-34 years old
- Married
- High school education
- Skilled or semi-skilled occupation
- Usually no prior DWI arrests
- Current valid driver's license
- BAC approximately 0.18 percent

(*20*)

This composite profile was compiled from data taken at a large number of the ASAP sites and closely approximated to that of drivers involved in fatal A/R crashes. At one ASAP site a profile analysis of A/R drivers involved in A/R crashes and ASAP-DWI's showed essentially no differences between the two profiles (*10*). Because of the similarity between the ASAP-DWI population and that of drivers involved in A/R fatal crashes, it would appear an ASAP-DWI violation is an appropriate high-risk driver selection criterion.

Within the general framework of ASAP special enforcement, different methods are used for identifying the drinking driver. Selection enforcement programs, roadblocks, and in-depth accident investigations have been conducted. Whether the same type of drinking driver is being identified by each of these techniques cannot be determined from existing data. Some differences might exist; but because of the lack of existing data, it was considered necessary to use the composite ASAP-DWI population.

The resultant high-risk driver selection criteria are:

Set E
• Male
• One or more ASAP-DWI violations in the last 3 years

TARGET SIZE

A total of 31,187 alcohol-related traffic arrests were reported from 19 Alcohol Safety Action Projects in 1972 (*20*). Thus, the use of an ASAP-DWI violation incurred in the last three years as a criterion will produce a target group small enough for effective pre-crash countermeasure targeting. Because of the evidenced similarity between this group and that of drivers involved in fatal crashes, the risk level of this group is considered high.

PHASE II STUDY PLAN:

DEVELOPMENT AND VALIDATION OF PREDICTION TECHNIQUES

Once we have applied the sets of selection criteria described in the previous section to pre-select groups of high-risk drivers, we have gone about as far as the existing literature can take us. To objectively identify the individuals who represent the greater risk within each of these groups, we need to derive equations which are predictive of crash-involvement. In Phase II, groups of drivers will be identified through the use of one or more of five sets of selection criteria, and will be used as data bases for development of prediction equations.

A major consideration in deriving prediction equations is their practical usefulness as a component of pre-crash countermeasure efforts. Thus, the use of new in-review data was minimized with a primary reliance on existent driver history information. Measures were taken to ensure that any new interview data, if found to be a major predictor of crash-in volvement, would be readily available or easily obtainable by any pre-crash countermeasure program wishing to implement the prediction equations as components of their effort.

The next few pages present the detailed study plan developed for Phase II. The plan is appropriate for any of the sets of high-risk driver selection criteria, though the method of initially selecting the drivers via the sets of criteria may vary depending upon the nature of the criteria. As outlined in Figure 3, the experimental design involves collecting interviews, driving history, and crash history data on 1500 drivers for each set of high-risk driver selection criteria. The prediction equations will be developed through the use of step-wise multiple regression techniques. The concurrent validity of the prediction equations will be assessed and those variables that are the key predictors identified.

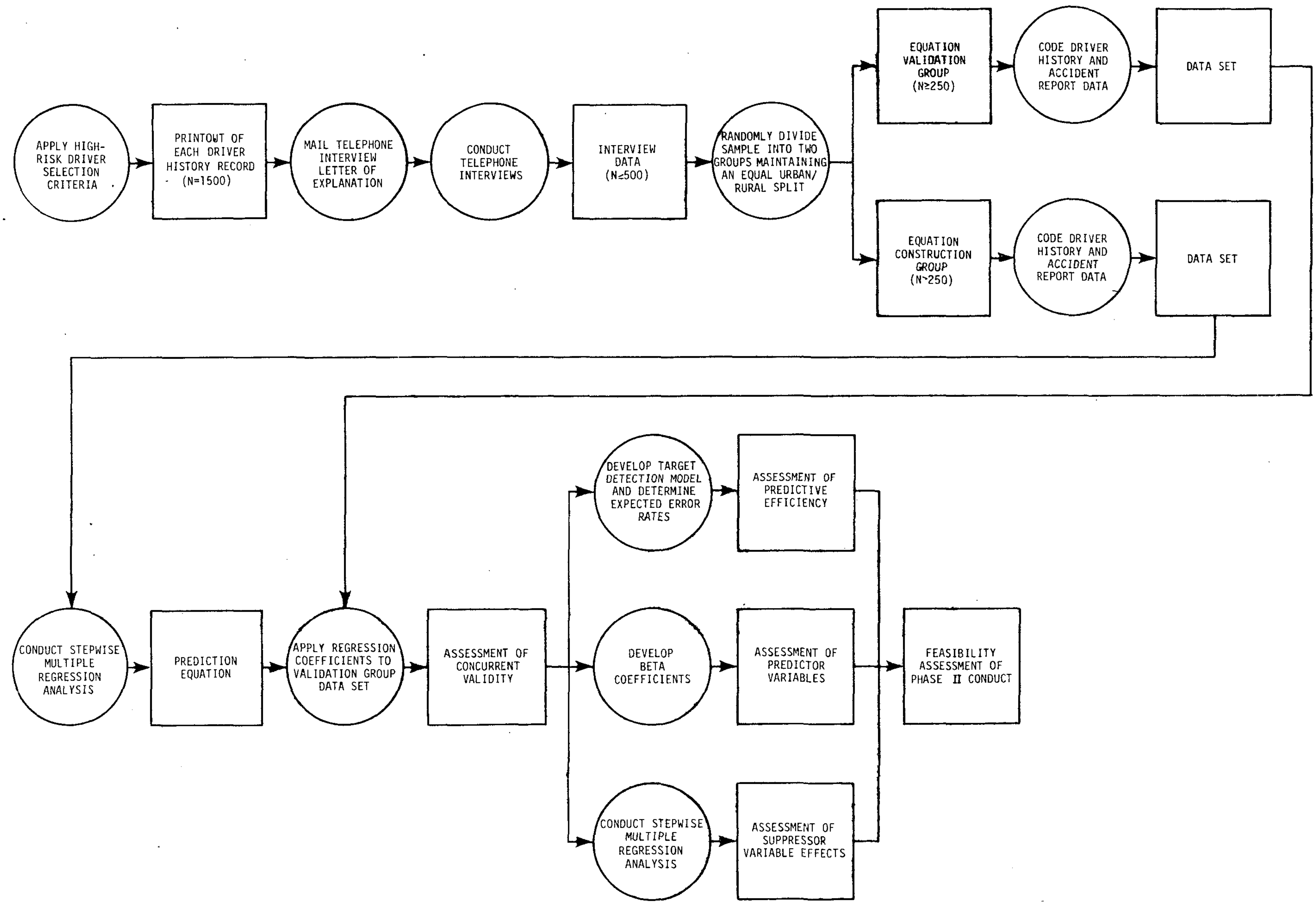


Figure 3. Flow chart of major tasks in Phase II.

SELECTION OF DATA COLLECTION SITES

The use of two data bases, one urban and one rural, was necessary to maximize the general geographic application of resultant prediction equations. It would, of course, be undesirable to develop prediction equations having a limited scope of application. The principal criteria in the selection of the data collection sites were:

- Existence of an automated driver history file
- Complete traffic conviction and crash history contained in driver history file
- Driver history records maintained for at least three years
- Availability of accident investigation reports for at least three years
- Driver history file and accident report files cross-indexed
- Support of necessary agencies

Needless to say, few data sites could satisfy the selection criteria. Two systems that did satisfy the criteria are those maintained by the States of South Dakota and Washington. Therefore, the rural data will be collected from South Dakota while the urban data from King County, Washington. Letters supporting the data collection process, and the project in general, from the agencies responsible for maintaining each record system are contained in Appendix A. Crash statistics for 1972 and 1973 for each location, as well as examples of driver history printouts, accident investigation reports, copies of driver's license applications, and other community descriptors are contained in Appendix B. Each data collection system is described in detail later.

SAMPLING PLAN

Systematic sampling procedures will be used for the initial selection of drivers on which data will be collected. The first step is to implement the sets of high-risk driver selection criteria. Driver history data files or other appropriate records will be searched to identify drivers satisfying each set. In addition to the selection criteria, only drivers who have held a valid driver's license one out of the past three years will be considered eligible for inclusion. Eliminating drivers who have had their licenses revoked briefly could eliminate many drivers whom we are particularly interested in--ASAP-DWI's, for instance. At the other extreme, this approach will remove some relatively new drivers. Though inexperience is often associated with crash-involvement, it fosters the same variability that makes the development of prediction models impossible. We feel the restriction is necessary being aware it does place a minor limitation on the model.

Every other driver identified will be included in the sample until a total of 1500 drivers, 750 at each data collection site, is reached. Because of potential difficulties in tracing drivers, gaining cooperation, etc., we will initially identify a total of 1500 drivers enabling us to obtain the desired sample size of at least 500 drivers on which complete data is available for each set of high-risk driver selection criteria.

As shown in Figure 4, each sample of at least 500 drivers on which complete data are collected will be randomly divided into two groups of 250 drivers each. An equal urban/rural split will be maintained in both groups. Data from the first group--the equation construction group--will be used for the initial development of the prediction equation. The second set of driver data--the equation validation group--will be used to assess the concurrent validity and predictive efficiency of the resultant equation.

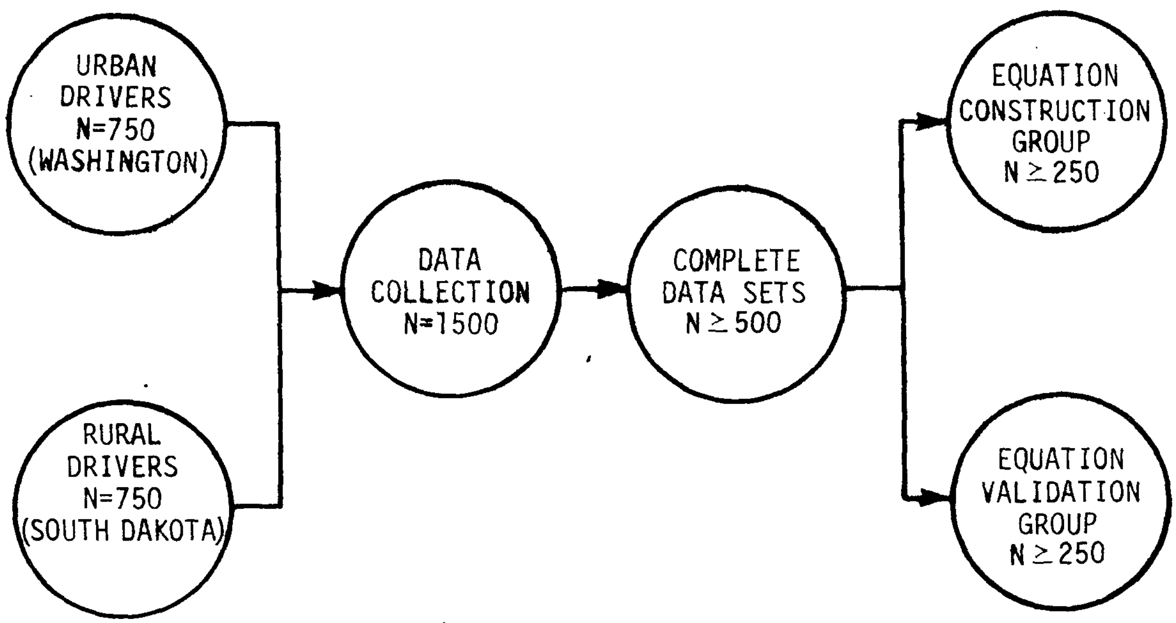


Figure 4. Development of the final driver groups and their associated sample sizes.

DATA ELEMENTS

An assessment was made of variables used in prior analyses to predict a driver's crash-involvement or to describe crash-involved drivers. An attempt was made to determine their role in predicting crash-involvement as well as their applicability for use as screening or selection criteria of high-risk drivers.

In selecting variables for inclusion in the battery of predictor variables, a major trade-off was encountered since it was considered essential that all variable data be easily obtainable from existing sources or on a limited basis through the conduct of simple interviews or questionnaires. For example, a large battery of relevant person-centered variables was considered. But, its use would have necessitated lengthy interviews with individual drivers. And the usefulness of high-risk driver prediction equations resulting from Phases II and III would have been impaired because of the cost and difficulty of collecting the necessary data.

By selecting variables in the light of a review of prior analyses (*1, 13, 16, 24, 25, 27*), the use of variables requiring new data collection was minimized. Only those variables most often correlated with crash-involvement or alcohol-related crash-involvement are included. Thus, data on variables found to be key predictors in the resultant prediction equations will be able to be collected via existing data collection practices or through minimal changes or additions to each procedure.

The crash criterion variables were selected because of their interest to pre-crash countermeasure efforts and the consistency or reliability with which they are reported.

The *total number of fatal and injury crashes over the past three years* will be used as the first criterion variable in the data analysis. It would have been of interest to develop prediction equations for each crash type. But, because of the rarity with which crashes occurs, this was considered impossible.

The use of alcohol-related crash-involvement as a second criterion variable was carefully considered since A/R crashes are the ultimate concern of the program. The principal difficulty in using this variable concerns reporting discrepancies of alcohol involvement in those crashes. These discrepancies would result in significant chance variations being associated with the criterion variable, making the development of an effective prediction model highly unlikely. Rather than futilely attempting to predict alcohol-related crashes, a proxy crash type will be used. A proxy crash type having similar characteristics as an A/R crash, but reported in a consistent manner, was sought. Since the incidence of alcohol-related crashes and driving after drinking is disproportionately greater in the nighttime hours, the number of fatal and injury crashes occurring from 8 p.m. to 4 a.m. was considered a satisfactory substitute. Though it may not be reported as such, the probability that alcohol is involved in this crash type is much greater than for other types. Further, the time of day of crashes is consistently reported. Thus, the second criterion variable is the *number of nighttime fatal and injury crashes a driver has been involved in over the past three years.*

The variables on which data will be collected, their source, and their intended use are listed in Table 7. A three-year time frame will be used for all historical data. The source code is as follows:

DH - Driving history

ACC - Accident investigation report

INT - Interview

The category "USE" was included for information purposes, to show why each item is included. If a variable is used as a criterion for high-risk driver selection or as a criterion variable of a prediction equation, then of course it would not be used as a predictor variable for that particular analysis.

TABLE 7

List of Variable Names and Their Associated Sources and Intended Uses

Variable Number	Variable Name	Source: DH	Source: ACC	Source: INT	Use: Predictor Variable	Use: Selection Criterion	Use: Criterion Variable
1	Age (nearest whole year)	x		x	x	x	
	DRIVING EXPOSURE:						
2	Annual mileage last 12 months			x	x		
3	Annual mileage two years ago			x	x		
4	Absolute amount of change (#2 - #3)				x		
5	Percentage of driving daytime (6 AM to 8 PM)			x	x		
6	Number of times driving at midnight (per month)			x	x		
7	Percentage of driving night-time (8 PM to 4 AM)			x	x		
8	Number of miles driven per work day			x	x		
9	Drinker (1 = yes, 0 = no)			x		x	
	DRINKING PATTERN--NORMAL:						
10	Number of drinking days per month			x	x		
11	Percentage at home			x	x		
12	Type of drink (1 = beer/wine; 2 = mixed drink; 3 = cocktail/straight liquor)			x	x		
13	Percentage in public places			x	x		
14	Average number of drinks per occasion			x	x		
15	Most number of drinks per occasion			x	x		
16	Normal drinking index (#10 x #14 x #12)				x		

Table 7 (Cont.)

Variable Number	Variable Name	Source: DH	Source: ACC	Source: INT	Use: Predictor Variable	Use: Selection Criterion	Use: Criterion Variable
	TYPE OF OCCUPATION: (1 = yes, 0 = no)						
17	Professional			x	x		
18	Manager			x	x		
19	Clerical/sales			x	x		
20	Craftsman			x	x		
21	Operative			x	x		
22	Laborer/unskilled			x	x		
	OCCUPATIONAL STATUS: (1 = yes, 0 = no)						
23	Full-time			x	x		
24	Part-time			x	x		
25	Student			x	x		
26	Retired			x	x		
27	Unemployed			x	x		
28	Annual income index (1 = 0 to $3,000; 9 = $24,000 and up)			x	x		
29	Formal education level (number of years)			x	x		
	MARITAL STATUS: (1 = yes, 0 = no)						
30	Married			x	x		
31	Single (never married)			x	x		
32	Divorced/separated (over one year)			x	x		
33	Widowed			x	x		
34	Recently divorced (one year or less)			x	x	x	

Table 7 (Cont.)

Variable Number	Variable Name	Source: DH	Source: ACC	Source: INT	Use: Predictor Variable	Use: Selection Criterion	Use: Criterion Variable
	DRINKING PATTERNS--SPECIAL OCCASIONS:						
35	Number of occasions per month			x	x		
36	Average number of drinks per occasion			x	x		
37	Most number of drinks per occasion			x	x		
38	Type of drink (1 = beer/wine; 2 = mixed drink; 3 = cocktail/ straight liquor)			x	x		
39	Special drinking index (#35 x #37 x #38)				x		
40	Drive after drinking (1 = yes, 0 = no)			x	x		
41	Number of times drive after drinking (per month)			x	x		
42	Normal driving after drinking index (#16 x #13 x #41)				x		
43	Special drive after drinking index (#39 x #41)				x		
44	Smoke cigarettes (1 = yes, 0 = no)			x	x		
45	Number of cigarettes per day			x	x		
46	Type smoked (1 = filter, 2 = non-filter)			x	x		
47	Hazard index (#45 x #46)				x		
48	Number reported traffic convictions (past three years)	x			x		
	TYPE OF REPORTED CONVICTION:						
49	Number of HMV	x			x	x	
50	Number of DWI	x			x		
51	Number of Reckless Driving	x			x		
52	Number of Speeding	x			x		

Table 7 (Cont.)

Variable Number	Variable Name	Source: DH	Source: ACC	Source: INT	Use: Predictor Variable	Use: Selection Criterion	Use: Criterion Variable
53	Number of DUR/DUS	x			x		
54	Number of Implied Consent	x			x		
55	Number of fatal and PI crashes (past three years)	x			x		x
	CRASH TYPE: NUMBER OF						
56	Fatal		x		x		x
57	Personal injury		x		x		x
58	Single vehicle		x		x		
59	Multiple vehicle		x		x		
60	Nighttime (8 PM to 4 AM)		x		x		x
61	Alcohol-related		x		x		
62	At-fault		x		x		

DATA COLLECTION

INTERVIEW DATA COLLECTION

Some problems are anticipated not only in securing cooperation of interviewees, but also in locating the drivers to be interviewed. Because of the mobility of the type of drivers to be interviewed, wrong addresses and telephone numbers are expected. This, of course, is the main reason for initially identifying 1500 drivers in order to develop complete data sets on 500.

Prior to the interviews, each of the 1500 drivers will be mailed a letter explaining the purpose of the study, the nature of the interview, and soliciting their cooperation. The interview will be short (10 or 20 minutes), since the collection of new data has been purposely minimized. Thus, telephone interviews were judged the most appropriate. This choice is further reinforced by the high cost of conducting personal interviews containing few questions to a group of drivers having the expected wide geographic spread. To increase driver cooperation with the telephone interviews, the letters will be written on the letterhead of a locally identifiable governmental organization. The reliability and validity of the resultant data are expected to be reasonably similar to that obtainable through the conduct of personal interviews.

The telephone interviews will be conducted approximately one week after the mailing of the letters of explanation. Interviews will use a standard interview format like that shown in Appendix C in both data collection sites. After briefly explaining the purpose of the interview, soliciting cooperation, and answering any questions, the interviewer will ask an initial question involving birthdate to verify the identity of the party to be interviewed.

The final structure and length of the telephone interview questionnaire and format would be pre-tested before actual data collection. Further, the results of using the questionnaire in a telephone mode would be compared to its use in a personal interview mode to assess problems of validity and probability. The results of these effects would be incorporated in the final design of the interview data collection process.

As outlined in Table 7, the data to be collected will involve variables related to occupation, marital status, education, salary, driving exposure, drinking patterns, driving after drinking patterns, and other related hazard indices. Call-backs for each driver will be limited to five. A flow chart of the major tasks and decision points involved in the collection of the telephone interview data is shown in Figure 5.

DRIVER HISTORY DATA COLLECTION

The driver history phase of data collection will involve data contained in the driver's driving history file and associated accident investigation reports. The data will be coded only for drivers from which interview data had been previously collected.

Most of the data is available directly from existent records. The major exception is data related to crash type. Acquiring data on crash type variables will require interpretation of information contained in accident investigation reports. Variables involving the number of nighttime, single vehicle, multiple vehicle, fatal, or injury crashes can be directly obtained from these reports. Determining the number of at-fault or alcohol-related crashes will require interpretation of the checklist data or narrative information found in them.

Property damage crashes will be excluded from the analyses because of the inconsistency with thich they are reported. The principal reason for this inconsistency is the varied monetary levels of damage at which state statutes require that a property damage crash be reported. The higher this amount of damage costs the less frequently accidents are reported creating the false impression that relatively few accidents occurred. Such differences would affect the combining of data bases for the purposes of developing the prediction equations. More importantly, they would affect the general applicability of any prediction equations that may result from Phases II and III which would possibly use the number of property damage crashes as a predictor variable.

A crash will be considered alcohol-related when the driver in question has been reported drinking. This will be inferred from any one of at least three different types of responses made by the investigating officer in the accident investigation report. It may involve the charging of the driver with the violation of driving-while-intoxicated or driving-while-impaired; it may involve the reporting of a positive blood alcohol concentration (BAC) or a notation under contributing circumstances indicating the use of alcohol on the part of the driver; or it might be inferred from the comments made by the investigating officer in the narrative description of the crash.

The at-fault crash type will refer to crashes in which the driver in question was considered responsible for the crash. A system similar to that designed by McCarrol and Haddon (*17*) will be used to establish responsibility. Using this format, the driver in question will be considered responsible when one of the following conditions is met:

- He was involved in a single vehicle crash
- His car was the only one moving in a multiple vehicle crash
- He obviously initiated the crash when more than one car was moving

If responsibility for a crash cannot be determined, or if more than one driver could have been responsible, it will not be counted as an at-fault crash. The number of at-fault crashes may well be different than the number in which the driver was judged legally culpable.

DATA COLLECTION FORM

A standardized data collection form has been developed and will be used in both data collection sites (see Appendix C). Measures were taken to ensure compatibility between the data collection form and existing data bases and procedures.

The data collection form integrates telephone interview data, driving history data, and crash data. Each response blank is cross-indexed with its respective variable number. Also, keypunch formating instructions are specified in the left-hand margin of the form, to facilitate direct conversion of the raw data from the forms to punched cards for automated data processing.

The telephone interview was designed to be easy to administer. The number of questions was minimized and arranged in a logical order to facilitate a natural flow of conversation in the telephone interview. Their level of threat was kept as low as possible. The interview questions will be printed in large type to facilitate the actual conduct of the phone interview. Response items requiring integration of interview data are noted in italics. The initial response, date of birth, will be compared to that in the driving history files to verify the identity of the interviewee. If there is a mismatch, the interview will be discontinued.

Finally, space is made available on the Data Collection Form for noting the data necessary for locating the original accident investigation reports associated with any accidents recorded in the driving history file.

DATA COLLECTION SYSTEM--SOUTH DAKOTA

The data collection system in South Dakota will be coordinated through the Division of Highway Safety of the Department of Public Safety. The director of this division is South Dakota's Governor's Representative for Highway Safety. By working through his office, access to data and/or computer software from Central Data Processing, the Office of Driver Licensing, the Office of Motor Vehicle Safety Inspection and Accident Records, and the Office of the Alcohol Safety Action Project is possible. The major components of the data collection system are shown in Figure 6.

Initial selection of drivers satisfying the sets of high-risk driver selection criteria will be based on the data in the files of the Department of Health, Office of ASAP, and the Office of Driver Licensing. The sampling procedures described earlier will be followed.

Drivers who satisfy A, B, and D sets of the high-risk driver selection criteria--male drivers under the age of 20 with one or more HMV, male drivers ages 20 through 24 with one or more HMV, and male drivers ages 65 and over--will be identified through the use of a driver selection computer program applied to the automated driver history data file maintained by the Office of Driver Licensing. The driving history and associated biographical

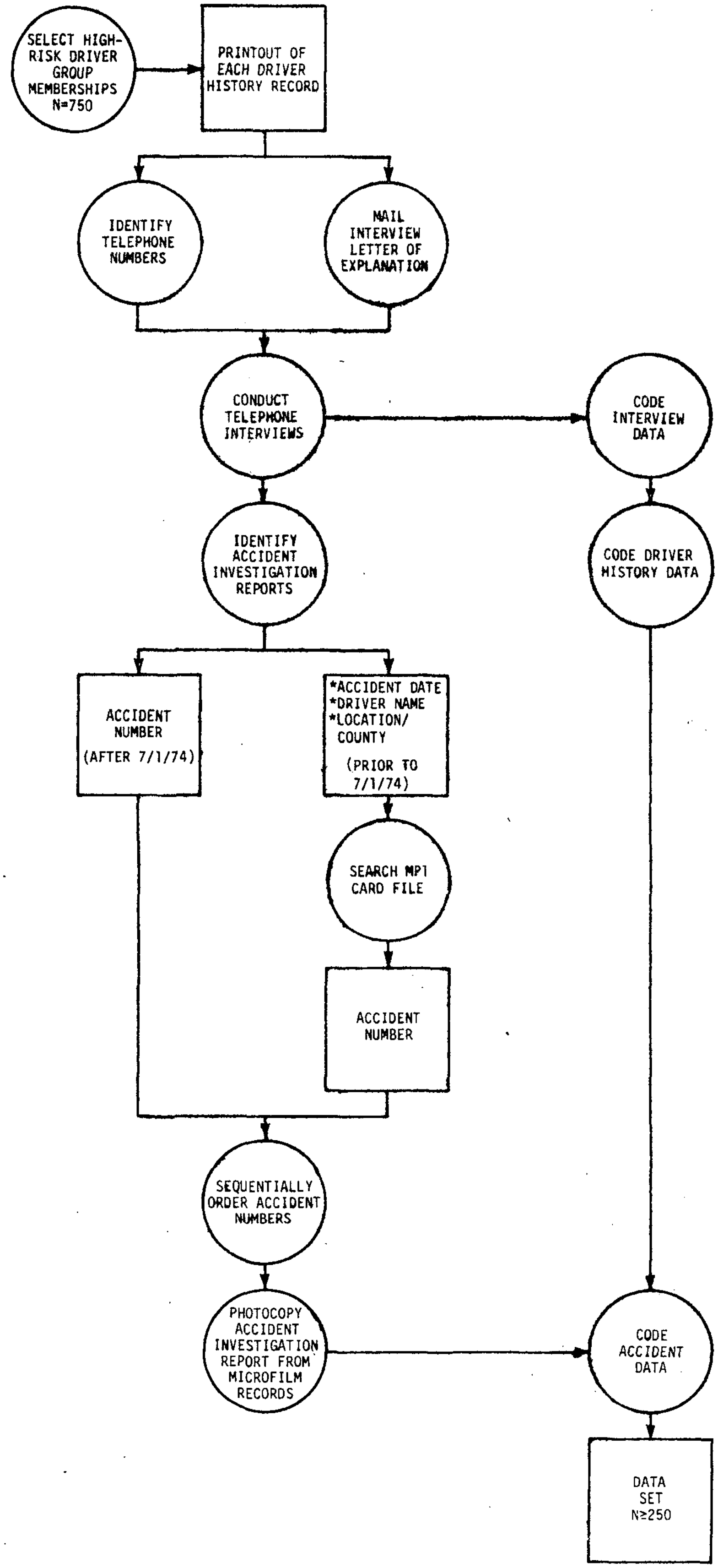


Figure 6. Flow chart of South Dakota Phase II data collection system.

data for each driver to be included in the initial sample will be printed out. The selection criterion of "drives-at-least-one-day-a-week" for set D will be implemented in the early stages of the telephone interview.

Male drivers who have one or more ASAP-DWI violations in the past three years will be identified via a manual search of DWI files maintained by the Office of Alcohol Safety Action Projects. Once the drivers have been identified, a permanent record of their driving histories will be made by selectively querying the automated driver history file.

The last set of high-risk driver selection criteria--recently divorced with children awarded to spouse--will prove more difficult to apply, since marital status is not included in the automated driver history record. Department of Health records will be searched to identify males who have been divorced in the last year with the spouse awarded custody of the children. Again, a printout will be made of their driving history by selectively querying the automated data file.

After the initial application of high-risk driver selection criteria, the data collection system is identical for each group. The pre-interview letter will be mailed on Division of Highway Safety stationery over the signature of the Governor's Representative for Highway Safety. Telephone interview data will be collected by Anacapa Sciences' staff working out of facilities supplied by the Office of Highway Safety. A Watts line will be installed to facilitate state-wide telephone communications. The telephone survey will be conducted from 7 p.m. to 10 p.m. weekdays, 9 a.m. to 8 p.m. Saturday, and noon to 8 p.m. on Sunday. Data collected will be coded on the standardized data collection form described earlier.

Driver histories will be searched and data will be coded for those drivers from which phone interview data have been obtained. Since printouts of each driver's history were previously made, it will only be necessary to review those documents and to code the necessary elements on the standardized data collection forms. During this process the identifiers necessary for accessing the original accident investigation forms will be coded. On records made after July 1, 1974, the key identifier of an accident number will be contained in the automated driver history file. To find an accident number on records prior to this date, it will be necessary to search the MP-1 card file. By using the accident date, driver's name, and county code, the appropriate MP-1 card can be identified and the accident number noted. The accident numbers would then be sequentially ordered for a search of the accident investigation reports on microfilm. Photocopies will then be made of each appropriate record. Anacapa staff would code the appropriate crash data from the photocopied accident investigation reports, thus completing the data set required for each driver.

DATA COLLECTION SYSTEM--KING COUNTY, WASHINGTON

Data collection efforts in King County, Washington, will be conducted by the Research Division of the State Department of Motor Vehicles. Because of local data confidentiality considerations, Anacapa Sciences' staff will not be directly involved in the data collection activities. The standardized data collection tools and procedures to be used in South Dakota would be closely adhered to in Washington. Research Division staff assigned to the project will have access to the necessary data to conduct all aspects of the data collection system by searching driver history files, accident investigation reports, Alcohol Safety Action Project files, and conducting telephone interviews. The major components of the data collection system are shown in Figure 7.

The general sampling plan procedures described earlier will be followed. Drivers who satisfy A, B, and D sets of high-risk driver selection criteria--male drivers under the age of 20 with one or more HMV, male drivers ages 20-24 with one or more HMV, and male drivers ages 65 and over--will be identified by querying the automated driver history data file. Of those drivers found satisfying the selection criteria, every other driver will be selected for inclusion in the initial sample. Finally, a printout of the driving history and associated biographical data will be made for each driver to be included in the sample. The selection criteria of drive-at-least-one-day-a-week for set D, or those drivers over the age of 65 will be implemented during the early stages of the telephone interview.

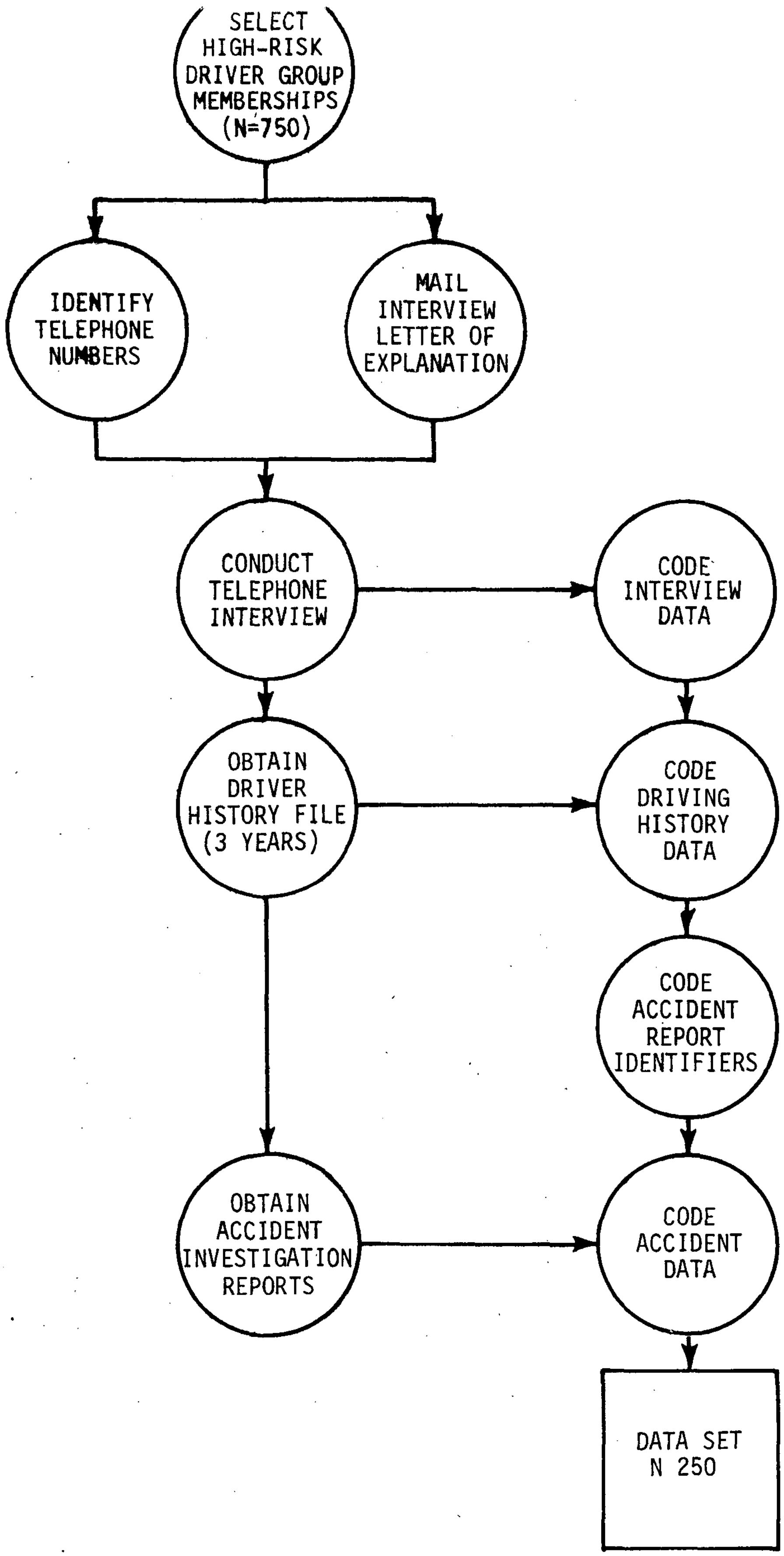


Figure 7. Flow chart of the Phase II data collection system (King County, Washington).

Male drivers who have incurred one or more ASAP-DWI violations during the past 3 years will be identified by a manual search of DWI files maintained for the now discontinued King County Alcohol Safety Action Project. Once the drivers have been identified, a printout of their driving history will be made by selectively querying the automated driver history file.

The last set of high-risk driver selection criteria will be the most difficult to apply since the divorced-within-the-last-year data is not contained in the automated driver history record. A search of court records within King County will be made to identify males who have been involved in a divorce in the last year in which children were involved and the spouse had been awarded the custody of the children. Again, a printout will be made of their driving history by selectively querying the automated data file.

After the initial application of high-risk driver selection criteria, the data collection system is essentially identical for each high-risk driver group. The letter explaining the purpose and the nature of the subsequent telephone interview will be mailed on Department of Motor Vehicles stationery over the signature of the Director of the Research Division. The telephone interview data will be collected by Research Division staff in only King County, Washington. The telephone surveys will be conducted from 7 p.m. to 10 p.m. weekdays, 9 a.m. to 8 p.m. Saturdays, and noon to 8 p.m. on Sunday. The data collected will be coded on the standardized data collection form described earlier.

Upon completion of the telephone interviews, the driver history data and subsequent crash data would be coded on the standardized data collection form. Since the printouts of each driver's driving history would have been previously made, it would be necessary to review those documents and to code the necessary data elements. A set of completed data collection forms would be provided to Anacapa Sciences for each set of high-risk driver selection criterion. The driver's name as well as other personal data would not be included on the form, thus maintaining the anonymity of the drivers to be included in the study.

DATA ANALYSIS

As described earlier, each sample group will be randomly divided into two groups for the purposes of data analysis. The equation construction group will be used for the initial development of prediction equations. The equation validation group will be used as a cross-validation group to determine the concurrent predictive validity and predictive efficiency of the equation.

PREDICTION EQUATION DEVELOPMENT

Step-wise multiple regression procedures will be used in development of the prediction equations (*7, 21, 28*). The step-wise approach is a variation of normal multiple regression procedures. The objective of step-wise multiple regression is to provide the highest level of crash criterion variable prediction using the smallest number of predictor variables.

The initial step in the analysis will be to choose a single variable considered to be the best predictor of the criterion variable. Based on prior analyses, a likely candidate would be the number of traffic convictions, because of its documented power as a crash predictor (*4, 8, 13, 22*). The second and subsequent steps involve the entering of predictor variables which would, in conjunction with prior variables, offer the highest level of prediction. The prediction equation resulting from the step-wise regression analysis will consist of the optimum combination of variables that provide the highest level of criterion variable prediction. The resultant prediction equation might take the form described in Figure 8.

As a by-product of the step-wise multiple regression analysis, a multiple correlation R and a coefficient of R^2 will be derived. The correlation among the predictor variables and the criterion variable evidenced by the multiple correlation will be subjected to a test of statistical significance through the use of an F test. R^2 will, of course, provide an estimate of the amount of criterion variable variance that can be predicted through the use of the predictor variables. The magnitude of R^2 will have major implications in the later assessment of the equation's predictive efficiency.

$$C_1 = b_1x_1 + b_2x_2 + b_3x_3 - b_4x_4 + R$$

where:

C_1 = number of fatal and injury crashes (crash criterion variables)

b_1, b_2, b_3, b_4 = regression coefficient

x_1 = number of traffic convictions (predictor variable)

x_2 = normal drinking index (predictor variable)

x_3 = laborer (occupation type) (predictor variable)

x_4 = employed fulltime (occupation status) (predictor variable)

R = residual

Figure 8. Example of prediction equation format.

CONCURRENT PREDICTIVE VALIDITY ASSESSMENT

The first stage in validating the prediction equations for use in pre-crash countermeasure efforts is to determine how accurately they predict the value of the criterion variable based on existent driving history, rather than that which may occur in the future.

To assess the concurrent predictive validity of the prediction equations, the regression coefficients will be applied to the data values obtained from the appropriate equation validation group of drivers. In this manner predicted crash criterion scores can be derived for each driver. As an index of the concurrent predictive power of the equation, a product moment correlation coefficient will be calculated between the predicted and actual crash criterion variable values. If the resultant correlation is statistically significant, the prediction equation will be considered to have at least concurrent predictive validity and not just reflect the unique characteristics of the equation construction group of the drivers. But, before the equation can be used in pre-countermeasure efforts, the longitudinal predictive validity of the equation will have to be assessed. This, of course, is the objective of Phase III.

PREDICTIVE EFFICIENCY ASSESSMENT

Realistically, no prediction equation will be infallible. The balance among correctly and incorrectly predicted crash occurrence constitutes the predictive efficiency of an equation and is a major factor controlling the future use of the equation in pre-crash countermeasure efforts.

To use effectively the concurrently validated prediction equations as components of pre-crash countermeasure efforts, it will be necessary to stipulate a cutoff value for the predicted criterion variable values. Drivers who have a score exceeding the cutoff value will be considered very likely to become crash-involved, and therefore candidates for pre-crash countermeasures. Drivers with scores below the cutoff value, though high-risk drivers, will not be considered likely enough to become crash-involved, and thus not appropriate candidates for pre-crash countermeasures.

A target detection model like that depicted in Figure 9 demonstrates the four possible results of comparing the crash-involved or non-crash-involved predictions to the actual criterion variable scores or actual frequency of crash-involvement. The two unshaded areas in the figure indicate correct predictions--that is, a driver was predicted to be crash-involved and his actual driving record did evidence at least one crash, or he was predicted to be crash-free, which was verified by his driving history. Wrong predictions are represented by the shaded areas. A false positive error occurs when a driver is predicted to be crash-involved and in fact he was crash-free. The false negative situation occurs when the driver is predicted to be crash-free and in fact he was crash-involved. For the purpose of applying pre-crash countermeasures, a false negative error is worse, though from a practical standpoint a high rate of false positive errors would greatly diminish the ability of the prediction equations.

Actual	Predicted	
	Not crash involved	Crash involved
Not crash involved	*Correct*	*False Positive*
Crash involved	*False Negative*	*Correct*

Figure 9. Model for predictive efficiency assessment.

Initially, the cutoff score would be established giving equal importance to the occurrence of false positive and false negative errors. Once this point of reference has been determined, the cutoff score would be manipulated to minimize the number of false negative situations without drastically increasing the number of false positives, which if became too large would destroy the practical utility or application of the model. The establishment of the cutoff points will result from subjective decisions. But, to facilitate the decision making process, the expected false positive and false negative errors will be calculated using the procedures shown in Figure 10.

$$\text{False Positive Rate} = \frac{P(A|\overline{B})(1-P(B))}{P(A|\overline{B}) + P(B)(P(A|B) - P(A|\overline{B}))}$$

$$\text{False Negative Rate} = \frac{(1 - P(A|B))P(B)}{1 - P(A|\overline{B}) - P(B)(P(A|B) - P(A|\overline{B}))}$$

where:

$P(A|B)$ = Conditional probability of a crash-involved prediction given that a driver is crash-involved.

$P(A|\overline{B})$ = Conditional probability of a crash-involved prediction given that a driver is crash-free.

$P(A)$ = Proportion of drivers predicted to be crash-involved.

$P(\overline{A})$ = Proportion of drivers predicted not to be crash-involved.

$P(B)$ = Proportion of drivers who are crash-involved.

$P(\overline{B})$ = Proportion of drivers who are not crash-involved.

Figure 10. Formulas for false positive and negative error rates.[11]

For example, a cutoff value might be selected that produces the frequencies shown in Table 8. Thus, of 1000 drivers, 600 were correctly predicted to be crash-free and 300 correctly predicted to be crash-involved; 50 each were incorrectly predicted to be crash-free or crash-involved.

TABLE 8

Results of Relating Crash-Involved Predictions to Actual Crash-Involvement

Actual	PREDICTED		Total
	Not Crash Involved ($\bar{A}$)	Crash Involved (A)	
Not crash involved ($\bar{B}$)	600	50	650
Crash involved (B)	50	300	350

The first step in using the formulas reported in Figure 10 is establishing the value for the probability of $A|B$ and the probability of $A|\bar{B}$.

$$P(A|B) = 300/350 = .86$$

$$P(A|\bar{B}) = 50/650 = .08$$

The false positive and negative error rates can now be calculated by substituting these values for $P(A|B)$ and $P(A|\bar{B})$ into the respective equations shown in Figure 10.

$$\text{False Positive Error Rate} = \frac{.08(1.0 - P(B))}{.08 + P(B)\ (.86 - .08)} = \frac{.08(1.0 - P(B))}{.08 + .78P(A)} \times \frac{100}{100} = \frac{8 - 8P(B)}{8 + 78P(B)}$$

$$\text{False Negative Error Rate} = \frac{(1.0 - .86)P(B)}{1.0 - .08 - P(B)(.86 - .08)} = \frac{.14P(B)}{.92 - .78P(B)} \times \frac{100}{100} = \frac{14P(B)}{92 - 78P(B)}$$

Accurate estimates of P(B) or the proportion of people who are crash-involved can now be developed. For the purposes of this example, three values for P(B) were used and their associated false positive and negative error rates calculated. Table 9 reports the error rates associated with each P(B) value.

TABLE 9

Error Rates Associated with P(B) Values

Proportion of drivers who are crash-involved P(B)	False Positive Error Rate	False Negative Error Rate
1/10000	.99892	.00001
1/100	.90205	.00153
1/10	.45569	.01662

If we assume that 10 percent of our population is crash-involved, the false negative error rate is quite small, but the false positive rate is rather large. The false negative error rate is about 16/1000; thus, 16 out of every 1000 drivers judged to be crash-free would in fact be crash-involved. The false positive rate is 45/100; thus, 45 out of every 100 drivers judged to be crash-involved would in fact be crash-free. Though the false negative error rate is acceptable, the number of false positives would certainly be too large to allow the use of prediction equations in a pre-crash countermeasure effort. The judgment of whether the error rates are acceptable will depend upon the specific high-risk driver group in question and the nature of the proposed pre-crash countermeasure program. High-priced or highly restrictive pre-crash countermeasures would, of course, necessitate relatively low false positive error rates.

PREDICTOR VARIABLE ASSESSMENT

To understand sufficiently the structure of the prediction equations, it will be of interest to assess the relative contribution of the predictor variables to the overall prediction of the criterion variable. This cannot be directly made on the basis of the regression coefficients associated with each prediction variable, since each may be in a different unit of measurement. It will be possible to make such an assessment through the calculation of a set of beta coefficients which are net regression coefficients that have been adjusted by expressing each variable in units of its own standard deviation (*28*). This adjustment eliminates the effects of different units of measurement and allows for comparison among the coefficients. Thus, if one coefficient is found to be greater than another, the predictor variable associated with that coefficient makes a greater contribution to the overall prediction of the criterion variable. The identification of these variables will guide the development of pre-crash countermeasure efforts. Further, it will ensure the development of pre-crash countermeasures directed toward group characteristics predictive of and associated with crash-involvement.

SUPPRESSOR VARIABLE ASSESSMENT

A final aspect in understanding the structure of the prediction equations would involve the identification and assessment of suppressor variable effects. Suppressor variable effects will, of course, be evidenced by a prediction variable having a near zero correlation with the crash criterion variable, but a substantial correlation with other predictors. To explore the role of the suppressor variable effects and to determine if they are simply the result of unique characteristics of the equation construction group, an additional multiple regression equation will be calculated using the equation validation group data and the *same* variables determined to be significant predictors in the development of the prediction equation using the initial driver data. A comparison of the regression coefficients associated with the variables would be made between each analytical result. If their role is substantiated in the development of the second equation, they would be considered indeed important to the prediction of the criterion variable. If not substantiated, their effect would be considered related to unique characteristics of the equation construction group of drivers.

FEASIBILITY CONSIDERATIONS

A number of considerations enter into assessing the feasibility of conducting a five-year longitudinal predictive validation study of the final prediction equations. This protracted study can be justified only if the program results at the end of Phase II have significant promise for eventual inclusion in actual pre-crash countermeasure efforts. The products of Phase II will have to meet three criteria. The first is the successful deviation of statistically significant, concurrently validated equations. Secondly, the assessment of predictive efficiency would be a major consideration. It must be possible to establish a cutoff value for the predicted crash criterion scores which will minimize the number of false negative errors without drastically increasing the number of false positive errors, such that the equation may be used as an effective component of pre-crash countermeasure efforts. The third and final consideration is that the data associated with the predictor variables must be readily available to any pre-crash countermeasure program wishing to use the equation as a screening mechanism or a traffic record forecasting device. This is not expected to be a major problem in this analysis, since availability of data or ease of data acquisition were major considerations in the initial selection of predictor variables.

PHASE III STUDY PLAN:
LONGITUDINAL PREDICTIVE VALIDATION

The Phase III study plan describes the methodology for conducting a five-year longitudinal study to assess the predictive validity of the prediction equations resulting from Phase II. The study plan concerns only those sets of high-risk driver group selection criteria for which statistically significant and concurrently validated prediction equations were developed. The five-year longitudinal study will be the true test of the predictive power of the equations.

The prediction of future crash-involvement, whether of general crashes or specific types of crashes, is of particular interest to pre-crash countermeasure efforts. Such efforts might involve drivers' licensing agencies, driver improvement programs, or possibly insurance companies. Therefore, to be suitable as an element of pre-crash countermeasure efforts, the prediction equations must not only have a relatively high concurrent validation coefficient, but also a sufficiently large predictive validity coefficient.

One attempt of non-concurrent prediction used only a one-year predictive period and found the efficiency of their model greatly diminished as compared to its efficiency when used for concurrent prediction (*8*). The proposed five-year predictive period should provide a much more equitable test of the predictive validity and efficiency of the prediction equations.

The experimental design developed for the Phase III study plan is appropriate for any of the prediction equations resulting from Phase II. The major steps of the experimental design are outlined in Figure 11.

SAMPLING PLAN

Systematic sampling procedures, similar to those of Phase II, will be used for the initial selection of drivers on which data will be collected. Methods of applying the high-risk driver selection criteria described in Phase II will again be used. Every other driver identified will be included

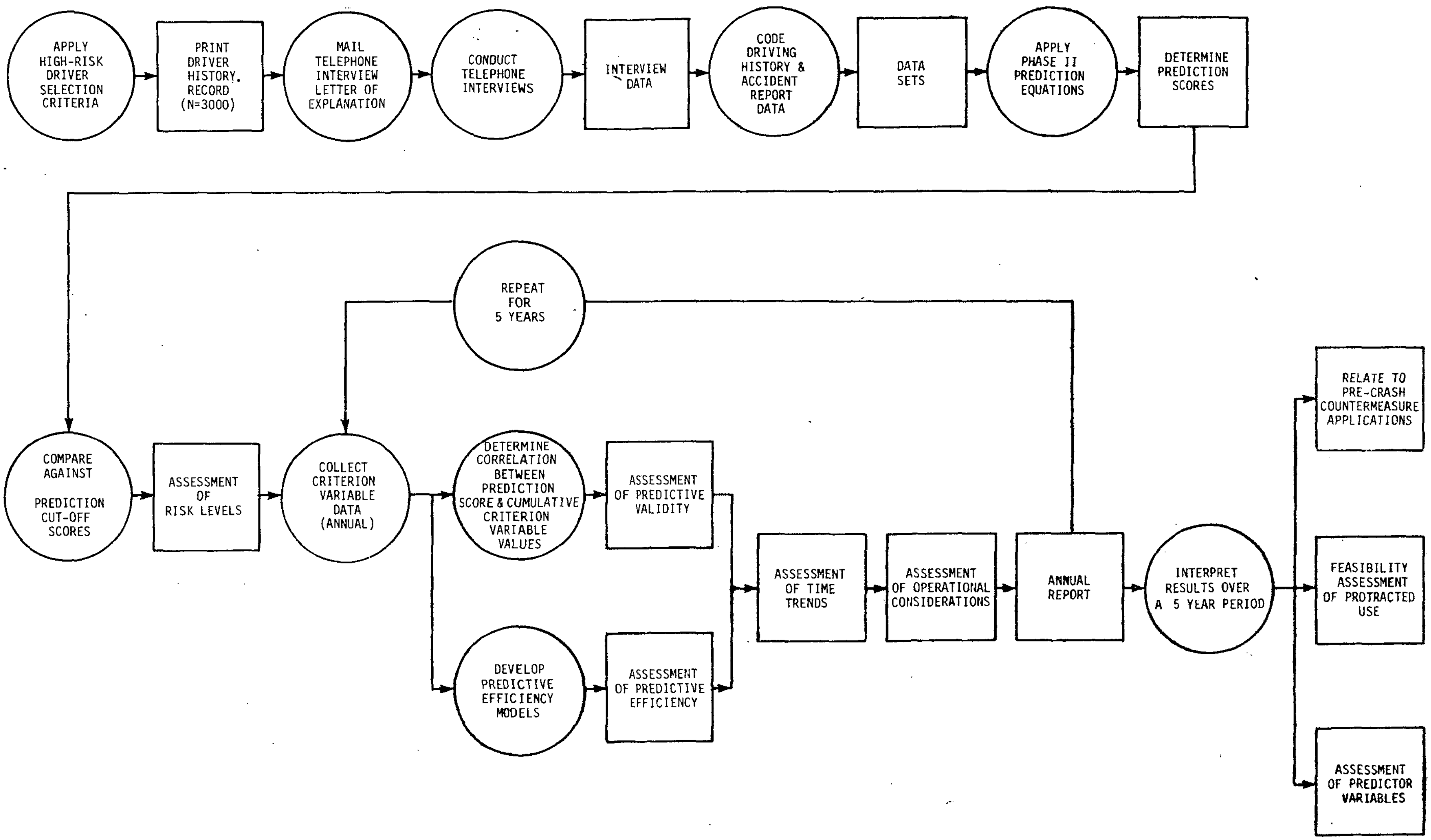


Figure 11. Flow chart of major tasks in Phase III.

in the sample until a total of 3000 drivers, or approximately 1500 at each data collection site, have been identified for each set of high-risk driver selection criteria. Also, to assess the use of high-risk driver selection criteria and prediction equations in a protracted mode, a randomly selected group of drivers will be necessary for comparison purposes. This will involve the random selection of 3000 drivers, 1500 from each data collection site. Because of some difficulties anticipated in following a driver's history for a period of five years and in gaining telephone interview cooperation, we anticipate that initially 3000 drivers for each group will have to be identified to obtain the desired sample size of 1000 drivers on which complete data for the full five-year period would be available. In summary, to assess the protracted use of the five sets of high-risk driver selection criteria, 18,000 drivers would be initially identified so that complete data sets could be developed for 6000.

As before, the driver samples will include equal numbers of urban and rural residents. Each driver will have held a valid driver's license in at least one of the prior three years. Further, a check will be made to ensure that each driver was not a member of the driver samples used in Phase II. And again, the rural data will be collected on drivers living in South Dakota, while the urban data on those living in King County, Washington.

DATA COLLECTION

The data collection sources and procedures described in the Phase II study plan will be used in the collection of the Phase III predictor data. Only data associated with significant predictors in the Phase II prediction equations will be collected in Phase III. The format, the telephone interview, and data collection form would be changed, dependent upon the nature of the data to be collected.

Crash criterion variable data will be collected annually. For each driver on which a complete predictor variable data set was obtained, a copy of his driving history and associated accident investigation reports will be obtained annually from appropriate agencies in South Dakota and Washington. If, in the last year, the driver in question has moved, an attempt will be made to obtain his driving record from the appropriate agency in his new state of residency. The expectation of successfully tracking drivers who change residency is low--another reason for an initially large sample.

DATA ANALYSIS

The prediction equations considered appropriate for the Phase III longitudinal study will be directly applied to the raw data collected from driver samples. As in Phase II, a prediction will be made for each driver by multiplying each predictor variable value by its respective regression coefficient and then summing across all of the values in the equation. The resultant score will be related to actual crash criterion variables data collected over the five-year period.

PREDICTIVE VALIDITY ASSESSMENT

The validation process will be ongoing and cumulative. Crash criterion variable data will be collected annually for a period of five years. Thus, for each driver an initial predicted crash criterion score and an actual crash criterion score will be available. The predictive validity coefficient, or product-moment correlation coefficient between the drivers' prediction scores and the actual crash criterion variable data, will be calculated for each year of data collection. Therefore, after the fifth or final year of crash criterion variable data collection, the initial prediction scores would be correlated with the crash criterion variable data collected over the entire five-year period.

Change in the predictive validity coefficient values over time will be assessed. It is expected that as the length of the predictive period increases, the magnitude of the predictive validity coefficient will also increase. The rate of increase is expected to plateau about the fourth or fifth year demonstrating a trend similar to that shown in Figure 12.

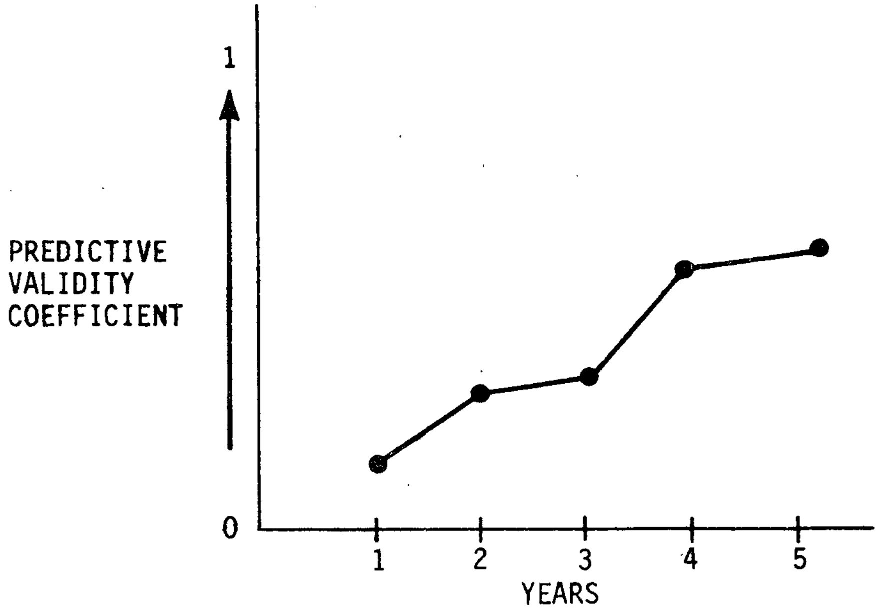


Figure 12. Expected pattern of predictive validity coefficients plotted over the five-year time period.

PREDICTIVE EFFICIENCY ASSESSMENT

The predictive efficiency of the equations will be assessed after each year of crash criterion variable data collection. The first step in the assessment will be the development of a detection model or table like that for nighttime crashes shown in Figure 13. The classification of a driver as a member of any one of the four cells would first depend on whether his prediction criterion score exceeded or was less than the cutoff value developed during Phase II. The second determinant of cell membership would be a driver's actual cumulative crash criterion variable scores. Thus, if his prediction score was greater than the cutoff value (as an example, a prediction of nighttime crash-involvement) and it was determined he was in fact crash involved he would be a member of the shaded cell in the matrix shown in Figure 13.

Such a matrix would be developed annually for each prediction equation. The magnitude of agreement between the predicted and actual crash occurrence will be statistically determined through the use of a Phi coefficient.

Actual	Predicted	
	No Nighttime Crash-Involvement	Nighttime Crash-Involvement
No nighttime crash-involvement	*(Frequency)*	*(Frequency)*
Nighttime crash-involvement	*(Frequency)*	*(Frequency)*

Figure 13. Model for predictive efficiency assessment.

The Phi coefficient, calculated annually, would also serve as an index of predictive efficiency which may be plotted over time. As with predictive validity, the efficiency of the equation can be expected to initially increase. But the increase in predictive efficiency values is not expected to continue over the five-year time period. As shown in Figure 14, the point in time when the Phi coefficient values plateau or become smaller would indicate the effective life-span of the prediction equation, using the initial set of predictor data.

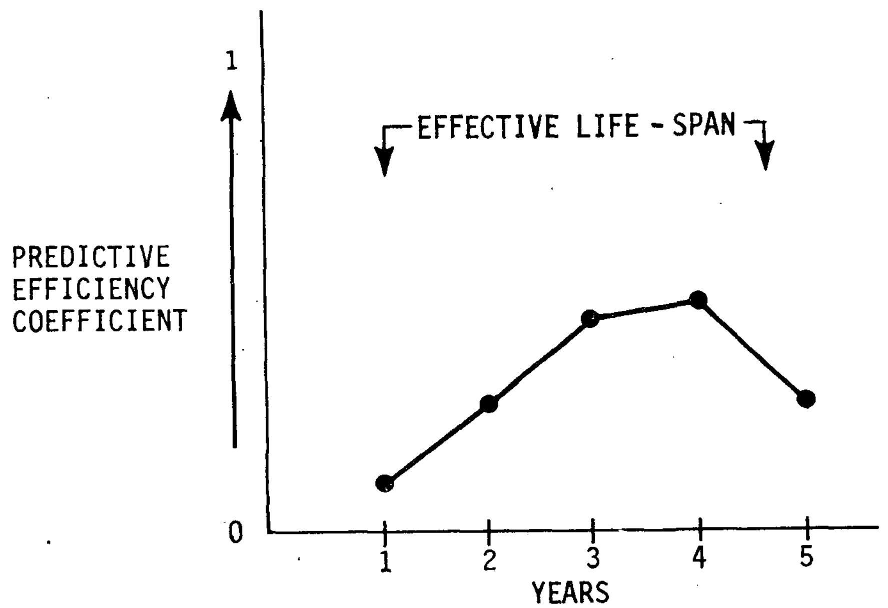


Figure 14. Expected pattern of predictive efficiency coefficients plotted over the five-year time period.

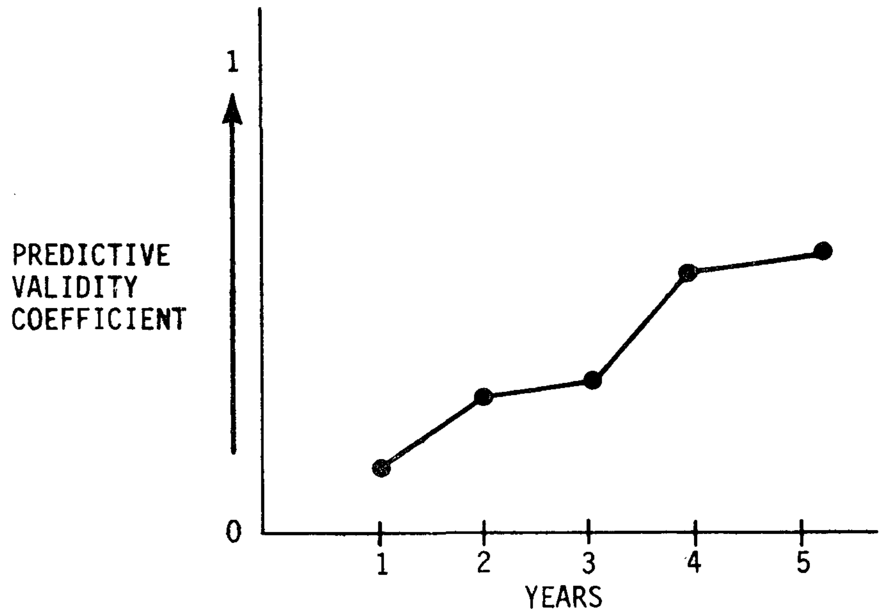


Figure 12. Expected pattern of predictive validity coefficients plotted over the five-year time period.

PREDICTIVE EFFICIENCY ASSESSMENT

The predictive efficiency of the equations will be assessed after each year of crash criterion variable data collection. The first step in the assessment will be the development of a detection model or table like that for nighttime crashes shown in Figure 13. The classification of a driver as a member of any one of the four cells would first depend on whether his prediction criterion score exceeded or was less than the cutoff value developed during Phase II. The second determinant of cell membership would be a driver's actual cumulative crash criterion variable scores. Thus, if his prediction score was greater than the cutoff value (as an example, a prediction of nighttime crash-involvement) and it was determined he was in fact crash involved he would be a member of the shaded cell in the matrix shown in Figure 13.

Such a matrix would be developed annually for each prediction equation. The magnitude of agreement between the predicted and actual crash occurrence will be statistically determined through the use of a Phi coefficient.

Actual	Predicted	
	No Nighttime Crash-Involvement	Nighttime Crash-Involvement
No nighttime crash-involvement	*(Frequency)*	*(Frequency)*
Nighttime crash-involvement	*(Frequency)*	*(Frequency)*

Figure 13. Model for predictive efficiency assessment.

The Phi coefficient, calculated annually, would also serve as an index of predictive efficiency which may be plotted over time. As with predictive validity, the efficiency of the equation can be expected to initially increase. But the increase in predictive efficiency values is not expected to continue over the five-year time period. As shown in Figure 14, the point in time when the Phi coefficient values plateau or become smaller would indicate the effective life-span of the prediction equation, using the initial set of predictor data.

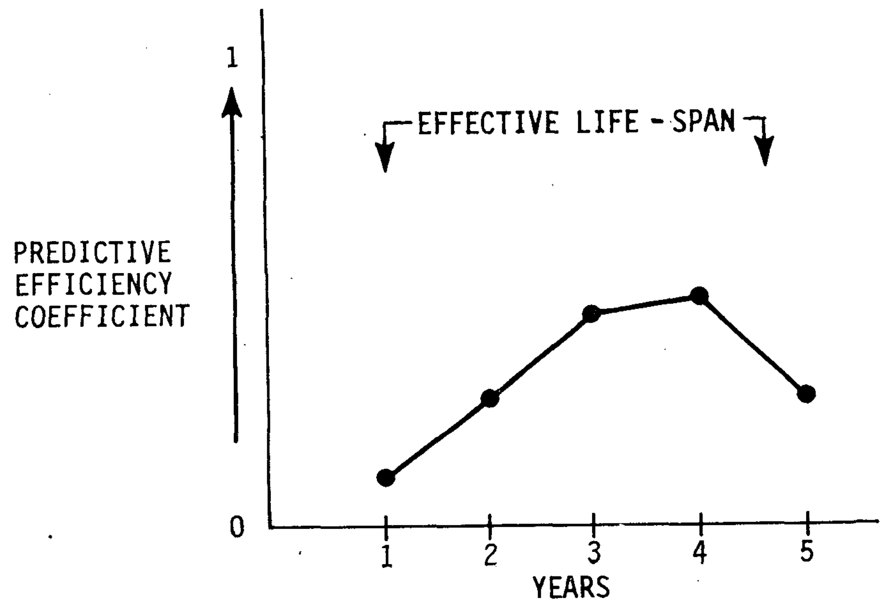


Figure 14. Expected pattern of predictive efficiency coefficients plotted over the five-year time period.

IMPLEMENTATION

Up to this point, our concern in assessing the protracted use of the prediction equations has been limited to assessing the predictive validity and efficiency associated with each equation. Assuming that an equation adequately possesses these characteristics, some other factors may effect the manner in which the equations would be incorporated into a pre-crash countermeasure effort.

As an example, an equation that accurately predicts the future crash-involvement of drivers identified with the use of a set of high-risk driver selection criteria may also accurately predict such for all drivers in general. If this were the case, use of the high-risk driver selection criteria would not be required. Such a finding would eliminate the cost of selecting a driver sub-group, since in fact the prediction equation could be applied to the general driving population.

To determine the predictive validity of the equations when applied to a general driver group, crash criterion scores will be predicted by applying each equation to data collected from a driver group randomly selected from the general driving population. Following the predictive validity procedures described earlier, prediction scores will be correlated with actual cumulative crash criterion scores. If the product moment correlation is statistically significant for any one of the prediction equations, the need for using the associated high-risk driver selection criteria would be questioned. A statistical test would then be made to determine if there was a difference between the correlation coefficient associated with the general driver group and that created through the use of the high-risk driver selection criteria. As illustrated in Figure 15, if there is no difference or if the coefficient associated with the general driver group was greater, use of the selection criteria would not be recommended. If the coefficient associated with the drivers preselected by the high-risk driver selection criteria was greater, then their future use would be justified.

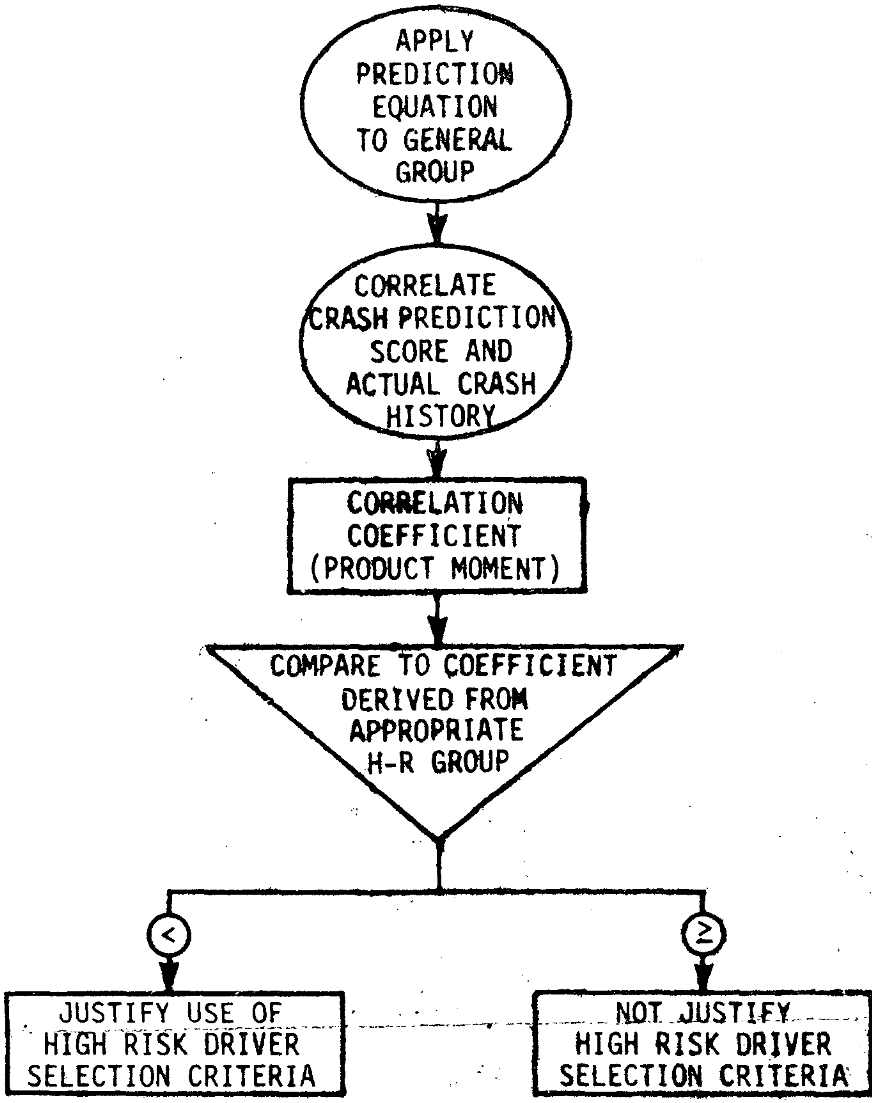


Figure 15. Major tasks and decision points to be used in justifying the use of the high-risk driver selection criteria

Also to be examined is the need for using the cutoff values for the predicted crash criterion scores. The use of the predictive efficiency matrix, thus the cutoff scores, is based on the assumption that individuals within each group of drivers selected via the high-risk driver selection criteria have different probabilities of crash-involvement. As illustrated in Figure 16, to assess the need for establishing cutoff values for each group, a set of matrices will be developed for each equation with the decision or prediction of whether the driver will become crash-involved being made on a random basis, rather than on whether his predicted crash

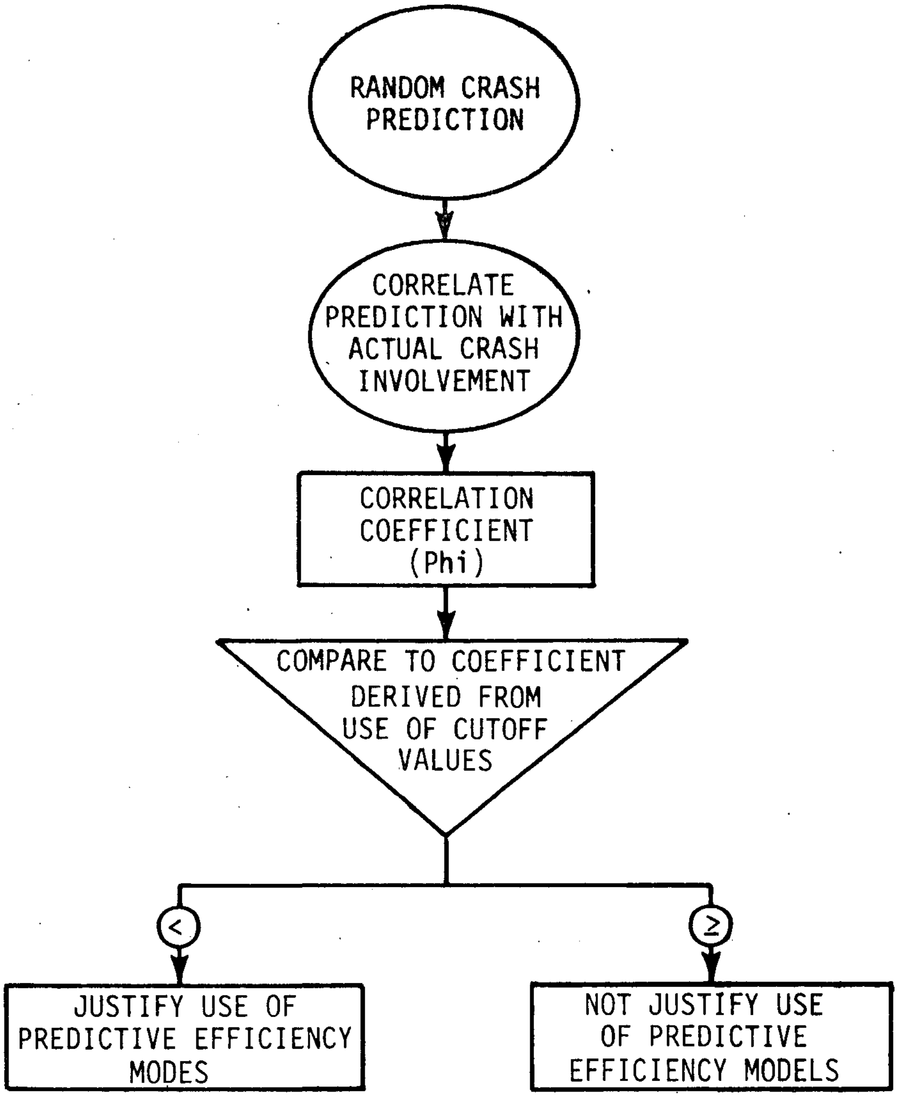


Figure 16. Major tasks and decision points to be used in justifying the use of the predictive efficiency models and their associated cutoff values

criterion score exceeds the cutoff value derived in Phase II. The amount of correlation between the prediction of crash-involvement made in this manner and the actual cumulative crash-involvement will be assessed through the use of a Phi coefficient. If any Phi coefficients were found to be statistically significant, the use of the cutoff scores would be questioned. A statistical test would then be made to determine whether the Phi coefficient based on random assignment, differs from that developed through the use of the cutoff scores. If there is no difference or if the Phi coefficient associated with random selection is greater, the cutoff values would not be recommended. Instead, we would recommend that any pre-crash countermeasure efforts should be leveled at the high-risk group in general rather than at certain members. If the Phi coefficient associated with the model created through the use of the cutoff values was greater, the use of the model, thus the cutoff values, would be considered justified.

PHASE III END PRODUCTS

An immediate result of the Phase III analyses will be an assessment of the capability of using the prediction equations in a protracted mode. Time trends of both the predictive validity and efficiency coefficients would be established so that the effective life-span of the prediction equations can be specified. These parameters are necessary before the prediction equations could be implemented as effective components of pre-crash countermeasure efforts.

Once prediction equations have been shown to be suitable for protracted use, the data that have to be obtained in order to use the equations will be specified based upon the nature of the predictor variables in each prediction equation. Since some of the data may not be currently collected by agencies or programs wishing to use the prediction equations, procedures for collecting such data will be specified. Since data availability and ease of data collection were major considerations in the development of the initial predictor battery, modifications to existing systems have been anticipated. As an example, modifications may involve certain questions being asked during the driver improvement interviews, the addition of fill-in-the-blank questions to driver licensing questionnaires, or the inclusion of data currently collected by driver licensing groups in their automated driver history files.

Methods for and difficulties of implementing the high-risk driver selection criteria will also be set forth. Since each set of selection criteria will have been used in State agencies to identify driver memberships for the conduct of Phases II and III, an exposure to the practical aspects of such implementation will have been encountered.

The final objective of the overall project will be the development of pre-crash countermeasures based on the nature of the relevant predictor variables and high-risk driver selection criteria. The pre-crash countermeasures will be described in terms of objectives, program format, methods of evaluation, and expected results. Since pertinent predictor variables as well as their relative contribution to the prediction of crash-involvement will have been specified for each group, the countermeasure can be directed toward or tailor-made to unique characteristics of the group *which are at this time unknown*. The ultimate objective will be the application of pre-crash countermeasures in a way that corresponds to the unique characteristics of the target group. Table 10 provides an overview of pre-crash countermeasures potentially relevant for use with each set of previously described high-risk driver selection criteria. Some of the techniques are commonly used now; but if applied only to the specific driver membership in question, should be more effective. Further, with the results of the proposed effort, the current approaches can be revised to effectively target unique characteristics of each driver group. The structure of an alcohol traffic safety group that is effective for one driver group can be totally inappropriate for another! As a case-in-point, the proposed countermeasures for set A and set B differs. This is primarily due to the nature, incidence, and severity of alcohol problems found in set B as opposed to A. To impose schools designed for set B or drivers 20-24 to those of set A would prove fruitless, or possibly damaging. Such schools would be tailor-made to characteristics or traits not necessarily evidenced by the younger drivers found in set A. The countermeasure list is by no means exhaustive, but does reflect, even at this stage, pre-crash countermeasures pertinent for each high-risk driver group. The dilemma of identifying a problem without anticipating a solution will be avoided.

TABLE 10

Potential Pre-Crash Countermeasures for Each Set of High-Risk Driver Selection Criteria

Selection Criteria	Potential Pre-Crash Countermeasure	Objective
SET A • Male • Under 20 years of age • One or more HMV in last three years	1. Suspension or revocation of license privilege. 2. Fine and/or jail sentence. 3. Installation of speed limiting devices. 4. Parent-young driver alcohol-traffic safety reeducation.	1. Deter driving. 2. Deter driving. 3a. Deter dangerous driving. b. Decrease crash severity. 4. Increase responsible driving.
SET B • Male • 20-24 years of age • One or more HMV in last three years	1. Installation of speed limiting devices. 2. Installation of alcohol interlock system as a condition of driving history. 3. Alcohol-traffic safety reeducation. 4. Conditional insurance premium increases. 5. Restricted license and vehicle identifier--luminous sticker (restrict nighttime driving).	1a. Deter dangerous driving. b. Decrease crash severity. 2. Deter driving after drinking. 3. Increase responsible driving. 4. Deter dangerous driving. 5. Deter nighttime driving.
SET C • Male • Divorced within last year • Spouse awarded custody of child	1. Installation of alcohol-interlock system as a condition of divorce. 2. Individual or group therapy as a condition of divorce or driver licensing.	1. Deter driving after drinking. 2a. Facilitate a responsible stress reaction to divorce situation. b. Deter driving after drinking.

Table 10 (Cont.)

Selection Criteria	Potential Pre-Crash Countermeasure	Objective
SET D • Male • 65 years of age or older • Drives at least one day a week	1. Installation of alcohol interlock device as a condition of driver license. 2. Mandatory periodic re-licensing examination (written and road). 3. Restricted license and vehicle identifier (luminous sticker--contingent with times and locations of dense traffic).	1. Deter driving after drinking. 2. Prevent licensing of incompetent drivers. 3. Decrease high information load driving.
SET E • Male • One or more ASAP-DWI violations in last year	1. Installation of alcohol interlock system as a condition of re-licensing. 2. Mandatory jail sentence. 3. Alcohol-traffic safety re-education. 4. Individual or group therapy with follow-up. 5. In-patient treatment with follow-up. 6. Install speed limiting device.	1. Deter driving after drinking. 2a. Deter driving after drinking. b. Create crisis situation which will facilitate re-education. 3. Increase responsible driving. 4. Increase responsible drinking thus driving. 5. Deter drinking thus driving after drinking. 6a. Deter dangerous driving. b. Decrease crash severity.

APPENDIX A

DATA COLLECTION SITE SUPPORT LETTERS

Department of Public Safety

DIVISION OF HIGHWAY SAFETY
Public Safety Building
Pierre, South Dakota 57501
(605) 224-3546

November 22, 1974

Roger E. Hagen, Ph.D.
Senior Scientist
ANACAPA SCIENCES, Incorporated
2034 De LaVina
Santa Barbara, California 93102

Dear Dr. Hagen:

We would like to take this means to confirm the support by the South Dakota Division of Highway Safety of your efforts involving the identification of high-risk driver groups. We further support the development of crash related predictive devices for use in pre-crash countermeasure efforts.

The conduct of the final two phases of the project are, of course, as yet only tentative, but if you should be offered the opportunity to conduct them, we will be most happy to participate by serving as a rural driver data collection site. We have found both the general plans for Phase II and III as well as the specific sections relating to South Dakota to be acceptable. The costs associated with data collection have been discussed and properly outlined.

The use of predictive techniques in driver improvement and other pre-crash countermeasure efforts have not previously been fully utilized in our state. Because our Division encompasses all of Drivers License, Accident Records, Safety Inspection, Federal 402 Safety Programs, Public Information & Education, and the SD:ASAP, we feel we are uniquely qualified to participate in an early identification of high-risk driver groups. As the Division of Highway Patrol is a sister organization, we feel strongly that follow-up can be provided after the identification and if needed, pre-crash countermeasure efforts can be implemented.

We are looking forward to the opportunity of working with you and Anacapa Sciences, Incorporated, in the near future.

Yours very truly,

DIVISION OF HIGHWAY SAFETY

J. M. ECKMAN
Director

JME:kr

STATE OF WASHINGTON
DEPARTMENT OF MOTOR VEHICLES

DANIEL J. EVANS, GOVERNOR
JACK G. NELSON, DIRECTOR

DEPARTMENT OF MOTOR VEHICLES

OLYMPIA, WASHINGTON 98501

December 20, 1974

Dr. Roger E. Hagen
ANACAPA Sciences, Incorporated
Post Office Drawer Q
Santa Barbara, California 93102

Dear Dr. Hagen

We have reviewed the Proposed Phase II workplan as set forth in your Technical Report 249: "Analysis of High-Risk Driver Groups for Alcohol Countermeasures," and find that the program objectives are consistent and compatible with our efforts and desires to develop more effective countermeasures for controlling the problem drinking driver.

The data elements you have identified for incorporation into a predictive model appear appropriate and reasonable. As you know, some of the personal information items you are seeking are relatively "sensitive" and will require extreme tact and skill to elicit from the target populations. I am certain, however, that successful techniques can be developed and applied to establish the required data base.

The driving history data you are requesting is available and should require only some re-programming and computer run-time to generate in nearly directly applicable format. The Department's driving records are, however, "secured" to protect the individual rights of each operator and as such could not be released in any identifiable format to unauthorized groups, organizations, agencies or individuals. I am confident, however, that successful negotiations could be undertaken which would produce the data base you are seeking for the next phase of your program.

Best wishes on your very worthwhile attack on a problem which has long eluded us and be assured that the Research and Technology Division will provide whatever support it can in order to maximize your probability of success.

Yours in traffic safety

C. L. Klingberg

C. L. Klingberg, Ph.D.
Research Supervisor
Research & Technology Division
(206) 753-2313

CLK:sb

APPENDIX B

DESCRIPTION OF DATA COLLECTION SITES

A brief description of each data collection site, a summary of their traffic crash statistics, as well as documents currently used in their driver licensing and driver history information systems are described or displayed in this Appendix.

KING COUNTY, WASHINGTON

King County, located in the northwestern part of the State, includes the city of Seattle, the State's major metropolitan area. One-third of the State's population, over 1-1/2 million people are concentrated in this geographic location. As an indicator of the size of the driving population, the King County vehicle registration is steadily increasing with a total of about 785,000 vehicles being registered in 1972.

The nature of the traffic safety problem within King County may be generalized from the Seattle traffic crash data reported in Table B-1 for the years of 1972 and 1973.

TABLE B-1

Seattle Traffic Accident Summary

	1973	1972
Traffic Accidents Reported*	20,148	19,832
Traffic Fatalities	63	53
Fatal Accidents	52	47
Traffic Injuries	9,689	9,623
Injury Accidents	6,664	6,631

*Reported accidents which resulted in $100 or more property damage to one vehicle, or in injury or death.

The final consideration in the selection of King County as the urban data collection site is that it was the location of a concentrated ASAP effort.

SOUTH DAKOTA

The entire State of South Dakota, the rural data collection site, embraces a total population of approximately 685,000 people. Of this group, 417,000 are licensed drivers with approximately 466,000 vehicles being registered in the State.

Although sparsely populated, the traffic safety problem within the State, as in most rural states, is magnified by great geographic distances involving a large number of miles of roadway.

A final aspect involved in the selection of South Dakota as the rural data collection site is that it is one of four state-wide ASAP efforts. Since one of the high-risk driver groups was to involve ASAP-DWI's, the selection of a rural data collection site was limited. A summary of the two-year crash statistics for South Dakota is shown in Table B-2.

TABLE B-2

South Dakota Traffic Accident Summary

	1973	1972
Traffic Accidents Reported*	14,985	17,883
Traffic Fatalities	286	294
Fatal Accidents	228	235
Traffic Injuries	6,774	6,718
Injury Accidents	4,321	4,267

*Reported accidents which resulted in $100 or more property damage to one vehicle, or in injury or death--$250 after 7-1-73.

EXISTENT RECORD SYSTEMS

Drivers license applications, driver history printouts, and accident investigation reports are included in this section. A review of these documents will provide an insight into the structure of the existent information systems in both the States of Washington and South Dakota. Further, the types of data elements currently available can be assessed.

Orig. Lic. ☐ Exam. Fee No. .... Exam. Fee Date .... Station No. ....

Inst. Per. ☐

Agri. Per. ☐

Washington State Driver's Application

Name ....

(Last) (First) (Middle)

Address			City or Post Office	Zip Code	Co. Code

Expiration Date			Sex	Birthdate			Weight	Height	Eyes
Mo.	Day	Yr.		Mo.	Day	Yr.		Ft. – In.	

History

Birthplace .... Dr. Training: ☐ No ☐ Yes (type)...............................

Prev. Dr. Lic. ☐ No ☐ Yes–Name .... Where..........................

Convicted/Forfeited bail: ☐ DWI ☐ Neg. Hom. with Veh. ☐ Hit & Run ☐ Reckless Dr.

Suspension: ☐ No ☐ Yes–Date .... Reason..

Judge.. Court .... City........................... State ....

Physical Condition

☐ Epilepsy ☐ Paralysis ☐ Heart trouble ☐ Fainting spells ☐ Dizzy spells ☐ Insanity

☐ Diabetes ☐ Narcotic drugs ☐ Other ....

Med. Cert. Issued .... Med. Cert. Req. Yr....... Mo. ...... Code.......... Cycle ....

Screening Tests
Vision
Color
Hearing

ACUITY	BOTH	RIGHT	LEFT		FUSION	COLOR	HEARING
Without Lenses	20/	20/	20/	Satisfactory			
With correction	20/	20/	20/	Unsatisfactory			

Restrictions

☐ None ☐ Corr. Lenses ☐ Medical ☐ F.R. (type) ....

☐ Area/Equip. ....

☐ Must be accompanied by licensed driver ☐ Endorse...................................

Other

Examinations

	1st TEST	2nd TEST	3rd TEST
Knowledge			
Driving			

I do hereby certify under the penalty of perjury that the information on this application, including name and birthdate is true and correct. Further, that I have no other valid driver's license or Washington identification card, and/or *instruction permit, in my possession.*

____
signed

MINOR'S SIGNATURE

I hereby certify that I am the ______________________ (Parent, Guardian, Employer) of this applicant who is applying for an instruction permit/driver license and I certify that his/her birthdate as given on this application is correct. My signature attests to the fact that I grant permission for the Department of Motor Vehicles to consider his/her application.

Signed ....

Witnessed by examiner:

Date of Issue ....

....

Validation No. ....

DLE-76 (R/9/74) S. F. 4948

STATE OF WASHINGTON
MOTOR VEHICLE COLLISION REPORT

OFFICIAL USE ONLY
NO.

COUNTY NO. | CITY NO. | SPR / URBAN / RURAL
ADM-CLS | PREFIX | ROUTE OR STREET CODE | SECTION
PREFIX | EQ | MILEPOST
RAMP | DIAGRAM DATA
INTER / NON INTER / X-RD CLS. | INTERSECTING STREET OR ROAD/OR REFERENCED CROSS STREET OR ROAD
SPEC. CODE USE

DATE OF COLLISION: MO DAY YEAR | DAY OF COLLISION: SUN MON TUES WED THUR FRI SAT | TIME OF COLLISION: HOUR . MINUTES ☐ AM ☐ PM

PLACE WHERE ACCIDENT OCCURRED: COUNTY | CITY, TOWN | IF OUTSIDE CITY LIMIT INDICATE HOW FAR: MILES N E S W OF | CITY, TOWN

ROAD ON WHICH ACCIDENT OCCURRED: GIVE NAME OF STREET, ROAD OR HIGHWAY | INTERSECTING WITH: STREET OR ROAD

NON INTERSECTION-LOCATION OF COLLISION

BETWEEN ____ STREET AND ____ STREET

IF NOT AT INTERSECTION: FEET N E S W OF — SHOW NEAREST INTERSECTING, STREET, HIGHWAY, HOUSE NUMBER, BRIDGE, RAILROAD CROSSING, MILEPOST OR IDENTIFYING LANDMARK

COLLISION INVOLVED — TOTAL NO. OF VEHICLES: ☐ VEHICLE-VEHICLE ☐ VEHICLE-OBJECT ☐ VEHICLE-PEDESTRIAN ☐ VEHICLE-BICYCLE ☐ VEHICLE-TRAIN ☐ NON-COLLISION ☐ OTHER (WRITE) ☐ HIT-RUN

OBJECT STRUCK (NAME OF OBJECT STRUCK) | OWNER OF OBJECTS NAME AND ADDRESS | LOCATION IN ROADWAY | FEET N E S W OF ROAD EDGE | ESTIMATED COST TO REPAIR OBJECT $

IF MORE THAN TWO CARS WERE INVOLVED IN THIS COLLISION OR MORE THAN TWO PERSONS WERE INJURED USE A SEPARATE COLLISION REPORT FORM

VEHICLE NO. 1 YOUR CAR	VEHICLE NO. 2 OTHER CAR
DRIVERS LAST NAME · FIRST NAME · MIDDLE	DRIVERS LAST NAME · FIRST NAME · MIDDLE
STREET ADDRESS · ROUTE NO. AND BOX NO.	STREET ADDRESS · ROUTE NO. AND BOX NO.
CITY · STATE · ZIP CODE · DRIVERS OCCUPATION	CITY · STATE · ZIP CODE · DRIVERS OCCUPATION
DRIVERS LICENSE NUMBER · STATE · SEX M F · DATE OF BIRTH MO DAY YEAR · AGE	DRIVERS LICENSE NUMBER · STATE · SEX M F · DATE OF BIRTH MO DAY YEAR · AGE
VEHICLE YR. · MAKE (CHEV-DODGE) · MODEL (NOVA-DART) · BODY STYLE (2DR.)	VEHICLE YR. · MAKE (CHEV-DODGE) · MODEL (NOVA-DART) · BODY STYLE (2DR.)
LICENSE PLATE NO. · STATE · TRAILER PLATE NO. · STATE	LICENSE PLATE NO. · STATE · TRAILER PLATE NO. · STATE
VEHICLE IDENTIFICATION NO. (1968 MODELS & NEWER) · ODOMETER (MILEAGE)	VEHICLE IDENTIFICATION NO. (1968 MODELS & NEWER) · ODOMETER (MILEAGE)
REGISTERED OWNER (LAST-FIRST-MIDDLE NAME) · DRIVERS LICENSE NO.	REGISTERED OWNER (LAST-FIRST-MIDDLE NAME) · DRIVERS LICENSE NO.
OWNERS ADDRESS (STREET, CITY AND STATE) · DATE OF BIRTH MO DAY YEAR	OWNERS ADDRESS (STREET, CITY AND STATE) · DATE OF BIRTH MO DAY YEAR
PARTS OF VEHICLE DAMAGED · ESTIMATED COST TO REPAIR VEHICLE $	PARTS OF VEHICLE DAMAGED · ESTIMATED COST TO REPAIR VEHICLE $

LIABILITY INSURANCE INFORMATION-VEHICLE NO. 1— WAS THERE AUTOMOBILE LIABILITY INSURANCE COVERAGE IN EFFECT FOR THIS ACCIDENT ON YOUR CAR ☐ YES ☐ NO

NAME AND ADDRESS OF LIABILITY INSURANCE POLICY HOLDER: NAME · ADDRESS · CITY · STATE · ZIP | NAME OF LIABILITY INSURANCE COMPANY

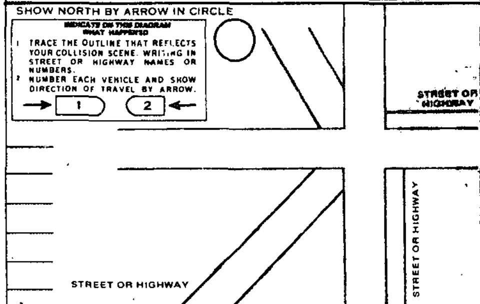
NAME AND ADDRESS OF LIABILITY INSURANCE AGENT · CITY · STATE · ZIP | LIABILITY POLICY NUMBER

1ST INJURY	2ND INJURY: (USE SEPARATE REPORT FOR ADDITIONAL INJURIES)
NAME · AGE	NAME · AGE
ADDRESS · SEX M F	ADDRESS · SEX M F
NATURE AND EXTENT OF INJURIES:	NATURE AND EXTENT OF INJURIES:
DID INJURIES REQUIRE EXAMINATION BY A DOCTOR? NO YES DOCTORS NAME	DID INJURIES REQUIRE EXAMINATION BY A DOCTOR? NO YES DOCTORS NAME
STATUS OF INJURED: ☐ DRIVER ☐ PASSENGER ☐ PEDESTRIAN · IN VEHICLE No. · ☐ OTHER WRITE IN	STATUS OF INJURED: ☐ DRIVER ☐ PASSENGER ☐ PEDESTRIAN · IN VEHICLE No. · ☐ OTHER WRITE IN
MARK FIRST ONE THAT APPLIES: KILLED ☐ · DISABLING INJURY (SEVERE) 5☐ · NON-DISABLING INJURY (MINOR) 6☐ · POSSIBLE INJURY (I.E. COMPLAINT OF PAIN ETC.) 7☐	MARK FIRST ONE THAT APPLIES: KILLED ☐ · DISABLING INJURY (SEVERE) 5☐ · NON-DISABLING INJURY (MINOR) 6☐ · POSSIBLE INJURY (I.E. COMPLAINT OF PAIN ETC.) 7☐

TOTAL INJURED

SHOW NORTH BY ARROW IN CIRCLE

INDICATE ON THIS DIAGRAM WHAT HAPPENED
1 TRACE THE OUTLINE THAT REFLECTS YOUR COLLISION SCENE. WRITING IN STREET OR HIGHWAY NAMES OR NUMBERS.
2 NUMBER EACH VEHICLE AND SHOW DIRECTION OF TRAVEL BY ARROW.
→ 1) (2 ←



DESCRIBE, BELOW, WHAT HAPPENED: (REFER TO VEHICLES BY NUMBER)

VEHICLES POSITIONS BEFORE COLLISION

VEHICLE	HEADED N S E W	ON STREET OR HIGHWAY NAME OR NO.	NO. OF LANES IN ONE DIRECTION	VEHICLE LEGALLY PARKED YES NO	IF PARKED WAS VEHICLE OCCUPIED YES NO
NO 1 (YOUR)	☐ ☐ ☐ ☐			☐ ☐	☐ ☐
NO. 2 (OTHER)	☐ ☐ ☐ ☐			☐ ☐	☐ ☐
PEDESTRIAN	☐ ☐ ☐ ☐	ALONG · OR CROSSING · FROM · TO			

INVESTIGATED BY: ☐ STATE PATROL ☐ OTHER POLICE ☐ CITY POLICE ☐ NO INVESTIGATION ☐ SHERIFF

PEDESTRIAN WAS USING: 1☐ SIDEWALK 2☐ WALKWAY 3☐ SHOULDER 4☐ MARKED CROSSWALK 5☐ UNMARKED CROSSWALK 6☐ OTHER

ROAD SURFACE (CHECK ONE) VEHICLE NO 1 NO 2
☐ 1 ☐ DRY
☐ 2 ☐ WET
☐ 3 ☐ SNOW
☐ 4 ☐ ICE
☐ 5 ☐ OTHER SPECIFY

WEATHER
1 ☐ CLEAR
2 ☐ RAINING
3 ☐ SNOWING
4 ☐ FOG
5 ☐ OTHER SPECIFY

LIGHT CONDITIONS
1 ☐ DAYLIGHT
2 ☐ DAWN
3 ☐ DUSK
4 ☐ DARK-STREET LIGHTS ON
5 ☐ DARK-STREET LIGHTS OFF
6 ☐ DARK-NO STREET LIGHTS
7 ☐ OTHER SPECIFY

TRAFFIC CONTROL (CHECK ONE) VEHICLE NO 1 NO 2
☐ 1 ☐ SIGNALS
☐ 2 ☐ STOP SIGN
☐ 3 ☐ YIELD SIGN
☐ 4 ☐ FLASHING RED
☐ 5 ☐ FLASHING AMBER
☐ 6 ☐ RR SIGNAL
☐ 7 ☐ OFFICER/FLAGMAN
☐ 8 ☐ OTHER SPECIFY

TYPE OF ROAD VEHICLE NO 1 NO 2 (CHECK ONE OR MORE)
☐ 1 ☐ ONE WAY
☐ 2 ☐ TWO WAY
☐ 3 ☐ REVERSIBLE ROAD
☐ 4 ☐ INTERCHANGE (LOOP/RAMP)
☐ 5 ☐ ALLEY
☐ 6 ☐ TWO WAY LEFT TURN LANES
☐ 1 ☐ SEPARATED
☐ 2 ☐ DIVIDED
☐ 3 ☐ UNDIVIDED

DRIVER/VEHICLE ACTIONS (CHECK ONE OR MORE) VEHICLE NO 1 NO 2
☐ 1 ☐ GOING STRAIGHT AHEAD
☐ 2 ☐ OVERTAKING AND PASSING
☐ 3 ☐ MAKING RIGHT TURN
☐ 4 ☐ MAKING LEFT TURN
☐ 5 ☐ MAKING U-TURN
☐ 6 ☐ SLOWING
☐ 7 ☐ STOPPED FOR TRAFFIC
☐ 8 ☐ STOPPED AT SIGNAL OR STOP SIGN
☐ 9 ☐ STOPPED IN ROADWAY
☐ 10 ☐ STARTING IN TRAFFIC LANE
☐ 11 ☐ STARTING FROM PARKED POSITION
☐ 12 ☐ MERGING (ENTERING TRAFFIC)
☐ 15 ☐ BACKING
☐ ☐ GOING WRONG WAY
☐ ☐ OTHER (SPECIFY)

REASON FOR NOT SEEING DANGER (OBSCURED VISION, DISTRACTIONS, ETC.)

WITNESS NAME	ADDRESS	SEX	AGE
1			
2			
3			

SIGNATURE OF PERSON COMPLETING REPORT | ADDRESS | DATE OF REPORT MO DAY YEAR
X

DISTRIBUTION OF COPIES: SHEET NO. 1 WASHINGTON STATE PATROL - OLYMPIA, WASHINGTON · SHEET NO. 2 TO DEPT. OF MOTOR VEHICLES - DIVISION OF FINANCIAL RESPONSIBILITY - OLYMPIA, WASHINGTON · SHEET NO. 3 TO LOCAL LAW ENFORCEMENT AGENCY WHERE THE ACCIDENT OCCURRED. · SHEET NO. 4 YOUR COPY

SF 4859 (REV. 8-71)

C 67

DL-005

FOR DEPARTMENT USE ONLY
RECEIPT NUMBER

STATE OF SOUTH DAKOTA
APPLICATION FOR DRIVERS LICENSE
PLEASE READ INSTRUCTIONS CAREFULLY
FORM MUST BE PRINTED IN INK

COMPLETE THE FOLLOWING: Drivers License No. ________ 15 Social Security Number ________ 22

NAME ________ 31 LAST FIRST MIDDLE DATE OF BIRTH ________ 59 (MONTH-DAY-YEAR)

ADDRESS ________ 108 STREET 136 CITY 152 STATE 154 ZIP

PERSONAL DATA ________ 159 SEX 160 EYES 163 WEIGHT 166 HEIGHT (FT. & IN.) 169 COUNTY NO. Date of Application 171 / /

CHECK CURRENT LICENSE STATUS

177

1.[ ] VALID OUT OF STATE
2.[ ] LOST OR EXPIRED OUT OF STATE
3.[ ] NEVER HAD ANY STATE LICENSE
4.[ ] LOST, EXPIRED, OR CANCELLED S. D. LICENSE
5.[ ] RENEWING VALID S. DAK. LICENSE
6.[ ] REISSUE PREVIOUSLY REVOKED S. DAK. LICENSE ($25.00 fee)
7.[ ] REQUEST EXAMINATION FROM THE DEPARTMENT
8.[ ] PREVIOUSLY REVOKED S. D. RESTRICTED PERMIT

CHECK ONE VEHICLE TYPE

178

1.[ ] AUTOMOBILE AND MOTORCYCLE
2.[ ] AUTOMOBILE ONLY
3.[ ] MOTORCYCLE ONLY

CHECK ONE LICENSE TYPE

179

4.[ ] INSTRUCTION PERMIT
5.[ ] RESTRICTED (6AM to 7PM) PERMIT
6.[ ] TEMPORARY S. DAK. LICENSE (For use until return to state)
7.[ ] REGULAR S. DAK. OPERATOR'S LICENSE (None of the above)

EXAMINERS USE ONLY

VISUAL ACUITY	BOTH EYES	RIGHT EYE	LEFT EYE
81	20/	20/	20/

W/O CORR. LENS ( ) WITH CORR. LENS ( )
CONTACTS ( )

DEPTH PERCEP. GOOD [G] FAIR [F] 90 POOR [P] NONE [N]

COLOR. 91 NORMAL [N] COLOR BLIND [B]

HEARING: GOOD [ ] FAIR [ ] POOR [ ] DEAF [ ]

STATEMENTS ISSUED. DL 7 92 DL 29 93
YES [Y] NO [N] YES [Y] NO [N]

AUTO: 94
TEST SET USED [ ] NOT REQUIRED [N]
95 NUM. OF WRITTEN QUESTIONS MISSED [ ] 98 DRIVING [ ]

MOTORCYCLE 101
TEST SET USED [ ] NOT REQUIRED [N]
102 NUM. OF WRITTEN QUESTIONS MISSED [ ] 105 DRIVING [ ]

106
PASSED: [P]

FAILED: 106
[E] EYE
[W] WRITTEN TEST
[D] DRIVE TEST
[N] NON-COOPERATION
[I] INCOMPLETE

DEPARTMENT USE
109
[1] DRIVER HISTORY CHECKED
[2] MEDICAL HISTORY CHECKED
[3] BOTH DRIVER & MED. HISTORY CHECKED
[4] CANCEL APPLICATION
[5] WAITING FURTHER INFORMATION (TEST SCORES)
110
[N] NO DRIVER HISTORY TO CONVERT

(ANSWER QUESTIONS 1 THRU 11)

1. IN WHAT CITY AND STATE WERE YOU BORN ________
2. WHAT IS YOUR PRESENT OCCUPATION ________
3. HAVE YOU HAD DRIVERS EDUCATION? YES ___ 65 NO ___ 65 IF YES, WHAT YEAR 19 ___ 66, WHAT TYPE; CLASSROOM ONLY [1] 68 CLASSROOM SIMULATOR AND BEHIND THE WHEEL [2] 68, CLASSROOM AND BEHIND THE WHEEL [3] 68, WHERE (IF IN STATE GIVE NAME OF TOWN, IF OUT OF STATE GIVE STATES NAME) ________ 69

YES [ ] 72 NO [ ] 72 4. HAVE YOU EVER BEEN CONVICTED OF A MOTOR VEHICLE VIOLATION OR MOTOR VEHICLE ORDINANCE VIOLATION WITHIN THIS STATE OR ANY STATE IN THE PAST FOUR YEARS? IF YES, VIOLATION(S) WHEN AND LOCATION ________

YES [ ] 73 NO [ ] 73 5. HAVE YOU EVER BEEN A PATIENT IN OR COMMITTED TO A MENTAL HOSPITAL OR INSTITUTION? IF YES, LIST NAME OF INSTITUTION, LOCATION, AND DATE DISCHARGED ________

YES [ ] 74 NO [ ] 74 6. HAVE YOU EVER BEEN AFFLICTED OR TREATED FOR ANY OF THE FOLLOWING? (CHECK PROPER BOXES) 75
[H] HEART CONDITION [D] DIABETES [E] EPILEPSY
[C] CONVULSIONS/FAINTING SPELLS/BLACKOUTS [F] PHYSICAL IMPAIRMENT
[A] ALCOHOLISM/OTHER DRUGS ________

YES [ ] NO [ ] 7. DO YOU WEAR GLASSES OR CONTACT LENSES? IF YES, GLASSES? [ ] CONTACTS? [ ]

YES [ ] NO [ ] 8. HAS YOUR NAME CHANGED IN THE LAST FOUR YEARS? FORMER NAME ________

YES [ ] NO [ ] 9. ARE YOU MARRIED? IF YES, SPOUSES FIRST NAME ________

YES [ ] NO [ ] 10. HAVE YOU EVER HAD YOUR DRIVER'S LICENSE: SUSPENDED [ ] REVOKED [ ] CANCELLED [ ] DENIED [ ]. IF YES, WHEN 19___ FOR HOW LONG ________ WHERE CONVICTED ________ REASON ________

YES [ ] NO [ ] 11. HAVE YOU EVER HAD A DRIVERS LICENSE? IF YES, WHAT FOREIGN COUNTRY OR STATE ________ IS LICENSE VALID [ ] OR EXPIRED [ ] ARE YOU IN POSSESSION OF MORE THAN ONE VALID LICENSE YES [ ] NO [ ]

RESTRICTIONS: 111 **(EXAMINER'S USE)** SPECIAL RESTRICTIONS: CODES ON REVERSE SIDE.

[G] W/CORR. [H] HEAR-AID
[C] CONTACTS [N] NO NIGHT DRIVE NO DRV. HIGH & RF
[O] L-OUT-MIR [S] NO DRV. SAT., SUN., HOL.

117 126 MPH 128 MILES

OTHER: ________

AUTO TEST QUESTIONS MISSED ________
MTCL TEST QUESTIONS MISSED ________

131 [ ] $25.00 FEE

AUTO DRIVING TEST

	TURNS	Good	Fair	Poor
RIGHT TURNS	Signal	0	3	6
	Speed	0	3	6
	Lane	0	3	6
	Signal	0	3	6
	Speed	0	3	6
	Lane	0	3	6
LEFT TURNS	Signal	0	4	8
	Speed	0	4	8
	Lane	0	4	8
	Signal	0	4	8
	Speed	0	4	8
	Lane	0	4	8

TRAFFIC DRIVING	Good	Fair	Poor
Starting (from curb-signal)	0	3	6
Stop Sign or Light	0	FAILURE	
Palming Steering Wheel		FAILURE	
Judgment of Distance	0	3	6
Judgment at Intersection	0	4	8
Correct Lane	0	3	6
Attention (signs-signals)	0	4	8
Stalls Motor	0	4	8
Use of Clutch	0	2	4
Right of Way, Ped.	0	FAILURE	
Attention to Driving	0	2	4
Shifting Ability	0	2	4
Use of Horn	0	2	4
Right of Way, Veh.	0	FAILURE	

SKILL TEST	Good	Fair	Poor
Emergency Stop	0	4	8
Backing	0	4	8
Use of Brakes	0	4	8
Parking on Hill	0	4	8
Parking Between Flags	0	4	8
Stop on Grade	0	3	6
Start on Grade	0	4	8
Attitude	☐	☐	☐
General Car Control	☐	☐	☐

Examiner:

MOTORCYCLE DRIVING TEST

CYCLE CONTROLS AND SKILL MANEUVERS						RIDING DEMONSTRATION		
Gear Selector	Sat.	N/Sat.	Choke	Sat.	N/Sat.	Observation of Traffic	Sat.	N/Sat.
Clutch	Sat.	N/Sat.	Starter	Sat.	N/Sat.	Use of Controls	Sat.	N/Sat.
Front Brake	Sat.	N/Sat.	Off/On Stand	Sat.	N/Sat.	Observance Signs/Signals	Sat.	N/Sat.
Rear Brake	Sat.	N/Sat.	Start Motor	Sat.	N/Sat.	Speed	Sat.	N/Sat.
Throttle	Sat.	N/Sat.	Put in Motion	Sat.	N/Sat.	Lane Position	Sat.	N/Sat.
Spark	Sat.	N/Sat.	Figure 8	Sat.	N/Sat.	Signalling	Sat.	N/Sat.
Light Switch	Sat.	N/Sat.	Straight Line	Sat.	N/Sat.	Stop Sign or Light	Sat.	N/Sat.
Dimmer Switch	Sat.	N/Sat.	Turning Arc	Sat.	N/Sat.	Judgment of Distance	Sat.	N/Sat.
Ignition Switch	Sat.	N/Sat.	Braking	Sat.	N/Sat.	Judgment at Intersection	Sat.	N/Sat.
Horn	Sat.	N/Sat.	Stop	Sat.	N/Sat.	Right-of-Way Observance	Sat.	N/Sat.

Sat.=Satisfactory N/Sat.=Not Satisfactory

Comments: ______________________________

I SUBMIT THIS APPLICATION WITH THE FULL KNOWLEDGE THAT ANY FALSE STATEMENT OR CONCEALMENT OF ANY MATERIAL FACT SUBJECTS ANY LICENSE HEREUNDER TO IMMEDIATE CANCELLATION.

Application Must Be Signed In Presence Of Examiner.

Subscribed and sworn to before me this ________ day of ______________________, 19____.

SIGN FULL NAME HERE ______________________________
(First) (Middle) (Last)

____
DRIVERS LICENSE EXAMINER

To Be Used Only If Applicant Is Under 18 Years Of Age

I do solemnly swear the above named applicant is my ______ child ______ step-child ______ ward and that the information given above on this application is true and correct. This is my authorization to the Department of Motor Vehicles to issue the type license applied for on this application to the minor named above.

Subscribed and sworn to before me this ________ day of ______________________, 19____.

DRIVER LICENSE EXAMINER ______________________________

____
SIGNATURE OF PARENT OR GUARDIAN (Full Name)

SPECIAL RESTRICTION CODES

Q = NOT TO EXCEED ___ MPH	V = DRV W/IN ( ) CITY LMTS
R = DRV W/IN ___ MI OF HOME	W = RAISED SEAT
S = PWR STEER/STEER KNOB	X = HAND CNTRL VEH
T = AUTO TRAN	Y = FOR WRK PURP
U = AUTO TURN SIG	Z = SPCL EQPT VEH

TIME	Leave Blank	**Officer's Investigation Summary of Motor Vehicle Accident** **STATE OF SOUTH DAKOTA**	Leave Blank

Date of Accident ______________________, 19____ Day of Week ____________________ Hour ______ ☐ A.M. ☐ P.M. How many vehicles involved____ If more than two vehicles use additional report forms.

LOCATION

Place Where Accident Occurred: County ______________________

Investigation At Scene ☐ Yes ☐ No Investigated by: ☐ H.P. ☐ SO ☐ PD ☐ BIA

If accident was outside city limits, indicate distance and direction (indicate distance either in feet or odometer mileage to the tenth of a mile) from nearest City, Highway Junction or Mile Post. (2 State Highways)

	N	S	E	W	
________	☐	☐	☐	☐	☐ Mile Post
________	☐	☐	☐	☐	☐ City Limits
________	☐	☐	☐	☐	☐ Highway Junction of________

(Use This Additional Line, If Necessary, To Identify Location of Accident)

Road on which accident occurred ______________________ System: ☐ U.S. or State ☐ County ☐ City St. ☐ Twp. ☐ Other

At its intersection with______________________ If urban______________________ (City or Town)

If not at intersection______________________feet N ☐ S ☐ E ☐ W ☐ of ______________________ (Show Nearest Intersecting Street)

OBJECT

Name of Object Struck (List Even If Not Damaged) ______ Location of Object (on or off highway) ______ $ ______ Damage

DRIVER NO. 1		DRIVER NO. 2	
Name of Driver	Sex	Name of Driver	Sex
Address		Address	
License No. / State / Date of Birth		License No. / State / Date of Birth	
Type of License / License Restrictions ☐ None		Type of License / License Restrictions ☐ None	
In Armed Forces: ☐ Yes ☐ No / CODES / Injury Class: / Safety Belt: / Ejected: ☐ Yes ☐ No		In Armed Forces: ☐ Yes ☐ No / CODES / Injury Class: / Safety Belt: / Ejected: ☐ Yes ☐ No	

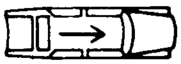
VEHICLE NO. 1	VEHICLE NO. 2
Model Yr. / Make / Body Style or Type / M.V.S.I. No.	Model Yr. / Make / Body Style or Type / M.V.S.I. No.
License Plate No. / State / Year / Odometer	License Plate No. / State / Year / Odometer
Vehicle Identification No. (VIN) / Trailer Plate No. / State	Vehicle Identification No. (VIN) / Trailer Plate No. / State
Name of Registered Owner	Name of Registered Owner
Address of Owner	Address of Owner
No. of Occ's / Veh. Drivable ☐ Yes ☐ No / Veh. Removed To:	No. of Occ's / Veh. Drivable ☐ Yes ☐ No / Veh. Removed To:

TYPE and CODES / INJURED PERSONS

Occup't of Veh. / (Specify Other) / Seat Pos: / Injury Class: / Safety Belt: / Ejected: ☐ Yes ☐ No		Occup't of Veh. / (Specify Other) / Seat Pos: / Injury Class: / Safety Belt: / Ejected: ☐ Yes ☐ No	
Name	Sex	Name	Sex
Address	Age	Address	Age
Occup't of Veh. / (Specify Other) / Seat Pos: / Injury Class: / Safety Belt: / Ejected: ☐ Yes ☐ No		Occup't of Veh. / (Specify Other) / Seat Pos: / Injury Class: / Safety Belt: / Ejected: ☐ Yes ☐ No	
Name	Sex	Name	Sex
Address	Age	Address	Age
Occup't of Veh. / (Specify Other) / Seat Pos: / Injury Class: / Safety Belt: / Ejected: ☐ Yes ☐ No		Occup't of Veh. / (Specify Other) / Seat Pos: / Injury Class: / Safety Belt: / Ejected: ☐ Yes ☐ No	
Name	Sex	Name	Sex
Address	Age	Address	Age

VEHICLE DAMAGE

VEHICLE NO. ONE circle damaged parts

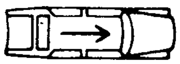


ESTIMATED AMOUNT OF DAMAGE $________

RED TAG NO.________

Other Damage to Vehicle________________

VEHICLE NO. TWO circle damaged parts



ESTIMATED AMOUNT OF DAMAGE $________

RED TAG NO.________

Other Damage to Vehicle________________

CODES

SEAT LOCATION

X—Unknown
SV—Special Vehicle
RD—Rear Deck Sta. Wgn.

USE SHADED AREA FOR 9 PASS. STATION WGN.

INJURY CLASSIFICATION

K—Dead before report made.
A—Visable signs of injury, as bleeding wound or distorted members: or had to be carried from scene.
B—Other visible injury, as bruises, abrasions, swelling, limping, etc.
C—No visible injury but complaint of pain or momentary unconsciousness.

SAFETY BELT

A—Used
B—Not Used
C—Not Installed
D—Failure
X—Use Unknown

INDICATE EACH ITEM THAT APPLIES TO THIS ACCIDENT

CONDITIONS

DRIVER ACTION (1 2 3)
- ☐ ☐ ☐ Speed too fast for conditions
- ☐ ☐ ☐ Did not grant right of way
- ☐ ☐ ☐ Followed too close
- ☐ ☐ ☐ Disregard stop or yield sign
- ☐ ☐ ☐ Failed to signal properly
- ☐ ☐ ☐ Disregard signal
- ☐ ☐ ☐ Improper turning
- ☐ ☐ ☐ Improper passing
- ☐ ☐ ☐ Improper parking
- ☐ ☐ ☐ Improper start from parked position
- ☐ ☐ ☐ Other Improper driving
- ☐ ☐ ☐ On wrong side of road
- ☐ ☐ ☐ Arrested for ______
- ☐ ☐ ☐ ______

DRIVER CONDITION (1 2 3)
- ☐ ☐ ☐ DWI
- ☐ ☐ ☐ Drinking—Ability impared
- ☐ ☐ ☐ Drinking—Ability unknown
- ☐ ☐ ☐ Physical impairment
- ☐ ☐ ☐ Very tired

VEHICLE CONDITION (1 2 3)
- ☐ ☐ ☐ Faulty brakes
- ☐ ☐ ☐ Improper lights
- ☐ ☐ ☐ Defective steering
- ☐ ☐ ☐ Defective tires
- ☐ ☐ ☐ Other ______
- ☐ ☐ ☐ No valid sticker

LIGHT CONDITION
- ☐ Daylight
- ☐ Dawn/dusk
- ☐ Darkness

MOTORCYCLE SAFETY EQUIP.
- ☐ Helmet used
- ☐ Helmet & eye protection used
- ☐ Helmet not used
- ☐ Unknown

ROADWAY ENVIRONMENTAL CONDITIONS

Road Defects
- ☐ Soft shoulder
- ☐ Holes, rut, bumps
- ☐ Objects on road
- ☐ Loose surface material
- ☐ Other ______
- ☐ No road defects

Surface
- ☐ Dry
- ☐ Wet
- ☐ Snow
- ☐ Ice
- ☐ Other

Weather
- ☐ Clear
- ☐ Rain
- ☐ Snow
- ☐ Fog
- ☐ Ice

Road Character (check two)
- ☐ Straight road
- ☐ Curve
- ☐ Level
- ☐ On grade
- ☐ Hill crest

Traffic Controls
- ☐ Stop sign
- ☐ Yield sign
- ☐ Stop & go signal
- ☐ R.R. signal
- ☐ Other ______
- ☐ No traffic control

Traffic Flow
Temp. change in traffic direction
☐ Yes ☐ No

Traffic Lanes
- ☐ Temp. reduction in No. lanes
- ☐ Temp. reduction in lane width
- ☐ None

ENFORCEMENT ACTION (Citations, Arrests, Violations, etc.)

ALCOHOL TEST:
- ☐ Driver No. 1 ☐ Requested for:
- ☐ Driver No. 2 ☐ Administered to:
- ☐ Pedestr. No.____ ☐ No Test

IDENTIFICATION

Police Notified	Date	Time ☐ A.M. ☐ P.M.	Time officer arrived ☐ A.M. ☐ P.M.	Photos Taken ☐ Yes ☐ No
Reporting Officer	Badge No.	Department	Date	
Approved by	Date Approved	Report forms given ☐ #1 ☐ #2 ☐ #3	Agencies Notified	

NARRATIVE

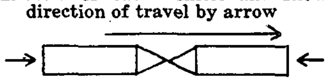
Accident Description ______

Indicate Primary Causes of Accident

DIAGRAM

ACCIDENT DIAGRAM

Instruction for use of diagram
1. Draw solid lines to indicate highway layout at scene of accident.
2. Number each vehicle and show direction of travel by arrow



INDICATE NORTH BY ARROW

VEH. #1 GOING	N ☐	S ☐	E ☐	W ☐
VEH. #2 GOING	N ☐	S ☐	E ☐	W ☐
VEH. #3 GOING	N ☐	S ☐	E ☐	W ☐

ACTIONS

Pedestrian Actions:
- ☐ Crossing at Intersection
- ☐ Crossing—Not at Intersection
- ☐ Walking in Roadway with Traffic
- ☐ Walking in Roadway Against Traffic
- ☐ Standing } in Roadway
- ☐ Playing } in Roadway
- ☐ Working } in Roadway
- ☐ Getting on/off Vehicle
- ☐ Not in Roadway
- ☐ ______ (Specify Other)

Driver-Vehicle Actions: (1 2)
- ☐ ☐ Going Straight Ahead
- ☐ ☐ Turning Left
- ☐ ☐ Slowing/Stopping in Roadway
- ☐ ☐ Overtaking
- ☐ ☐ Entering/Leaving Parked Position
- ☐ ☐ Parked
- ☐ ☐ ______ (Specify Other)
- ☐ ☐ U-Turn
- ☐ ☐ Turning Right
- ☐ ☐ Passing
- ☐ ☐ Backing

ACCIDENT NO.

OFFICE USE

TYPE ACCD.

TYPE COLL.

LOCATION

OFFICER'S INVESTIGATION SUMMARY OF MOTOR VEHICLE ACCIDENT

STATE OF SOUTH DAKOTA

DEPARTMENT OF PUBLIC SAFETY

X-COOR

Y-COOR

SYSTEM

TIME

DATE OF ACCIDENT ______________, 19___ DAY OF WEEK ______________

HOUR ________ A.M. P.M.

HOW MANY VEHICLES INVOLVED ________
IF MORE THAN TWO VEHICLES USE ADDITIONAL REPORT FORMS.

LOCATION

PLACE WHERE ACCIDENT OCCURRED: COUNTY ______________

INVESTIGATION AT SCENE: YES NO

INVESTIGATED BY: HP SO PD BIA

If accident was outside city limits, indicate distance and direction (indicate distance either in feet or odometer mileage to the tenth of a mile) from nearest CITY, HIGHWAY JUNCTION or MILE POST.
(2 State Highways)

N S E W

MILE POST

CITY LIMITS

HIGHWAY JUNCTION OF

DISPL. (Office Use)

(Use This Additional Line, If Necessary, To Identify Location of Accident)

ROAD ON WHICH ACCIDENT OCCURRED ______________ SYSTEM: U.S. OR STATE COUNTY CITY ST. TWP. OTHER

AT ITS INTERSECTION WITH ______________ IF URBAN ______________ (City or Town)

IF NOT AT INTERSECTION ______________ FEET N S E W OF ______________ (Show Nearest Intersecting Street)

OBJECT

NAME OF OBJECT STRUCK (LIST EVEN IF NOT DAMAGED) | LOCATION OF OBJECT (ON OR OFF HIGHWAY) | $ DAMAGE

DRIVER NO. 1

NAME OF DRIVER | SEX
ADDRESS | AGE
LICENSE NO. | STATE | DATE OF BIRTH
TYPE OF LICENSE | LICENSE RESTRICTIONS | NONE
CODES: | INJURY CLASS: | SAFETY BELT: | EJECTED: YES NO
EXTRICATED BY: | EQUIPMENT REQUIRED:

DRIVER NO. 2

NAME OF DRIVER | SEX
ADDRESS | AGE
LICENSE NO. | STATE | DATE OF BIRTH
TYPE OF LICENSE | LICENSE RESTRICTIONS | NONE
CODES: | INJURY CLASS: | SAFETY BELT: | EJECTED: YES NO
EXTRICATED BY: | EQUIPMENT REQUIRED:

VEHICLE NO. 1

MODEL YR. | MAKE | BODY STYLE OR TYPE | M.V.S.I. NO.
LICENSE PLATE NO. | STATE | YEAR | ODOMETER
VEHICLE IDENTIFICATION NO. (VIN) | TRAILER PLATE NO. | STATE
SPEED | POSTED LIMIT | BEFORE IMPACT | AT IMPACT
CODES: | HOW ESTIMATED?
NAME OF REGISTERED OWNER
NO. of Occ's | ADDRESS OF OWNER
VEH. DRIVABLE YES NO | VEH. REMOVED TO:

VEHICLE NO. 2

MODEL YR. | MAKE | BODY STYLE OR TYPE | M.V.S.I. NO.
LICENSE PLATE NO. | STATE | YEAR | ODOMETER
VEHICLE IDENTIFICATION NO. (VIN) | TRAILER PLATE NO. | STATE
SPEED | POSTED LIMIT | BEFORE IMPACT | AT IMPACT
CODES: | HOW ESTIMATED?
NAME OF REGISTERED OWNER
NO. of Occ's | ADDRESS OF OWNER
VEH. DRIVABLE YES NO | VEH. REMOVED TO:

INJURED PERSONS

OCCUP'T OF VEH. | (SPECIFY OTHER) | SEAT POS: | INJURY CLASS: | SAFETY BELT: | EJECTED: YES NO
EXTRICATED BY: | EQUIPMENT REQUIRED:
NAME | SEX
ADDRESS | AGE

OCCUP'T OF VEH. | (SPECIFY OTHER) | SEAT POS: | INJURY CLASS: | SAFETY BELT: | EJECTED: YES NO
EXTRICATED BY: | EQUIPMENT REQUIRED:
NAME | SEX
ADDRESS | AGE

OCCUP'T OF VEH. | (SPECIFY OTHER) | SEAT POS: | INJURY CLASS: | SAFETY BELT: | EJECTED: YES NO
EXTRICATED BY: | EQUIPMENT REQUIRED:
NAME | SEX
ADDRESS | AGE

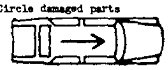
OCCUP'T OF VEH. | (SPECIFY OTHER) | SEAT POS: | INJURY CLASS: | SAFETY BELT: | EJECTED: YES NO
EXTRICATED BY: | EQUIPMENT REQUIRED:
NAME | SEX
ADDRESS | AGE

OCCUP'T OF VEH. | (SPECIFY OTHER) | SEAT POS: | INJURY CLASS: | SAFETY BELT: | EJECTED: YES NO
EXTRICATED BY: | EQUIPMENT REQUIRED:
NAME | SEX
ADDRESS | AGE

OCCUP'T OF VEH. | (SPECIFY OTHER) | SEAT POS: | INJURY CLASS: | SAFETY BELT: | EJECTED: YES NO
EXTRICATED BY: | EQUIPMENT REQUIRED:
NAME | SEX
ADDRESS | AGE

VEHICLE DAMAGE

VEHICLE NO. ONE
Circle damaged parts



ESTIMATED AMOUNT OF DAMAGE $ ______________

RED TAG NO. ______________

OTHER DAMAGE TO VEHICLE ______________

VEHICLE NO. TWO
Circle damaged parts

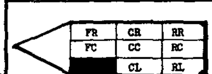
ESTIMATED AMOUNT OF DAMAGE $ ______________

RED TAG NO. ______________

OTHER DAMAGE TO VEHICLE

CODES

SEAT LOCATION



X-UNKNOWN
SV-SPECIAL VEHICLE
RD-REAR DECK STATION WAGON

USE SHADED AREA FOR 9 PASSENGER STATION WAGON

INJURY CLASSIFICATION

K-DEAD BEFORE REPORT MADE.
A-VISIBLE SIGNS OF INJURY, AS BLEEDING WOUND OR DISTORTED MEMBERS: OR HAD TO BE CARRIED FROM SCENE.
B-OTHER VISIBLE INJURY, AS BRUISES, ABRASIONS, SWELLING, LIMPING, ETC.
C-NO VISIBLE INJURY, BUT COMPLAINED OF PAIN OR MOMENTARY UNCONSCIOUSNESS.

SAFETY BELT

A-USED
B-NOT USED
C-NOT INSTALLED
D-FAILURE
X-USE UNKNOWN

EXTRACTION CLASSIFICATION

1. NOT REQUIRED
2. BY AMBULANCE/RESCUE ATTENDANT
3. BY POLICE
4. BY PASSER-BY
5. OTHER (SPECIFY)

TYPE EMERGENCY EQUIPMENT REQUIRED

1. COMMERCIAL AMBULANCE
2. RESCUE SQUAD
3. OTHER (SPECIFY)
4. NONE

SPEED ESTIMATE

1. POLICE STATEMENT
   A. FORMULA CALCULATION
   B. SKID MARKS AND MEASUREMENTS
   C. FACTORS NOT STATED
2. DRIVER STATEMENT
3. OCCUPANT STATEMENT
4. WITNESS STATEMENT

MAIL COMPLETED REPORT TO: DEPARTMENT OF PUBLIC SAFETY, OFFICE OF ACCIDENT RECORDS, PIERRE, SOUTH DAKOTA 57501

C 72

INDICATE EACH ITEM THAT APPLIES TO THIS ACCIDENT

CONDITIONS

DRIVER ACTION

1 2 3
- SPEED TOO FAST FOR CONDITIONS
- DID NOT GRANT RIGHT OF WAY
- FOLLOWING TOO CLOSE
- DISREGARD STOP OR YIELD SIGN
- FAILED TO SIGNAL PROPERLY
- DISREGARD SIGNAL
- IMPROPER TURNING
- IMPROPER PASSING
- IMPROPER PARKING
- IMPROPER START FROM PARKED POSITION
- OTHER IMPROPER DRIVING
- ON WRONG SIDE OF ROAD
- ARRESTED FOR ____

DRIVER CONDITIONS

1 2 3
- DWI
- DRINKING - ABILITY IMPAIRED
- DRINKING - ABILITY UNKNOWN
- PHYSICAL IMPAIRMENT
- VERY TIRED

VEHICLE CONDITION

1 2 3
- FAULTY BRAKES
- IMPROPER LIGHTS
- DEFECTIVE STEERING
- DEFECTIVE TIRES
- OTHER ____
- NO VALID STICKER

LIGHT CONDITION

- DAYLIGHT
- DUSK
- DAWN
- DARKNESS

ROAD SURFACE TYPE

- DIRT
- GRAVEL
- BITUMINOUS (BLACK TOP)
- CONCRETE
- OTHER

MOTORCYCLE SAFETY EQUIPMENT

- HELMET USED
- HELMET & EYE PROTECTION USED
- HELMET NOT USED
- UNKNOWN

ROADWAY ENVIRONMENTAL CONDITIONS

ROAD DEFECTS
- SOFT SHOULDER
- HOLES, RUT, BUMPS
- OBJECTS ON ROAD
- LOOSE SURFACE MATERIAL
- OTHER ____
- NO ROAD DEFECTS

SURFACE
- DRY
- WET
- MUDDY
- SNOW
- ICE
- OTHER

WEATHER
- CLEAR
- CLOUDY
- RAINING
- SNOWING
- FOG
- OTHER

ROAD CHARACTER
(CHECK ALL THAT APPLY)
- STRAIGHT ROAD
- CURVE
- LEVEL
- ON GRADE
- HILL CREST
- BRIDGE
- INTERCHANGE
- R.R. CROSSING
- INTERSECTION

TRAFFIC CONTROLS
- STOP SIGN
- YIELD SIGN
- STOP & GO SIGNAL
- R.R. SIGNAL
- OTHER ____
- NO TRAFFIC CONTROL

TRAFFIC FLOW
TEMP. CHANGE IN TRAFFIC DIRECTION
- YES
- NO

TRAFFIC LANES
- TEMP. REDUCTION IN NO. LANES
- TEMP. REDUCTION IN LANE WIDTH
- NONE

ENFORCEMENT ACTION (Citations, Arrests, Violations, etc.)

ALCOHOL TEST

- DRIVER NO. 1
- DRIVER NO. 2
- PEDESTR. NO. ____
- REQUESTED FOR:
- ADMINISTERED TO:
- NO TEST

IDENTIFICATION

POLICE NOTIFIED	DATE	TIME	A. M. / P. M.	TIME OFFICER ARRIVED	A. M. / P. M.	PHOTOS TAKEN: YES / NO

ACCIDENT REPORTED BY:	CODE	HOW REPORTED:	
REPORTING OFFICER	BADGE NO.	DEPARTMENT	DATE
APPROVED BY:	DATE APPROVED	AGENCIES NOTIFIED	

NARRATIVE

ACCIDENT DESCRIPTION

INDICATE PRIMARY CAUSES OF ACCIDENT

DIAGRAM

ACCIDENT DIAGRAM

INSTRUCTION FOR USE OF DIAGRAM

1. DRAW SOLID LINES TO INDICATE HIGHWAY LAYOUT AT SCENE OF ACCIDENT.
2. NUMBER EACH VEHICLE AND SHOW DIRECTION OF TRAVEL BY ARROW.

INDICATE NORTH BY ARROW

VEH. #1 GOING N S E W

VEH. #2 GOING N S E W

VEH. #3 GOING N S E W

ACTIONS

PEDESTRIAN ACTIONS:
- CROSSING AT INTERSECTION
- CROSSING - NOT AT INTERSECTION
- WALKING IN ROADWAY WITH TRAFFIC
- WALKING IN ROADWAY AGAINST TRAFFIC
- STANDING } IN ROADWAY
- PLAYING } IN ROADWAY
- WORKING } IN ROADWAY
- GETTING ON/OFF VEHICLE
- NOT IN ROADWAY
- ____ (SPECIFY OTHER)

DRIVER-VEHICLE ACTIONS:

1 2
- GOING STRAIGHT AHEAD
- TURNING LEFT
- SLOWING/STOPPING IN ROADWAY
- OVERTAKING
- ENTERING/LEAVING PARKED POSITION
- PARKED
- U-TURN
- TURNING RIGHT
- PASSING
- BACKING
- ____ (SPECIFY OTHER)

CODES

ACCIDENT FIRST REPORTED BY:

1. OCCUPANT OF INVOLVED VEHICLE
2. PASSING MOTORIST
   A. WITNESS
   B. NOT A WITNESS
3. POLICE
4. RESIDENT/BY-STANDER
   C. WITNESS
   D. NOT A WITNESS
5. OTHER - SPECIFY

HOW ACCIDENT WAS REPORTED:

1. TELEPHONE
2. DIRECT CONTACT
3. RADIO
4. OTHER - SPECIFY

APPENDIX C

TELEPHONE INTERVIEW FORMAT - DATA COLLECTION FORM

Major factors associated with the design of the telephone interview questionnaire format were: minimal number of questions, minimal level of threat associated with each question, and a natural question flow.

To facilitate the coding of data, each response blank is cross-indexed with its respective variable number. Also, card format instructions necessary for the keypunching of data are listed on the left-hand margin. The Alpha code indicates which card of the three card record is involved, while the numeric code locates the column(s) on that card. The initial question concerning date of birth is included as a check to verify the identity of the party to be interviewed.

(ABC1)	________	High-Risk Group
(ABC2)	________	Data Collection Site 1. South Dakota 2. King County, Washington
(ABC3-12)	________	Drivers License Number
	________	Date of Birth
(A12-14)	______(1)	Age (nearest whole year)

(A15-34) ____________________ / ____________ / ____ / Name
(Last) (First) (MI)

(A35-59) ________________________________ Address

(A60-74) ________________________________ City

____________________ Telephone Number

ACCIDENT CROSS INDEX DATA

1 ________	4 ________	7 ________
2 ________	5 ________	8 ________
3 ________	6 ________	9 ________

	______	1. WHAT IS YOUR DATE OF BIRTH?

> Check against driving history data. If there is a mismatch, discontinue interview.

(B13-16)	______ (2)	2. HOW MANY MILES WOULD YOU ESTIMATE YOU HAVE DRIVEN IN THE LAST 12 MONTHS? (HUNDREDS)
(B17-20)	______ (3)	3. WHAT WOULD YOU ESTIMATE YOUR ANNUAL MILEAGE WAS TWO YEARS AGO? (HUNDREDS)
(B21-23)	______ (4)	*Absolute amount of change (#2-#3)*
(B24-25)	______ (5)	4. WHAT PERCENTAGE OF YOUR DRIVING TIME WOULD YOU ESTIMATE OCCURS IN DAYTIME HOURS, SAY FROM 6 A.M. TO 8 P.M.?
(B26-27)	______ (6)	5. HOW MANY TIMES PER MONTH WOULD YOU ESTIMATE YOU ARE DRIVING AT 12 O'CLOCK AT NIGHT?

(B28-29) ________ (7) 6. WHAT PERCENTAGE OF YOUR DRIVING TIME WOULD YOU ESTIMATE OCCURS DURING NIGHTTIME HOURS, SAY FROM 8 P.M. TO 4 A.M.?

(B30-32) ________ (8) 7. ON THE AVERAGE, HOW MANY MILES DO YOU DRIVE EACH WORK DAY?

(B33) ________ (9) 8. DO YOU EVER DRINK ALCOHOLIC BEVERAGES?

If no--go to #15.

(B34-35) ________ (10) 9. HOW MANY DAYS PER MONTH DO YOU HAVE A DRINK?

(B36-37) ________ (11) 10. WHAT PERCENTAGE OF TIME DO YOUR DRINKING AT HOME?

(B38) ________ (12) 11. WHAT TYPE OF DRINK DO YOU NORMALLY HAVE?

1 - Beer/wine
2 - Mixed drink
3 - Cocktail/straight liquor

(B39-40) ________ (13) 12. WHAT PERCENTAGE OF TIME DO YOU DO YOUR DRINKING IN PUBLIC PLACES?

(B41-42) ________ (14) 13. ON THE AVERAGE, HOW MANY DRINKS DO YOU NORMALLY HAVE PER SITTING WHEN SPECIAL EVENTS OR OCCASIONS ARE NOT INVOLVED?

(B43-44) ________ (15) 14. WHAT WOULD YOU ESTIMATE IS THE MOST NUMBER OF DRINKS YOU HAVE HAD UNDER THESE CONDITIONS?

(B45-48) ________ (16) *N. Drinking Index (#10 X #14 X #12)*

15. WHAT IS YOUR CURRENT OCCUPATION?

(B49)	________ (17)	PROFESSIONAL		0 - No
(B50)	________ (18)	MANAGER		1 - Yes
(B51)	________ (19)	CLERICAL/SALES		
(B52)	________ (20)	CRAFTSMEN		
(B53)	________ (21)	OPERATIVES		
(B54)	________ (22)	LABORER/UNSKILLED		

16. WHAT IS YOUR CURRENT OCCUPATIONAL STATUS?

(B55) ________ (23) FULL-TIME

(B56) ________ (24) PART-TIME

(B57) ________ (25) STUDENT

(B58) ________ (26) RETIRED

(B59) ________ (27) UNEMPLOYED

(B60) ________ (28) 17. WHAT IS YOUR CURRENT ANNUAL INCOME?

1 - 0 to $3,000
2 - $3,000 to $6,000
3 - $6,000 to $9,000
4 - $9,000 to $12,000
5 - $12,000 to $15,000
6 - $15,000 to $18,000
7 - $18,000 to $21,000
8 - $21,000 to $24,000
9 - $24,000 or more

(B61-62) ________ (29) 18. HOW MANY YEARS OF FORMAL EDUCATION HAVE YOU COMPLETED?

19. WHAT IS YOUR CURRENT MARITAL STATUS?

(B-63) ________ (30) MARRIED 0 - No

(B-64) ________ (31) SINGLE (NEVER MARRIED) 1 - Yes

(B-65) ________ (32) DIVORCED/SEPARATED (OVER 1 YEAR)

(B-66) ________ (33) WIDOWED

(B-67) ________ (34) RECENTLY DIVORCED (1 YEAR OR LESS)

If non-drinker go to #26.

(B68-69) _______ (35) 20. HOW MANY TIMES PER MONTH WOULD YOU ESTIMATE THAT YOU ATTEND SPECIAL OCCASIONS OUTSIDE OF YOUR HOME THAT INVOLVE DRINKING?

(B70-71) _______ (36) 21. ON THE AVERAGE, HOW MANY DRINKS WOULD YOU ESTIMATE YOU NORMALLY HAVE AT SUCH EVENTS?

(B72-73) _______ (37) 22. WHAT WOULD YOU ESTIMATE IS THE LARGEST NUMBER OF DRINKS YOU HAVE HAD AT SUCH AN EVENT?

(B74) _______ (38) 23. WHAT TYPE OF DRINK DO YOU TYPICALLY ORDER AT SUCH EVENTS?

1 - Beer/wine
2 - Mixed drink
3 - Cocktail/straight liquor

(B75-78) _______ (39) *S. Drinking Index (#35 X #37 X #38)*

(B79) ______ (40) 24. DO YOU EVER DRIVE AFTER DRINKING?

0 - No
1 - Yes

If NO, go on to question 26.

(C13) ______ (41) 25. HOW MANY TIMES PER MONTH WOULD YOU ESTIMATE YOU DRIVE AFTER DRINKING?

(C14-18) ______ (42) *N. D/D Index (#16 X #13 X #41)*

(C19-23) ______ (43) *S. D/D Index (#39 X #41)*

(C24) ______ (44) 26. DO YOU SMOKE CIGARETTES?

0 - No
1 - Yes

If NO, discontinue interview.

(C25-27) ______ (45) 27. ON THE AVERAGE, HOW MANY CIGARETTES DO YOU SMOKE PER DAY?

(C28) ______ (46) 28. DO YOU SMOKE FILTER OR NON-FILTER CIGARETTES MOST OFTEN?

1 - Filter
2 - Non-filter

(C29-31) ______ (47) *Hazard Index (#45 X #46)*

DRIVING HISTORY (3 YEARS)

(C32-33)	________ (48)	Number of reported traffic convictions
(C34-35)	________ (49)	HMV
(C36-37)	________ (50)	DWI
(C38-39)	________ (51)	Reckless Driving
(C40-41)	________ (52)	Speeding
(C42-43)	________ (53)	DUR/DUS
(C44-45)	________ (54)	Implied Consent

CRASH HISTORY (3 YEARS)

(C46-47)	________ (55)	Number of fatal and personal injury crashes
(C48-49)	________ (56)	Fatal
(C50-51)	________ (57)	Personal Injury
(C52-53)	________ (58)	Single Vehicle
(C54-55)	________ (59)	Multiple Vehicle
(C56-57)	________ (60)	Nighttime (8 P.M. - 4 A.M.)
(C58-59)	________ (61)	Alcohol-Related
(C60-61)	________ (62)	At-Fault

REFERENCES

1. Baker, S., *Characteristics of fatally injured drivers.* John Hopkins University, School of Hygiene and Public Health, FH 11-7092, 1970.

2. Borkenstein, R., Crowther, R., Shumate, R., Ziel, W., & Zylman, R. *The role of the drinking driver in traffic accidents.* Bloomington: Indiana University, 1964.

3. Brown, S., Bohnert, P., Finch, J., Pokorny, A., & Smith, J. *Alcohol safety study: Drivers who die.* Houston, Texas: Baylor University, 1968.

4. Burg, A. *The relationship between vision test scores and driving record: General findings.* Technical Report 67-24, ITTE, UCLA, 1967.

5. Cahalan, D. *Problem drinkers.* San Francisco: Jossey-Bass, Inc., 1970.

6. Carlson, W., & Clark, C. *Alcohol in the night.* HIT Lab Report, 1971.

7. Cooley, W., & Lohnes, P. *Multivariate procedures for the behavioral sciences.* New York: John Wiley and Sons, 1962.

8. Coppin, R., McBride, R., & Peck, R. *The 1964 California driver record study, part 9, the prediction of accident involvement from driver record and biographical data.* Sacramento, California: California Department of Motor Vehicles, 1967.

9. Crancer, A., Jr., & Quiring, D. Driving records of persons hospitalized for suicidal gestures. *Behavioral Research in Highway Safety,* 1970, 1, 33-42.

10. Ellingstad, V. *Analytic study I: An analysis of overall project impact.* South Dakota: Pierre, DOT-HS-045-1-061, 1974.

11. Fleiss, J.L. *Statistical methods for rates and proportions.* New York: John Wiley and Sons, 1973.

12. Hagen, R.E. Sex differences in driving performance. *Human Factors Journal,* 1974, in press.

13. Harano, R., McBride, R., & Peck, R. *The prediction of accident liability through biographical data and psychometric tests.* Final Report No. 39, Sacramento, California: California Department of Motor Vehicles, 1973.

14. Hyman, M. Accident vulnerability and blood alcohol concentrations of drivers by demographic characteristics. *Quarterly Journal on Studies of Alcohol.* 1968, 4:Supplement, 34-57.

15. Ingersoll, R., Trow, J., & Clarke, D. *The high risk driver: A descriptive study.* Concord, New Hampshire: New Hampshire Division of Public Health, 1970.

16. Institute for Research in Public Safety. *Tri-level study of the causes of traffic accidents: Interim report.* Indiana University, DOT-HS-034-3-535-73-TAC, 1973.

17. McCarroll, J., & Haddon, W. A controlled study of fatal automobile accidents in New York City. *Journal of Chronic Diseases.* 1962, 15, 811-826.

18. McDonald, J. Suicide and homicide by automobile. *American Journal of Psychiatry.* 1964, 121, 366-370

19. National Commission on Marijuana and Drug Abuse. *Drug use in America: Problem in perspective.* U.S. GPO, St. No. 5266-00003, 1973.

20. National Highway Traffic Safety Administration, *ASAP evaluation of operations - 1972.* Detailed Analysis, DOT-HS-800-874, 1974, 2.

21. Nie, N., Bent, D., & Hull, C. *SPSS: Statistical package for the social sciences.* New York: McGraw-Hill, 1970.

22. Peck, R., McBride, R., & Coppin, R. The distribution and prediction of driver accident frequencies. *Accident Analysis and Prediction.* 1971, 2, 243-299.

23. Perrine, M.W. Identification of personality, attitudinal and biographical characteristics of drinking drivers. *Behavioral Research in Highway Safety.* 1970, 2(4).

24. Perrine, M.W. *The Vermont driver profile: A psychometric countermeasure for early identification of potential high-risk drivers.* NHTSA Technical Report, FH-11-7543, May 1973a.

25. Pollack, S. *Drinking driver and traffic safety project.* 1969, 2, PB 188972.

26. Selzer, M. & Payne, C. Automobile accidents, suicide and unconscious motivation. *American Journal of Psychiatry.* 1962, 119, 237-240.

27. Selzer, M., & Vinokur, A. *Detecting the high-risk driver: The development of a risk questionnaire.* DOT-HS-801-099, 1967.

28. Spurr, W., & Bonini, C. *Statistical analysis for business decisions.* Homewood, Illinois: Richard Irwin, Inc., 1967.

29. Voas, R. *Cars that drunks can't drive.* Presentation at the annual meeting of Human Factors Society, San Francisco, California, 15 October 1970.

30. Voas, R. *Alcohol, drugs, and young drivers.* NHTSA Technical Report, 1974, in press.

31. Waller, J.A. Factors associated with alcohol and responsibility for fatal highway crashes. *Quarterly Journal of Studies on Alcohol.* 1972, 33, 160-170.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS-801 436		

4. Title and Subtitle	5. Report Date
ANALYSIS OF HIGH RISK DRIVERS FOR ALCOHOL COUNTERMEASURES Final Report	March 1975
	6. Performing Organization Code
7. Author(s) T.S.Overton, W.Douglas, B.J.Bagdis, M.G.Temple	8. Performing Organization Report No.
9. Performing Organization Name and Address Ketron Inc. 530 E.Swedesford Rd. Wayne, Pa. 19087	10. Work Unit No. (TRAIS)
	11. Contract or Grant No. DOT-HS-4-00992
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration 400 7th Street, S.W. Washington, D.C. 20590	13. Type of Report and Period Covered 6/1/1974 to 12/31/1974 Final Report
	14. Sponsoring Agency Code N 43-40

15. Supplementary Notes

16. Abstract

Five types of drivers have been identified as having high accident probabilities. The research plan draws a sample of each identified type as well as one for fatal accidents. The study will contrast accident involved drivers with average drivers of each high risk driver type. The analysis will differentiate between four types of accidents: fatal single vehicle, fatal multi vehicle, personal injury single vehicle, and personal injury multi vehicle accidents.

17. Key Words	18. Distribution Statement
High Risk Drivers, Accident Involvement, Alcohol Countermeasures, Accident Prediction	Document is available to the public through the National Technical Information Service, Springfield, Virginia 22151

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	83	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

INTRODUCTION

This document represents both an end and a beginning. It is the final report of the initial phase of the NHTSA contract entitled "Analysis of High Risk Groups for Alcohol Countermeasures." However, unlike most NHTSA research contract reports, the following pages present a research plan much more than research results.

The above contract is organized into three phases. Phase I prepares a research plan for Phase II. Phase II will employ that research plan to assemble and analyze historical driving records and behavorial data on specified driver types. The output of Phase II will be a risk prediction technique which will be employed during Phase III in a five-year longitudinal study of specific drivers.

This report then is a plan for research. The first section summarizes in a few pages the research strategy and its underlying rationale. The second section covers the same ground in more detail. The third, fourth, and fifth sections discuss the intended data sources, data collection procedures, and analytic treatments, respectively. A final section presents an administrative plan for the Phase II effort complete with task breakdowns and time phasings. An appendix contains the questionnaire to be used for much of the data collection. Preliminary cost estimates for the second phase comprise a separate document -- "Analysis of High Risk Groups for Alcohol Countermeasures, Phase II Section of High Risk Drivers, Cost Estimates."

1.0 Summary

Five types of drivers have been identified as having high accident probabilities relative to the general driving population. The research plan draws a sample of drivers of each identified type as well as two accident samples — one for personal injury accidents and one for fatal accidents. The analysis will contrast accident involved drivers with average drivers of each high risk driver type. The study will yield several products useful for administrators concerned with traffic safety:

(1) Procedures for screening of drivers for membership in broadly defined high risk groups

(2) Estimates of accident probabilities for individuals in these groups

(3) Identification of variables and procedures for further screening of each group to identify higher risk sub-groups

(4) Estimation of the impact of those variables upon accident probabilities

(5) Specification of the composition of each subgroup in terms of variables available only to researchers

(6) Estimation of the impact of those research variables upon the accident probabilities

(7) Estimation of the fraction of accidents caused by each group and subgroup

The analysis will be presented independently for four types of accidents: fatal-single vehicle, fatal multi-vehicle, personal injury-single vehicle, personal injury-multi-vehicle.

Key differences between the research plan and its predecessors are its emphasis upon finding higher and lower risk members of driver types already known to be high risk, its allowance for different accident types to be associ-

ated with different driver attributes, and its realization that the importance of one driver attribute may well depend upon the presence or absence of another.

The information provided by this analysis will be useful to the traffic safety administrator who must make decisions such as:

- are directed countermeasure programs likely to significantly affect the number of serious accidents?
- are there significant variations in accident risk among subgroups of a specific type of high risk driver?
- if so, is it cost-effective to undertake countermeasures targeted towards those subgroups?

2.0 Research Strategy

2.1 Motivation for the Study

NHTSA is currently considering the costs and benefits of directing specifically designed accident countermeasures toward selected groups of high risk individuals. In order for such an approach to be successful in practice, several key requirements have to be met:

(1) The characteristics of high risk individuals must be known,

(2) Individuals with high risk characteristics must be selectively addressable by countermeasure programs, and

(3) Individuals with high risk characteristics must be susceptable to modification of their accident risks through application of some countermeasure.

These requirements are necessary but not sufficient for the directed approach to be cost-effective. The determination of efficiency depends upon the costs of the directed countermeasure programs, the accident probabilities of the high risk individuals, the fraction of serious accidents involving those individuals, and the responsiveness of those individuals to the countermeasures.

The research plan presented in this document is a partial feasiblity test of the first key requirement listed above. However, it is designed with the entire NHTSA directed countermeasure effort in mind. As such, it identifies accident probabilities and the fraction of serious accidents involving each identified type of driver.

Further, the plan takes into account other aspects of the directed countermeasure approach. Certainly, any classification scheme will result in false negatives and false positives. In the present context, a false positive (a driver who, although possessing the characteristics associated with a high accident probability, is indeed not more dangerous than the average driver) poses problems of equity and cost for the traffic safety administrator considering a directed countermeasure. If the countermeasure is onerous for the driver subjected to it, the existence of a large number of false positives opens the administrator to criticism on grounds of unjust discrimination. Further, if the countermeasure is costly to administer to each individual subject, a large rate of false positives would inflate costs without return. False positives are not easy to detect in this context since it is difficult to discriminate between the safe driver and the risky driver who happened to be accident free within any selected study period. This problem can never be eliminated, but it can be lessened by searching for groups with very high accident probabilities (the higher the average accident probability, the lower the chance of there being a significant number of safe drivers in the group) and by seeking characteristics which reliably differentiate group members in terms of accident risk.

The false negative (a driver who, although not possessing the characteristics of the identified high risk driver, is at high risk of accident involvement) poses a quite different problem for the traffic safety administrator who is evaluating directed countermeasures. The existence of a substantial number of false negatives can lead the administrator to downgrade the potential impact of directed countermeasures because of a low fraction of accidents involving the incomplete set of high risk driver types. The only way to reduce the possibility of false negatives is to broaden the search for driver attributes which correlate with accidents. The broadening does have a natural limit -- when the attributes being added are so difficult to measure or employ that the knowledge of their predictive merit would be of no value. In our opinion, that limit has not yet been reached.

Second, the issue of <u>selective addressability</u> of identified high risk drivers by some countermeasure program also has impact upon the research plan for Phase II. A high risk driver may be selectively addressed in two ways: <u>indirectly</u> (a program directed to the general driver which has particular meaning or a heightened impact to him) or directly (a program in which only those drivers identified as high risk actually participate). It is not within the scope of the present research to investigate the relative merits of these two approaches. Nonetheless, the research plan attempts to separate those driver attributes which could be used in a direct countermeasure program (such as driving record) from those which could only be used in an indirect program (such as employment status). The plan concentrates, but not exclusively, upon analysis of the feasibility of explicit identification of individuals with higher than average risk of accident involvement with alcohol in their systems.

2.2 Accident Research Methodology

The high risk driver phenomenon has been studied by numerous researchers using a variety of approaches. The following paragraphs attempt to summarize the methods employed in previous research in order to provide a setting for a discussion of the research plan for Phase II. Four key dimensions along which past research approaches have differed are: reference setting, measure of accident risk, verification techniques, and study sites.

Most research directed at the high risk driver involves the comparison of one group of drivers with another. Identification of the groups being compared and the objectives of the comparison is hereafter referred to as the reference setting of the research. Generally, two of three groups of drivers are included in the reference setting for a particular study. These three recurring groups are: (1) drivers drawn from the general driving population, (2) drivers possessing some characteristics or set of characteristics which are hypothesized to be associated with high accident risk, and (3) drivers who have been recently involved in a traffic accident. Figure 1 illustrates the reference setting concept.

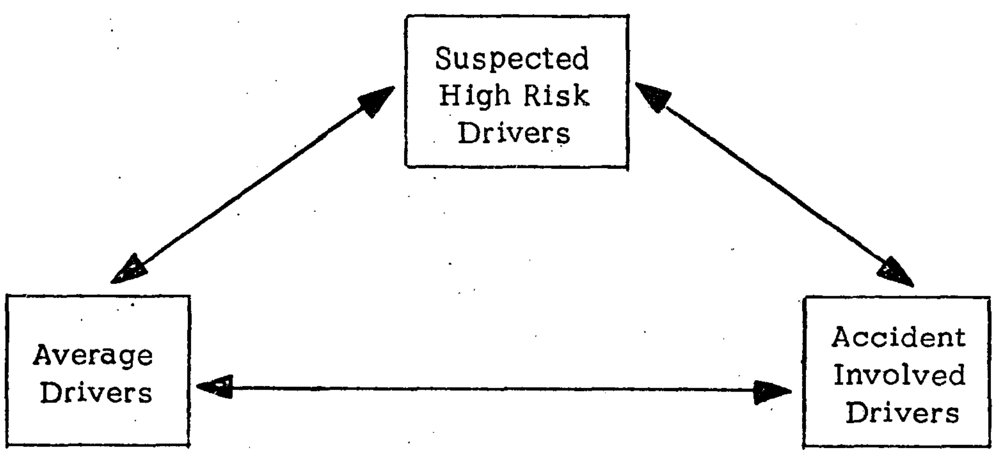


FIGURE 1

Reference Setting
High Risk Driver Analyses

Initial studies contrasted accident involved drivers with average drivers seeking to find driver characteristics associated with accidents (2, 30, 36). Building off the results of these analyses, researchers compared the driving records of the average driver with those of hypothesized high risk driver types (6, 8, 23). Finally, researchers have tried to further confirm their identification of high risk drivers by measuring the similarity of the hypothesized risk group with accident involved drivers (25, 30). These three research structures have constituted the majority of work performed to the present. However, a fourth type is indeed worth mentioning at this time, and that is the non-comparison study which looks at one group and tries to determine its internal make-up. This type of study has been performed for hypothesized high risk groups such as DUIA (28, 46), drivers involved in fatal accidents (41), and the population at risk (29).

Each reference setting has its use, and each has made contributions. At the present state-of-art, we feel that the first two discussed reference settings have shown that there are driver attributes associated with accident involvement although no single attribute seems to lead to levels of accident risk which are high in an absolute sense. Further progress in the identification of the high risk driver (if indeed any is possible) is likely to stem from comparison of the hypothesized high risk driver types with accident involved drivers. The objective of the comparison should be the investigation of the <u>differences</u> between these groups rather than their similarity. Any systematic differences uncovered can then be used to refine definition of high risk driver types and thereby increase the accident risk levels of the identified drivers.

Past research has employed two basic types of measures of relative accident risk for a certain driver type. Both seek to express the accident likelihood of a driver of a certain type relative to the accident likelihood of a reference (generally an average) driver. The first measure is straightforward: the fraction of drivers of the target type who have an accident during a specified time period divided by the corresponding fraction computed for the reference drivers (for example, 38, 42). The second measure is less direct in that it is calculated from a sample of accident-involved drivers and a general driver sample: the fraction of accident-involved drivers who are of the hypothesized high risk type divided by the corresponding fraction in the general driver sample (for example, 29, 30, 43).

Each measure has its advantages. The direct measure is intuitively appealing. Because of the low absolute probability of accidents (particularly for serious accidents), the sample sizes required can become substantial. The Bayesian or second measure overcomes the problems caused by accidents being rare events. Where possible the use of both approaches in the same study seems advisable.

As a third dimension, past research can be differentiated according to the techniques used for verification of hypotheses. In truth, little prior research has involved hypothesis testing. Searching a body of data on a group of drivers for accident correlated factors and calculating a measure of risk classification accuracy is quite different from using that same "prediction technique" on a new body of data (for a classic example, see 39). Clearly, each study cannot engage in the luxury of prospective longitudinal validation. However, various half-way measures are available such as limiting exploratory analyses to predefined hypotheses, and split sample analyses (sometimes referred to as "cross-validation"). Accident research is in transitional status. It has moved from the largely descriptive phase to the stage of exploratory research in which the available data is searched for plausible hypotheses. The experimental stage of the future will demonstrate increasing emphasis on prior hypotheses and research designs carefully constructed to confirm or reject those hypotheses. In this transitional state, studies will often neither be purely tests of prior hypotheses (because of inadequate knowledge) nor purely exploratory (because much structure already exists).

As a final differentiating characteristic among studies, there is the jurisdictional-geographical scope of the research. Studies range from state-wide analyses (8) to investigations of drivers appearing before a particular judge (37). Because of variation in record-keeping, enforcement practices, judicial practices, and other more general sociological characteristics which may relate to accident correlates (15, 47), the narrower the jurisdictional-geographical focus, the more likely the research will be a fair test of the existence of driver characteristics which correlate with accidents. As the jurisdictional-geographical scope of the study widens, the above mentioned variations have to be explicitly included in the analysis to protect against distortion. That distortion can lead to claims of statistical significance for a relationship which simply does not hold in a substantial part of the studied geography. On the other hand, the distortion can be such as to preclude the finding of significant relationships which happen to hold only in portions of the studied area.

2.3 Study Plan

The research plan presented in this section calls for the drawing of a general driver sample, an accident-involved driver sample, and samples of drivers from each of five rather broadly defined high risk driver groups. The research will reveal:

- the accident risk of the average driver in each pre-identified high risk group
- the existence of attributes which reliably differentiate between higher and lower risk members of each group
- the effect of such attributes upon the accident risk of group members
- the fraction of total accident-involved population contributed by each group or subgroup

The target group approach was selected in order to concentrate the data gathering and analysis in the areas found fruitful in past research. The specific groups selected previously have been found to have elevated accident risk. Further, members of each group can be identified economically by a traffic safety administrator. The groups are: drivers arrested for driving under the influence of alcohol (DUIA), drivers between the ages of 16 to 24, drivers who have an alcohol related arrest or have been treated for alcohol abuse, drivers who have a non-traffic minor arrest record, and drivers who are under high levels of stress.

The analytic plan will seek to find the importance of various demographic, behavioral, attitudinal, and driving record data in differentiating higher and lower risk members of each group. The analysis of each group will be carried out separately and interaction between driver attributes will be explicitly treated within each group. Research is beginning to indicate that the impact of a specific driver attribute upon accident risk depends upon the presence or absence of other driver attributes. For example, Pelz (25) has found that the impact of alcohol usage among youth is much stronger in the presence of an anti-social attitude.

Detailed discussion of the sampling plans for each group are presented in Section 4 and the analysis plans are presented in Section 5. The remainder of this section discusses the rationale behind selection of each of the 5 risk groups.

2.3.1 DUIA Risk Group

Individuals convicted for DUIA have been frequently studied by highway traffic safety researchers and have been the object of considerable countermeasure activity. The basis for this interest is a belief that drinking drivers have elevated accident risks and that DUIA convictions represent the most direct means of intercepting the drinking driver.

The selection of this group for intensive study is based only partially on empirical evidence pointing to elevated accident risk. Many sources have found the driver convicted of DUIA to have poor driving records (Perrine (28), Waller (43), Pollock (30), Filkins (10)). However, the poorness of the accident record of the driver convicted of DUIA is less clear. If risk index is defined to be the accident probability of a group of drivers divided by the accident probability of the general driver, then the risk index for the driver convicted of DUIA varies from 1.1 to 10 depending on the study and the accident categories included in the calculation of the index. Perrine (29) and Waller (43) both reported all accidents for their drivers. Using the Bayesian technique to evaluate risk indices, the Perrine study yields a risk index of 1.1 and the Waller study, an approximate 2.0.

Using the direct approach, a Selzer (38) study yields risk indices of 3.0 for all accidents and 4.0 for accidents involving personal injury. Using the direct approach, drivers convicted of DUIA for the first time have a risk index of 1.1 for all accidents in Pollock (30). Using the Bayesian approach, the risk index is approximately 10 for fatal accidents in the same study.* The evidence opens the possibility that the person convicted for DUIA is a high risk driver for the serious accident but not for the routine accident.

This group is worthy of particular attention even if, as a whole, it did not represent a high risk group. There may well exist driver attributes which differentiate as to accident risk within this group and if so, the resulting high risk individuals would be at quite high risk of an alcohol involved accident. Further, the attention received by this group demands that it be analyzed, even if only as a reference group, in any investigation of the driver at high risk of an alcohol related accident.

2.3.2 Youth Risk Group

Youthful drivers have been studied as high risk drivers by a large number of researchers. That youth are overrepresented in the accident involved driver population is given in highway safety research.

In his survey article in 1972, Goldstein (11) cites the stability of the high accident rate for youth aged 15 - 24. He presents accident rates leading to risk indices of approximately 1.6. That figure is immediately applicable to Pennsylvania (27) in which the risk indices for 1971 were 1.53, 1.72, and 1.86 for all accidents, all injury accidents, and fatal accidents respectively. Pelz (25, 26) studies young men in Michigan and estimates a self-reported annual accident rate of 30 percent which corresponds to a risk factor in excess of 6.0. McGuire (21) found a correspondingly high risk index for 17 - 20 year old airmen. The 1971 California longitudinal study of youthful drivers (13) shows a lesser but still substantially elevated accident rate leading to a risk factor of approximately 3.0.

---

* The fraction of the fatality sample having a prior conviction for DUIA was reported as 10% in Pollock (30).

Many researchers have investigated accident rates and driver attributes within this group. There seems to be evidence of a peak in accident probability as youth enter into the transitionary period of late adolescence and early adulthood (13, 25,26). Alcohol is involved in a large fraction of accidents in which youths were fatally injured. Goldstein cites a Minnesota study in which 60% of fatally injured youthful drivers had measurable blood alcohol. Perrine reports a similar figure in Vermont. Evidence indicates that youths become impaired by alcohol at lower blood alcohol levels than adults (48). Pelz speculates that alcohol related accidents are more prevalent towards the end of the youth period around age 22-23.

2.3.3 Alcohol Abuse Risk Group

Many studies have been made of drivers who manifest abuse of alcohol in the context of highway safety research. Elevated accident probability is found in all such research. The research plan calls for collection into this category, those who have manifested alcohol abuse through a non-traffic alcohol-related citation, through an arrest for DUIA with a prior conviction for DUIA, and through treatment for alcoholism at medical facilities within the prime study area.

Alcoholics under treatment have had their prior driving records compared to those of average drivers by Selzer and Vinokur (40), Schmidt and Smart (33), and Eelkema (8). The risk indices calculated from this data range are 1.2, 2.5, and 2.0, respectively. Eelkema also looked at the risk index of post-treatment alcoholics and found it to be 1.5.

Drivers with multiple convictions for DUIA have a risk index of about 2.0 for all accidents according to data reported by Pollock (30).

Non-traffic alcohol related offenses are over-represented in the fatal accident population investigated by Pollock. The risk index for this group is in excess of 5.0 based on the reported data.* Selzer and Chapman (38) report a risk index of 2.0 for those individuals arrested for drunk and disorderly conduct who score as alcoholics on MAST tests.

---

* There is some question regarding this index because of partial mixing of DUIA offenses with other alcohol related offenses but 5.0 should represent a lower limit.

2.3.4 Non-Traffic Arrest Risk Group

The individual with sociopathic attitudes has been looked at by traffic safety researchers but primarily in secondary analyses of data collected for other purposes. Where the factor has been studied, it has shown considerable correlation with accident rates.

Pollock shows individuals with criminal arrests to be over-represented in the fatal accident group leading to a risk index of 3.0. Pelz cites anti-social attitude as being prevalent among the highest risk individuals in the study. The California longitudinal study of youth found that the citzenship score of high school students was an important variable in the attempt to form a predictive model for accidents among youth. Schuckit (34) believes that many individuals classified as alcoholics are in fact sociopaths manifesting their anti-social behavior through heavy alcohol use. Even if alcohol abuse is stopped, other outlets will be found. That belief may provide an important step in the unraveling of the complex role of alcohol in traffic accidents.

2.3.5 Stress Risk Group

A broadening circle of researchers feel that stress may play a key role in accident causation. At the present, research is being carried out upon both behavioral and physiological responses to stress. Stress has been found to be associated with medical illness (Rahe (31)) and with on-the-job accidents (for example, Cobb and Rose (4), Margolis et al (18)).

In the traffic safety field, McMurray (22) and Hyman (14) have found that one important life event - divorce - has an associated elevation of accident risk. McMurray found that people involved in divorce had risk indices ranging from 1.1 to 2.25 during the year of the divorce. Only male plaintiffs had accident rates close to the average driver during that period. The accident rates were highest in the three months immediately after the filing for divorce and higher during the year of the divorce than during the surrounding seven-year period. Hyman had analogous results. He showed in addition that divorced individuals have higher probabilities of alcohol-involved traffic accidents. Brenner and Selzer (3), in reporting upon a contrast between fatally injured drivers and a control group, found a risk index of 3.0 for drivers with recent history of personal conflicts, personal tragedy, employment difficulties, or financial problems. Selzer and Vinokur (39) showed accident correlations with a modified version of the Social Readjustment Rating Scale as developed by Holmes and Rahe (12).

2.4 Summary of Research Design

The research design is targeted toward five types of high-risk drivers. Samples of drivers who fit all five type definitions will be drawn from residents of Lehigh County, Pennsylvania. Samples of drivers recently involved in four types of serious accidents will be drawn from Lehigh County and selected contiguous counties. A final sample will be drawn from the general driving population of the county. Questionnaire and driving record data will be gathered from drivers in each of these seven samples. The accident sample will be split into five groups corresponding to the pre-identified high-risk driver types.

Once the data has been gathered and arranged in this form, each group will be analyzed separately to calculate average risk indices for the group and to isolate subgroups having significantly elevated accident rates. This analysis will be repeated for each accident type. The general structure of the design is illustrated in Figure 2.

Due to NHTSA interest in the accident involvement of drivers convicted of DUIA, two supplemental studies will be executed. Philadelphia County is a large county with an Alcohol Safe Driver Program which is essentially an ASAP. Lancaster County is a largely rural county in southeastern Pennsylvania whose dominant culture is formed by the strict Anabaptist sects. The arrest and dispostion of violators of statutes against driving under the influence of alcohol varies markedly among the three sites of Allentown, Philadelphia, and Lancaster. The supplemental studies involve the extraction of drivers arrested for DUIA in the two additional counties together with comparison groups of average and accident-involved drivers. The contrast between the three DUIA analyses will provide material useful for attempting to extend the Allentown results into other cultural environments.

The chief differences between the proposed research and its predecessors are:

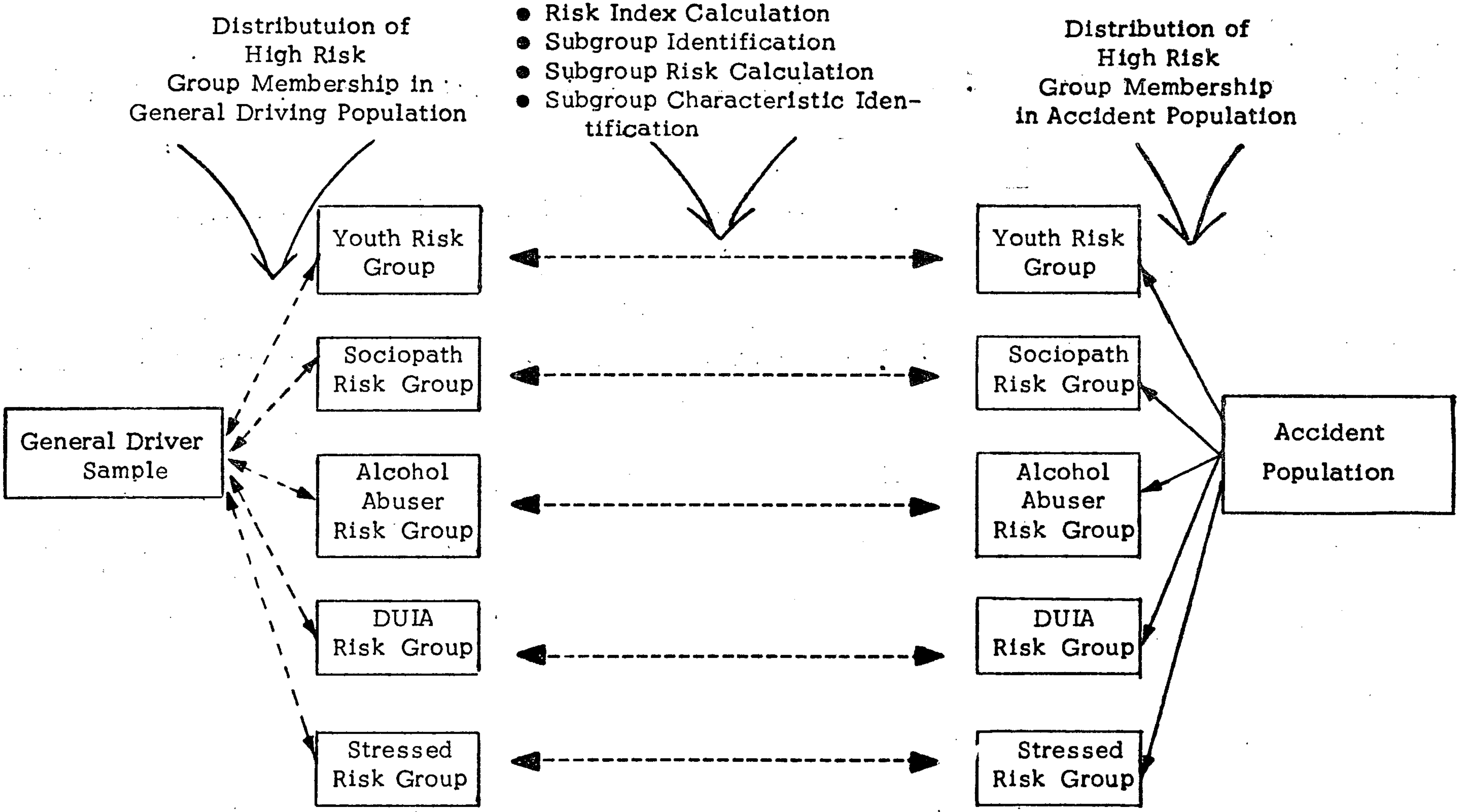
- its separate treatment of four types of serious accidents thereby allowing associated driver attributes to vary over accident type

- its deliberate sampling bias toward high-risk drivers so as to provide adequate numbers for in-depth analyses of the effect of secondary driver attributes

- its intention to use analytic methods explicitly acknowledging the possible importance of interaction effects

FIGURE 2

RESEARCH DESIGN



2.5 Site Selection

The State of Pennsylvania is an appropriate site for the investigation of driver attributes associated with alcohol-related accidents. Its Department of Transportation has an up-to-date system for storage and retrieval of driver and accident records. Its governor has formed a Council on Alcoholism and Drug Abuse which has been active in traffic safety throughout its brief existence. It is currently assisting the three alcohol traffic safety programs in the state. Additionally, it is actively attempting to acquaint its drivers with key facts relating to safe alcohol usage through a mass mailing program.

There is to be one central geographic site for the study — Allentown, Pennsylvania. This manufacturing city is a regional business center of 110,000 people and is the county seat of Lehigh county, which has a population of 255,000. There are approximately 81,000 licensed drivers in the county. There are forty fatal accidents and about 2,500 personal injury accidents in the county each year. Arrests for driving under the influence of alcohol numbered approximately 200 in the city proper and 300 in the entire county in 1973. The city police maintain an excellent record-keeping system in addition to a publicly available daily log of incidents. This site will serve as the jurisdiction for the majority of the analysis. *

The counties of Lehigh, Northampton, Carbon, and Berks are a contiguous set of counties with characteristics similar to those of Lehigh alone. The contained cities of Bethlehem, Easton, and Reading are all manufacturing centers. There are 815,000 thousand people in the four-county area. Each year there are roughly 150 fatal accidents and 7,500 personal injury accidents in the area. This four-county area will be used as a source of the fatal accident driver group.

Lancaster, Pennsylvania is a city of 57,000 people in a county of the same name with a population of 320,000. There were approximately 102,000

* Research (16) indicates that cities of less than 250,000 people lack the urban-suburban cultural splitting characteristic of larger cities. This eliminates a possible source of bias in that only inner city police logs will be used for certain samples.

licensed drivers and approximately 300 arrests for driving under the influence of alcohol in the county in 1973. There are about 70 fatal accidents and 2,600 personal injury accidents in the county each year. Like Allentown, the police force of the city proper has one of the best record keeping systems in the state. This site will be used in parallel with Allentown to assess the accident probability of drivers arrested for DUIA.

York County will be used along with Lancaster to provide fatal accident-involved drivers who have prior DUIA convictions. There are 590,000 people and about 113 fatal accidents per year in the two counties. The Anabaptist sects are an important cultural factor in each county.

Philadelphia, Pennsylvania has had an ASAP-like program since 1972. This site will be used to provide another source of drivers with DUIA on their records.

3.0 Data Sources

3.1 Institutional Sources

The Statement of Work for DOT Contract No. HS-4-00992 specifically states that the selection of groups who represent high-risk individuals shall be based on the feasibility as well as the legality of singling out individuals within these groups for the application of countermeasures prior to any alcohol accident involvement. With that in mind, the following data sources were approached: not for all information contained within each agency, but for only that portion which can be legally extracted by a traffic safety administrator.

3.1.1 Pennsylvania Department of Transportation

- Bureau of Traffic Safety, Records Division

The Bureau of Traffic Safety is the repository for all records on all licensed drivers in Pennsylvania. The record-keeping system of this Bureau is both manual and computerized with the manual system structured such that each individual has a folder containing hard copies of citations, accident reports, suspension/revocation notices, vehicle registrations and license. The computer files contain all of the above information and can be accessed by: name, or partial name; license number; vehicle registration number, or partial number; driver age; or driver county of residence. Also all violation data is based on convictions not arrests.

Other data sources within the Bureau of Traffic Safety include:

— School Division -- sends notices to individuals required to attend the Pennsylvania Safe Driving School. This division is a source of multiple or serious traffic offenders.

- Financial Resources Division -- is charged with obtaining financial statements from individuals under suspension/revocation for serious violations, such as DUIA and hit and run and also individuals with an outstanding judgment.

- Bureau of Accident Analysis

The Bureau of Accident Analysis is responsible for compiling information on all reportable accidents occurring in the state. The Bureau receives all police accident reports, from which information is extracted, coded, and placed on the computer system. This system is capable of providing:

- Name, address, age and sex of all individuals involved in an accident
- Accident location, time, and conditions
- Causal factors
- Type of accident (fatal, personal injury, property damage)
- Type of vehicle(s) involved

The system also has the capability for providing printouts in a format useful to the Traffic Safety Administrator.

3.1.2 Philadelphia ASAP

The Philadelphia ASAP, formally entitled the Philadelphia Alcohol Safe Driving Program, was founded in 1972 and contains as part of its program both in-patient/out-patient alcohol treatment programs and safe driving schools. When the program was first instituted, only first offender DUIA's were admitted into the program. However, it was soon realized that this discrimination was preventing those individuals with a real need from obtaining help. At the present time, individuals convicted of DUIA in the Philadelphia area have two options: entering the alcohol safety program, or the standard penalties dictated by the

Pennsylvania Penal Code. An individual choosing to enter the program is required to complete a series of questionnaires which elicit information on drinking/driving behavior, general demographics, and personality. The results determine whether that person is referred to an alcohol treatment program, safe driving school, or both. A person refusing to enter the program, although he cannot be required to complete the questionnaires, may be directed by the presiding judge, as part of his punishment, to participate in an alcohol treatment program or safe driving school. The Philadelphia ASAP includes as part of its overall operation a follow-up treatment program which will help in evaluating the effects of this program on future driving habits.

3.1.3 Allentown City Police

The Records Department of the Allentown Police Department is organized in such a fashion as to lend itself readily to the data collection needs of a Traffic Safety Administrator. The Records Sergeant maintains a file of arrests by violation type (non-traffic except for DUIA and hit-and-run). This file is also arranged alphabetically, color-coded by year, and contains basic demographic information. Hard copy arrest sheets are kept at several locations within the Department. The Records Department is also responsible for maintaining a daily log of arrests. This log is public information and contains the name, address, and violation of each person arrested in a given time period. Although the legality of accessing the actual arrest files is somewhat in question, the daily log will provide the necessary information. It is held intact at least through 1970, which is sufficient for the current research.

3.1.4 Lancaster City Police Department

The Lancaster City Police have been contacted and their Records Department has indicated a structure similar to that of the Allentown Police Department. A daily log is accurately maintained and copies are available back to 1969. As with Allentown, this log is public information and will provide the researcher with all necessary information.

3.1.5 Court Records

Court records which will be used to identify individuals under various types of stress are broken into two categories: the Records of the Federal District Court in Allentown will be accessed to obtain names and addresses of individuals filing for bankruptcy, while civil suit and divorce records will be obtained from the county court system. Such records are public information, therefore, pose no legal problems.

3.1.6 County Coroner

A second data source for identification of individuals under short-term stress is death certificates recorded in the Office of the County Coroner. These certificates would provide the names of next of kin; they are public information, therefore posing no legal problem.

3.1.7 Alcohol Treatment Center

The Northampton County Alcoholism Treatment Center – located in the Muhlenberg Medical Center, Allentown, Pennsylvania — will be used as a source of locally residing alcoholics who have undergone medical treatment for alcoholicism.

3.2 Questionnaire

The only legal and economic means of acquiring a large portion of the desired personal data is through the use of interview and mail questionnaire techniques. The questionnaire will be administered initially by mail in three waves. The first mailing will be accompanied by a 50¢ piece as an incentive to boost response. Past research (Erdos (36) and Armstrong (1)) has shown the response boosting capability of this device. Two weeks later, a post card reminder will be sent. After another two weeks a second copy of the questionnaire will be mailed. The expected cumulative response rate from the three waves is sixty percent. Past sociological research results lend credibility to that estimate (Hochstim and Athanasopoulous (49), and

Overton and Armstrong (24)). Hochstim cites five surveys ranging in length from 8 to 23 pages on which three-wave mail response varied from 70 to 81 percent. Personal interview follow-up raised response to a minimum of 83 percent. The 10 three-wave surveys reported by Overton have response rates of 40, 23 and 14 for the three waves for a total of 77 percent response. None of these surveys employed any monetary incentive.

The mail response results will be followed up with a wave of personal interviews to boost response rates into the vicinity of eighty percent. Where necessary the interviewers will gather needed data items from relatives of the target subject.

The questionnaire itself is contained in this report as Appendix A. It contains items on: demography; driving patterns; job, homemaking, and school stress; personality; family environment; alcohol usage; social support; health; life events; and activities. The job stress, social support, and activity scales are drawn from the work alone by Dr. William H. Kroes of the National Institute of Occupational Safety and Health. The home and school stress scales are adopted from the job scale. The life events scale is adopted from the scale used by Selzer and Vinokur (39). The items on the family environment scale were developed by the Social Ecology Laboratory at Stanford University. The personality scale is the short form of the Eysenck Personality Inventory (9). Several questions on drinking behavior are drawn from the work of Cahalan (5).

4.0 Data Collection: Plan

There are to be seven samples of licensed Pennsylvania drivers drawn to provide the study population. This section outlines the manner in which each sample is to be drawn, source and type of data to be collected, and the anticipated sample sizes.

The sample sizes planned for the study are designed to provide an adequate number of cases for analysis of the accident risk impact of secondary variables within each risk group. Consequently, sample sizes appear large. The style of the research design is partially hypothesis testing — are the pre-identified risk groups actually significantly different from the average driver? — and partially exploratory — what variables differentiate within each group between higher and lower risk drivers? Exploratory research simply does not allow precise estimation of sample sizes. Sample sizes have been estimated to provide adequate numbers of cases for investigations of the impact of combinations of driver attributes. Additionally, the design has provided some additional cases to allow random splitting of the samples for the purposes of cross-validation.

4.1 Youth Risk Group

Selection Criteria

The proposed risk group defined as youth will consist of licensed drivers who were between the ages of 16-24 and resided in Lehigh County during the period 1971-1974. Because of the dynamic nature of this period, it is our intention to split this group into two categories: 16-20 and 21-24. Past research shows that several accident peaks occur during the eight-year period with the causal factors changing from peak to peak and also a distinct separation of alcohol and non-alcohol related accidents (25,26).

Given the retrospective nature of our proposed study, the identification of these subjects will be as follows:

- Records of the Pennsylvania Board of Traffic Safety (BTS) will be accessed and sorted by age and county of residence from which a list of individuals presently age 20 and 24, holding valid Pennsylvania drivers licenses, and residing in Lehigh county will be obtained, thus giving us subjects who were 16 or 20 in 1970 and who can be tracked as they pass through the various accident peaks.

A second source of subjects will be the area college rolls.* This source will be used to avoid biases in our sample. From these rolls, we can replace individuals not meeting residence requirements because of attendance at a college or university outside of the study area with matching local college students.

Data Collection and Sample Size

The data collection techniques used for this group will include the use of standard questionnaires and driving record data obtained from BTS. Eight hundred subjects evenly split between the two age groups will be identified. Through research in questionnaire response rates, we believe a reasonable estimate is 40% response for the first mailing. After two weeks, a reminder post card will be sent to non-respondents. We feel this mailing will boost cumulatively by 10-15 percentage points. After two weeks, a second set of questionnaires will be sent. These, however, will be sent certified mail. An additional five percentage points are expected from this mailing. To prevent undue biases in our sample, the remaining non-respondents will be contacted and interviewed on a personal basis.

---

* There are three four-year colleges and a community college in Allentown and ten colleges in the Allentown area.

The total response rate expected for this group is at least 80%. Past research in questionnaire response rates leads us to believe that by using the proposed methods an 80% response is realistic, and likely to be higher still. It must also be mentioned at this time that a high return is important to avoid sample biases. This is true in general, particularly for a heterogeneous group such as this one.

Given the 80% return, questionnaires for these 600 individuals will be screened to insure compliance with the residence criterion. The expected loss for this group is between 30% and 40%. At this point, the local college roles will be accessed to obtain the names of individuals both attending college and living in the Lehigh Valley. Approximately 120 students will be sent a questionnaire and all the above steps will be taken until an 80% response is attained. These individuals will then be substituted on a one to one basis for each subject from the original 600 lost due to attendance of school out of the study area. Complete driving records will be extracted from BTS for all remaining drivers and combined with the questionnaire data to form the basis for group analysis.

4.2 Sociopath Risk Group

Selection Criteria

The proposed sociopath risk group consists of drivers who in the period 1968-1969 have had some contact with the Allentown police, specifically for "Part II" offenses partially defined as:

- Larceny
- Disorderly conduct
  - disturbing the peace
  - unlawful assembly

- Offenses against family and children
  - desertion, non-support
  - neglect
  - non-payment of alimony
- Liquor Law Offenses
  - furnishing alcoholic beverages to a minor
  - illegal transportation/manufacture of alcoholic beverages
  - consumption of alcoholic beverages by a minor
- Vandalism
  - destruction, injury, disfigurement or defacement of public or private property
- Gambling
  - bookmaking
  - numbers or lottery
  - operation of a gambling house

Data Collection and Sample Size

The Allentown city police daily log, which lists arrests by name of person arrested, address, and type of violation, will be used to identify the majority of subjects. Because of the transient nature and makeup of this group, a somewhat different data collection approach will be used. After the initial identification of subjects (target 400) the first step will be the extraction of their driving records from BTS. This will be done primarily to check compliance with the residence criterion. The expected loss due to non-compliance is 50%.

The next step is the collection of questionnaire data. The makeup of this group dictates the means for collection of this information. The use of a mail questionnaire for this group would yield a very low response. Therefore, the questionnaire will be administered via personal interview in several waves if necessary. Even using this technique, only 50% response is anticipated. Such a response rate is difficult to use in a scientific study. There is some solace in the fact that the sociopath risk group is such that those individuals most likely not to respond are of a hard-core nature and would, therefore, be least affected by traffic safety countermeasure programs directed towards them.

Complete driving records will be extracted for the remaining 100 individuals and combined with the questionnaire data to form the basis for analysis.

4.3 Alcohol Abuser Risk Group

Selection Criteria

Identification of the individual suffering from alcohol absue will always be a principal problem in the field of addiction treatment. Any means of identifying alcohol abusers dependent upon routinely collected data can only touch a fraction of the relevant population. Nonetheless, estimation of the impact of readily identifiable abusers upon automobile accidents is a worthwhile endeavor. Drivers will be included in this group if they meet any of the following criteria:

- arrest for DUIA on Allentown police logs during 1969 and at least one prior conviction for DUIA
- arrest for non-traffic alcohol offense on Allentown police logs during 1969, including disorderly conduct arrest where alcohol can be identified as one of the contributing factors
- admitted for study or treatment at an area alcoholism treatment facility during 1969.

Data Collection and Sample Size

Through the use of the Allentown police daily log, a risk group of 400 subjects meeting either of the first two criteria will be identified. Driving records for these individuals will be extracted from BTS and screened for residence and prior DUIA convictions. As a result of this initial screening, it is our belief that approximately 100 subjects will be lost, reducing the sample to 300. Questionnaires will then be sent to the remaining drivers with an expected response of 40%. The remaining 180 subjects will be contacted and personally interviewed. Even allowing for substantial losses of potential respondents due to inadequate addresses and other reasons, we should have no difficulty reaching our target of 150 respondents.

In order to identify individuals admitted to an area alcohol treatment facility, the mail questionnaire will be given to the director of the facility who, in turn, will forward it to patients meeting our criteria of residence in Lehigh county and admission for treatment during 1970. In this study, this is the only study group which could not be routinely accessed by the traffic safety administrator. We, nonetheless, have included these individuals because they are undeniably important for comparison with past research and possibly quite important to the total alcohol-involved accident picture.

4.4 DUIA Risk Group

Selection Criteria

Pennsylvania drivers arrested for DUIA in 1970 will be identified from the daily logs of the city police of Allentown and Lancaster. Drivers with a prior conviction for DUIA will be dropped from this group and included in the alcohol abuser group. In addition, the logs of the Philadelphia city police will be searched for DUIA arrests of Pennsylvania drivers in 1972. That date marks the beginning of the Philadelphia Alcohol Safe Driver Program.

Data Collection and Sample Size

As mentioned above, data will be collected for three separate sets of subjects. This procedure will be used so that an analysis can be performed showing the effects of different socio-economic variables, ethnic cultures, and the effects alcohol safety programs have on the DUIA risk population.

Initially, approximately 300 individuals will be identified from each of the sites. BTS records for these subjects will be obtained and screened for residence and prior DUIA convictions. Approximately 20% loss is expected, the remaining 750 will be mailed the standard questionnaire in a three-wave series comparable to that done for the youth risk group. The anticipated response rate for the three mailings is 40%. Personal interviews will then be arranged with non-respondents to bring the sample size to the desired level of 150 subjects per site. To achieve that level, 60% total response is necessary.

All interview data will be combined with the individuals complete driving record. Summary data will also be collected from the tests administered to convicted DUIA drivers in the Philadelphia Alcohol Safe Driver Program and used in the analysis of this group.

4.5 Stressed Risk Group

Selection Criteria

The stressed risk group is defined such that individuals involved in a life stress situation in 1972 can be identified. The interception date of 1972 was selected so that the effects of stress can be analyzed both prior to and following the event.

Records of the state and federal court system will be used to extract names and addresses of individuals who during 1972 either: filed for bankruptcy; were defendents in sizeable civil suits; or had applied or received a divorce. Lehigh county coroner records will be used to identify next of kin for people deceased during this year.

Finally, in an attempt to elicit the predictive value of economic stress, KETRON proposes to include in this group a sample of individuals unemployed as a result of the unforeseen closing of the Lehigh Portland Cement Company plant and offices in the Allentown area.

Data Collection and Sample Size

Approximately 400 individuals will be identified from the sources listed above. Current address information for these individuals will be obtained from the BTS to ensure compliance with the residence criterion. Because of the group makeup and the likelihood of relocation following divorce, death of spouse, or lay-off; a 40% rejection rate is expected. The next proposed step will be the issuance of the standard questionnaire. This again will be done via a three-wave mailing effort. Overall expected response rate is 60%. All non-respondents will be contacted and personal interviews attempted. The target sample size for the stressed risk group is 200 subjects.

Like the youth risk group, this group is for the most part heterogenous thus requiring a high overall return on the questionnaire to minimize sample biases. Every effort will be made to assure at least 80% total response.

4.6 General Drivers

Selection Criteria

As with all research of this nature, the selection of a sample from the general driving population is a necessary item. A random sample of Pennsylvania drivers residing in Allentown and Lancaster counties and Philadelphia will be drawn using sequential random sampling of drivers' names extracted by BTS. The BTS computer file software has the capability to extract lists of drivers by county of residence.

Data Collection and Sample Size

The target size for this group is approximately nine hundred drivers equally spread between the three geographic areas. Approximately 1,500 names and addresses will be procured from BTS. These potential subjects will be screened on the 1971-1974 residence criterion with an anticipated loss of 20%. The remaining individuals will be sent the standard questionniare with expected response rates of 40%, 15%, 5% for each mailing, respectively. The remainder of the sample will be obtained through personal interviews of non-respondents. Complete Pennsylvania driving records will then be extracted for all selected drivers.

4.7 Accident Group

Selection Criteria

A sample of drivers involved in personal injury accidents in Lehigh, Lancaster, and Philadelphia counties will be drawn. Since the number of fatal accidents in Lehigh and Lancaster is inadequate to build the needed sample size from recent accidents, the accident study has been expanded to include similar contiguous counties. For Lehigh, the expanded area includes Berks, Carbon, and Northampton. For Lancaster, only York had to be added.

Data Collection and Sample Size

The records of fatal accidents occurring in Lehigh, Northampton, Bucks, and Carbon counties during 1973 and 1974 will be used to identify approximately 450 involved drivers meeting a limited residence criterion (Pennsylvania residence, 1971-1974). The records of fatal accidents occurring in Lancaster and York Counties during 1972-1974, will be matched against the driving records of involved drivers to yield roughly sixty drivers with past convictions for DUIA. Fatal accident records of Philadelphia for 1973-1974 will be matched against driving records also to select approximately 60 drivers with past convictions for DUIA.

An analogous procedure will be employed for personal injury accidents. The greater incidence of such accidents will allow use of a one-year period for each study area.

The standard questionnaire will be mailed to the 1,140 individuals identified (570 fatal accident population, 570 personal injury). The same procedures mentioned earlier will be used: three questionnaire mailings followed by personal contact and interview of non-respondents. A return of 300 individuals from the Lehigh and contiguous county fatal population is expected. Also anticipated is a 65% return rate for those convicted DUIA subjects from Lancaster or York county and Philadelphia. The interviewers will be instructed to conduct colateral interviews with relatives of deceased drivers.

The final accident group for which complete driving records will be obtained will consist of:

- 300 Pennsylvania drivers involved in a fatal accident in Lehigh or a contiguous county in 1973 - 1974

- 300 Pennsylvania drivers involved in a personal injury accident in Lehigh or a contiguous county for 1974

- 40 drivers convicted for DUIA involved in a fatal accident in Lancaster or York county in 1972-1974

- 40 drivers convicted for DUIA involved in a personal injury accident in Lancaster or York county in 1974

- 40 drivers convicted for DUIA involved in a fatal accident in 1973-1974 in Philadelphia

- 40 drivers convicted for DUIA involved in a personal injury accident in Philadelphia in 1974

Coupled with driving records and standard questionnaire data for each driver, both living and dead, in our final sample, information from the report prepared for the selected accident will be obtained. This information will include:

- whether or not the driver was judged responsible by the Pennsylvania Bureau of Accident Analysis (not necessarily an indication of legal responsibility)

- whether the accident was single or multiple-vehicle

- whether the driver was killed

- whether the driver was injured

- number of other drivers killed

- number of other drivers injured

- number of passengers killed

- number of passengers injured

- date, day of week, and time of day of accident

- county of accident

- police jurisdiction reporting accident

- whether or not driver was arrested for DUIA
- whether or not driver was judged to be impaired by alcohol
- identification number of accident

4.8 Data Collection and Sample Size Summary

The preceeding section has described in detail the selection criteria, data sources, and sample sizes for each of the proposed study groups. The means of interception for individuals falling into each of these groups were carefully chosen. The criteria used in selection of these interception points were first, to provide the best possible sample and second, and just as important, to identify and provide to the traffic safety administrator legally and economically feasible ways of potential high risk driver identification.

Table 1 provides a capsule summary of the proposed group design.

Table 2 serves as a final summary of the data collection process. It presents for each pre-identified risk type, the number of average drivers expected and the number of accident involved drivers expected. This is the data which will be presented for the analysis discussed in the following section. The derivation of these estimates is explained briefly below.

Four hundred average youthful drivers are expected to result from the sampling procedure. Of the three hundred accident-involved drivers, roughly 30 percent are expected to be between the ages of 16 - 24 from the Pennsylvania accident statistics.

Pollock found that 36 percent of fatally injured drivers had a prior non-traffic arrest record so we expect about 100 accident involved drivers to fall into the sociopathic risk class. These drivers are matched by 100 drivers coming from the police log sampling.

TABLE 1

GROUP DESIGN

Group	Means of Interception	Filter	Number of Questionnaires Sent	Number of Personal Interview Attempted	Number of Questionnaire Returns	Filter	Number of Driver Histories Pulled
General Drivers - Allentown - Lancaster - Philadelphia	- BTS data file sorted by county	1971-1974 county residence	400 400 400	160 160 160	300 300 300	NONE	500 (done prior 500 to ques- 500 tionnaire)
Youth Risk Group - Age 20 - Age 24 - Supplement	- BTS data file - BTS data file - Local college rolls	None 1971-1974 residence	400 400 120	160 160 50	300 300 100	1971-1974 residence	200 200
Sociopath Risk Group	- Allentown Police Daily log	Part II Offenses - larcency - disorderly conduct - family offenses - liquor low violations - gambling 1971-1974 residence	NONE*	200	100	---	400 (done prior to ques-tionnaire)
Alcohol Abuser Risk Group	- Allentown Police Daily log - Lehigh county alcohol treatment center	Non-traffic alcohol related arrests Multiple DUIA 1971-1974 residence	300 100	180	150 40	---	500 (done prior to ques- 40 tionnaire)
DUIA Risk Group - Allentown - Lancaster - Philadelphia	- Daily log for Allen-town, Lancaster and Philadelphia	1971-1974 residence	250 250 250	150 150 150	150 150 150	---	300 (done prior 300 to ques- 300 tionnaire)
Stress Risk Group	- County court records - Federal court records - County coroner - Employment rolls Lehigh Portland Cement	1971-1974 residence	250	100	200	---	400 (done prior to ques-tionnaire)
Accident Groups - Allentown - Lancaster - Philadelphia	- BAA accident files by county	1971-1974 residence	900 120 120	450 60 60	600 80 80	---	900 (done prior 120 to ques- 120 tionnaire)

Brenner and Selzer found 30 percent alcoholics in a fatal accident group. Pollock found approximately 15 percent of fatally injured drivers to have a non-traffic alcohol-related arrest. Together these might account for 35 percent of the accident sample for about 100 drivers. A total of 190 alcohol abusers are anticipated in the matching sample — 150 from the police logs and 40 from the alcoholism treatment center.

Pollock found 10 percent of his fatal driver group to have a past DUIA conviction. A similar result in our accident sample would leave 30 drivers to be compared to the 150 gathered from police logs.

Finally, the 200 drivers drawn from situations of likely high stress, will be matched by 150 accident-involved drivers if the results of Brenner and Selzer are repeated in which they found about one half of a fatal accident group to suffer from a high stress level.

TABLE 2

Approximate Ultimate Sample Sizes

Risk Group	Average Group Members	Fatal Accident* Involved
Youth	400	90
Sociopath	100	100
Alcohol Abuser	190	135
DUIA	150	30
Stressed	200	150

* There will be a similar column for personal injury accidents.

5.0 Data Analysis

5.1 General Discussion

The primary purpose of this project is to test the feasibility of various programs for routine identification of specific drivers who are high-risk. The secondary purpose is to further the knowledge of characteristics possessed by high-risk drivers. Both purposes require measures of ability to predict drivers who are relatively likely to become accident statistics, yet there is a fundamental difference. One may know the characteristics of high-risk drivers without being able to use that knowledge to administer an on-going high-risk driver screening programs. The known characteristics of high-risk drivers may require data which is unavailable to the traffic safety administrator because its collection:

(1) violates formal or informal prohibitions against invasions of privacy,

(2) requires cooperation of individuals only possible under the quarantees of anonimity in a research study,

(3) requires levels of cooperation between organizations which are unrealistic because of different and possibly conflicting objectives, or merely

(4) demands funding in excess of its opportunity cost.

There is nonetheless substantial merit to furthering knowledge of the characteristics of high-risk drivers. That knowledge can provide direction to future research funding, and can permit evaluation of the merit of counter-measure programs directed against specific groups of drivers. Also of value, is the use of such knowledge to estimate the fraction of all fatal and serious accidents which can be attributed to high-risk drivers. There is clearly a point at which additional sophistication in identification of driver characteristics which correlate with accident probability will not be an effective use of federal funds. Attempts to seek additional predictive characteristics are the only means to determine if that point has been reached.

5.2 Presentation of Results

The analysis of each high-risk group will result in the calculation of several performance statistics for the group and for several subgroups. The performance statistics will be provided for four types of accidents: fatal single-vehicle, fatal multiple-vehicle, personal injury-single vehicle, and personal injury-multiple vehicle. For each accident type, three performance statistics will be calculated: the probability of a group or subgroup member being involved in an accident over a four-year period, both adjusted and unadjusted for mileage driven, as well as the fraction of all accidents which involve drivers who fall into the group or subgroup.

The performance statistics for each accident type will be presented for the group as a whole and for subgroupings based upon those variables which provide discrimination between higher and lower risk members of the group. The subgroupings will be prepared and presented to allow the administrator to determine the utility of each piece of data he can collect at a reasonable cost and reliability. Data collectable only in a research program will then be used to further breakdown the subgroup membership. As a result of this pattern of analysis, the administrator can ascertain the composition of each grouping of drivers addressable by him. This data should be useful in planning countermeasure alternatives for each considered target group.

In addition to these results, there will be an attempt to present models which can be used with the collected data to predict accident probabilities for <u>individual drivers</u>. These models would likely, but not necessarily, differ from group to group. Actual measures of the predictive validity of such models are likely to be compromised by limited sample sizes and time frames. However, some portion of the data will be held out of the data base used for model development so that at least limited cross-validation tests may be performed.

Two further comments are in order. First, the accident probabilities will likely be presented as risk indices in order that their numerical significance be readily apparent. Such indices present the ratio of the group or subgroup accident probabilities to the corresponding probabilities for the general driving population. It is worth noting that the appropriate reference group for a driver identification program is the population of licensed drivers rather than the population of drivers likely to be on the road at any particular time or place. Second, these will be, in fact, four analyses: one for each specified type of accident. The accident typology was selected to provide a test for differences in driver characteristics between fatal and serious accidents as well as between single and multiple vehicle accidents.

5.3 Methods of Analysis

There are three basic steps in the analysis plan for the study. First, accident probabilities will be estimated for the general driver population and for the average member of each pre-identified high risk group. These calculations allow the creation of risk indices for each high risk group. The second step is the quest for secondary variables which are useful in identifying subgroups of drivers which have substantially elevated or depressed risk indices relative to other members of their high risk group. The last basic step in the analysis plan is the development of models which estimate risk indices for individual drivers.

These three steps involve a progression from the general to the specific, from simple models (typologies) to complex models (multivariate regression with transformation of variables and selected interaction effects, for example), and from use of readily acquired data to demands for data available only to the researcher.

5.3.1 Calculation of Group Risk Indices

Calculation of group risk indices requires estimation of accident probabilities for the general driver population and for the average member of each pre-identified high risk group. These probabilities may be estimated in a number of ways. For instance, the probability of a youthful driver being involved in a fatal accident over a four-year period could be estimated as:

(1) the fraction of all drivers in the youth group who were involved in a fatal accident over the four-year period,

(2) the general driver accident probability multiplied by a ratio which reflects the over representation of youthful drivers in the fatal accident population.*

5.3.2 Identification of Risk-Classified Subgroups

For each pre-identified high risk group, two samples of drivers will be compared in an attempt to derive a typology based on accident probability. As an example, the two samples which will be compared for the youthful drivers are: (1) the youthful drivers in the accident population, and (2) the youth high risk group. Presumably, if there are characteristics which cause some youth to be a higher risk driver than fellow youths, these characteristics will be overrepresented in the accident population. Various computational means will be employed to seek any such variables. Manual comparison of profiles of the average member of each group is the simplest possible means. The problem fits fairly well the purpose for which Automatic Interaction Detector (AID) was designed, especially since we

---

* This ratio is the fraction of accident population who are youthful drivers divided by the fraction of the general driver population who are youthful drivers.

expect interaction between variables to be significant.* The small sample sizes with which we are forced to deal makes the analyst regard use of AID with caution since it is unconstrained by any hypothesized causal model and thus seeks any relationship evident in the empirical data.

A combination of judgement, results of structure-seeking statistical packages such as AID, and concern for the consistency of empirical results with prior evidence will produce a set of subgroups for each group. This partitioning of each group's population will be an attempt to maximally differentiate types of individuals with respect to accident risk index. Each subgroup will have a set of defining variables and a risk index.

The measure of risk will be defined in various ways to assess the stability of the classification scheme. For example, the dependent variable submitted to AID as a measure of risk might be a one—zero variable representing high and low risk, respectively. High risk might be designated to mean involvement in a fatal accident over the study period and low risk designated to mean any other accident record. A classification scheme based on that definition of risk could be compared to one based on a modified risk measure which defined a low risk individual as a driver who was accident-free over the study period. Such comparisons should produce a more robust classification scheme and might well provide useful insight into the consistency of the high risk profile over various accident types.

---

* For instance, we expect that aggression and alcohol use will have a significant interaction term within the youth group. Also, we expect extroversion, neuroticism, and alcohol use to require explicit treatment of interaction.

5.3.3 Individual Driver Risk Indices

The risk index of a specific driver could be estimated by determining his group or subgroup membership and assigning the associated risk index. This is essentially a typological prediction model. The analysis plan calls for an attempt to go beyond that crude model to find the relationships between underlying variables which result in the observed risk index variation over type of driver. Such a model would then allow (1) the calculation of risk factors for individuals which fall in between established subgroup definitions, (2) estimation of risk factors for subgroups defined along lines other than those employed originally, and (3) estimates of the effects of individual variables and groups of variables on accident probability.

We have had success in past analysis of similar problems through the use of multiple regression upon aggregated and transformed data. Each subgroup defined in the earlier analysis would supply one data point to the regression — its risk index and the defining set of variable values. A multiple regression package would then try to predict risk index as a function of the available variables. Since each point in that regression is an average over a possibly different number of individuals, we have found weighted regression to be valuable for this analysis.

6.0 Administrative Plan

This section is structured in such a way as to present the major tasks involved in the execution of Phase II of this study, provide complete breakdowns of each taks, and provide a task schedule for the Phase II effort.

6.1 Task Description

The four major tasks involved in the execution of Phase II are briefly discussed below.

- Task I -- Preparation for Data Collection

  — Identification of Individual Driver Subjects

Names and addresses of individuals meeting criteria for inclusion in the study will be acquired under this subtask. As specified in the plan for Phase II, this step will involve extraction of names from:

- daily police logs of Allentown, Lancaster, and Philadelphia
- automobile operator's license files of Pennsylvania
- automobile accident files of Pennsylvania
- rolls of students at colleges in the Allentown metropolitan area
- Lehigh county civil court records
- Federal court records in Lehigh county
- Lehigh county coroner records
- Employment rolls of selected Allentown area employers

— <u>Administrative Preparation</u>

Under this broad subtask fall many preparatory work steps such as final printing of questionnaire and supporting materials, finalization of arrangements with the Northampton Area Alcoholism Treatment Center, and the hiring and training of data technicians and interviewers.

- Task II -- Data Collection

— <u>Administer Mail Questionnaire</u>

A three-wave mail questionnaire program will be carried out using the mailing lists derived under Task I.

— <u>Interview Non-Respondents to Mail Questionnaire</u>

The questionnaire will be administered by project personnel to all cooperating non-respondents of the mail questionnaire. Extensive efforts will be made to establish correct addresses, contact individuals by phone or personal visit, and provide interview opportunities flexible in both time and place so as to gain response levels which are adequate to represent the sought population groups.

— <u>Acquire Driving Records</u>

The full driving records of each identified Pennsylvania driver will be acquired from the Bureau of Traffic Safety of the Pennsylvania Department of Transportation.

- Task III -- Data Analysis

— <u>Data Preparation</u>

Under this subtask, the assembled data will be coded, key-punched, key-verified, and edited.

- <u>Data Analysis</u>

The prepared data will be analyzed using statistical techniques deemed appropriate by the analysts once the data is in hand. Preliminary planning calls for the use of hypothesis testing to demonstrate the validity of prior notions regarding driver-risk factors. However, the main emphasis will be on the creation and verification of procedures for estimating the risk levels associated with various driver characteristics. Current plans call for the use of the Automatic Interaction Detector package, linear discriminant analysis, and weighted multiple regression techniques.

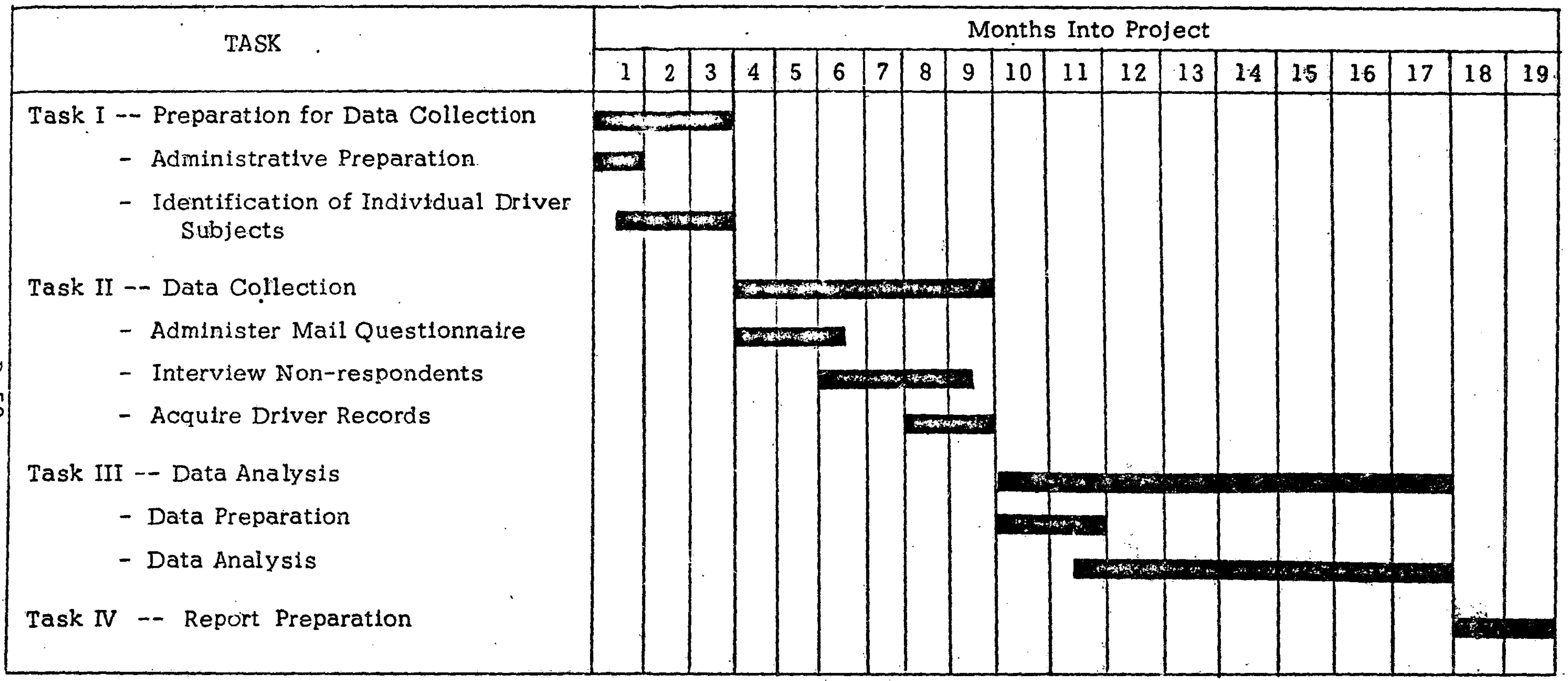
- Task IV -- Report Preparation

The results of the second phase of the study will be summarized under this task. The summary will present results in a form useful to the traffic safety administrator who needs to make decisions upon the likely efficacy and equity of various countermeasure programs. A separate section of the report will address itself to the alternative means for advancing the state of knowledge regarding the association of driver characteristics and accidents. A prospective study of drivers identified in Phase II will be one of the alternatives specifically addressed in that section.

6.2 Time Phase

The following figure represents the time sequence for the Phase II effort.

Phase II -- Task Schedule



BIBLIOGRAPHY

1. Armstrong, J. Scott, "Prepaid Monetary Incentives in Mail Surveys", to be published Journal of Marketing Research, 1974-1975

2. Barnack, J. E. and D. E. Payne, "Injury Producing Private Motor Vehicle Accidents Among Airmen", Bulletin Highway Res. Bd., 285:1-22, 1961

3. Brenner, B. and M. L. Selzer, "Risk of Causing a Fatal Accident Associated with Alcoholism, Psychopathalogy and Stress: Further Analysis of Previous Data", Behavioral Science, Vol. 14, 1969

4. Cobb, S. and R. M. Rose, "Hypertension, Peptic Ulcer, and Diabetes in Air Traffic Controllers", JAMA 224: 489-492, 1973

5. Cahalan, Sissan, and Crosley, American Drinking Practices, 1969

6. Crancer, A., Jr. and D. L. Quiring, Jr. "Driving Records of Persons Hospitalized for Suicidal Gestures", BRHS Vol. 1, #1: 33-42, January 1970

7. Dohrenwend, Barbara S. and Bruce P. Dohrenwend, Stressful Life Events: Their Nature and Effects, Chapter 1G, "Perception of Life Crisis Events", Wiley, N. Y., 1974

8. Eelkema, R. C., J. Brossean, R. Koshnich and C. McGee, "A Statistical Study on the Relationship Between Mental Illness and Traffic Accidents -- A Pilot Study", Amer. J. Public Health, 60:3: 459-469; 1970

9. Eysenck, Sybil B. G. and Hans J. Eysenck, "An Improved Short Questionnaire for the Measurement of Extraversion and Neuroticism", Life Sciences, Vol. 3, pp. 1103-1109, 1964

10. Filkins, L. D., C. D. Clark, C.A. Rosenblom, W.L. Carlson, M.W. Kerlan and H. Manson, "Alcohol Abuse and Traffic Safety: A Study of Fatalities, DWI Offenders, Alcoholics, and Court-Related Treatment Approach" DOT, N.H.S.B., Final Report, Contract FH-11-655 Contract FH 11-7129, Highway Safety Research Institute, The University of Michigan, Ann Arbor, June 1970

11. Goldstein, L. G., "Youthful Drivers as a Special Safety Problem", Accid. Anal & Prev., Vol. 4, pp. 153-169, 1972

12. Holmes, Thomas H. and Richard H. Rahe, "The Social Readjustment Rating Scale", J. of Psychosamatic Research, Vol. II, pp. 213-218, 1967

13. Harrington, D. M., "The Young Driver Follow-Up Study: An Evaluation of the Role of Human Factors in the First Four Years of Driving", California Department of Motor Vehicles, Rep. #38, 1971

14. Hyman, M.H., "Accident Vulnerability and Blood Alcohol Concentrations of Drivers by Demographic Characteristics", Quart. J. Stud. Alc. Suppl., #4, 1968

15. Hyman, M.H., "The Social Characteristics of Persons Arrested for Driving While Intoxicated,", Quart. J. Stud. Alc. Suppl., #4, 1968

16. Kirschenbaum, Allen, "City-Suburban Destination Choices Among Migrants to Metropolitan Areas", Demography, 9:2, pp. 321-335, May 1972

17. Kraus, A.S., W.R. Ghent and M.S. Thompson, "Pre-Driving Identification of Young Drivers With a High Risk of Accidents", J. of Safety Research, 2:2: 55-66, June 1970

18. Margolis, B. L., W. H. Kroes, and R. P. Quinn, "Job Stress: An Unlisted Occupational Hazard", J. of Occupational Medicine, Vol. 16, #10, October 1974

19. Minnesota Department of Public Safety, "The Alcohol-Impaired Driver and Highway Crashes", St. Paul 1970

20. McGuire, F. L., "A Typology of Accident Proneness" BRHS, Vol. 1, #1: 26-32, January 1970

21. McGuire, F. L., "Smoking, Driver Education, and Other Correlations of Accidents Among Young Males," J. of Safety Research, Vol. 4 #1: 5-11, March 1972

22. McMurray, L. "Emotional Stress and Driving Performance: the Effect of Divorce", BRHS, Vol. 1, #2: 100-114, Summer 1970

23. Mulford, H. A., "Iowa's Drinking Driver 1961: With a Method for Identifying Drinking Drivers in a Survey Sample", Social Problems, 12: 198-211, 1964

24. Overton, T. S. and J. S. Armstrong, "Non-Response Bias in Mail Questionnaires," submitted to Journal of Marketing Research, 1974

25. Pelz, D. C., S. H. Schuman, "Drinking, Hostility and Alienation in Driving of Young Men", Prepared for Third Annual Alcoholism Conference -- NIAA -- Washington, D. C., 1973

26. Pelz, D. C., T. L. McDale and S. H. Schuman, "Drinking-Driving Behavior of Young Men in Relation to Accidents", Unpublished Manuscript, April 15, 1974

27. Pennsylvania State Statistical Abstract, 1972

28. Perrine, M. W., "Identification of Personality, Attitudinal, and Biographical Characteristics of Drinking Drivers", BRHS, Vol. 2, #4: 207-226, Winter 1970

29. Perrine, M. W., J. A. Waller, and L. S. Harris, "Alcohol and Highway Safety: Behavioral and Medical Aspects", Final Report, Contracts No. FH-11-6609 and No. FH-11-6899, US DOT, NHTSA, National Commission on Safety Education, Washington, D. C., 1971

30. Pollack, Seymour, M.D., "Drinking Driver and Traffic Safety Project," Annual Report to the National Highway Traffic Safety Bureau, July, 1969 and July, 1970

31. Rahe, R.H., Life Crisis and Health Change -- in Philip, R.A., and Winterborn, J.S. (Ed), Psychotropic Drug Responses: Advances in Prediction, Springfield, Ill., Charles C. Thomas, 1969

32. Rosenberg, N., I.D. Goldberg, and G.W. Williams, "Alcoholism and Drunken Driving-Evidence from Psychiabric and Driver Registers", O.J. S.A. 33: 1129-1143, 1972

33. Schmidt, W.S. and R. G. Smart, Alcoholics, Drinking and Traffic Accidents, Quart. J. Alcohol 20: 631, 1959

34. Schukit, M. A., "Alcoholism and Sociography -- Diagnostic Confusion", Q.J.S.A. 34: 157-167, 1973

35. Scott, C., " Research on Mail Surveys," J. of the Royal Statistical Society, Series A, 124 pp. 143-195, 1961

36. Selzer, M. L., "Alcoholism, Mental Illness, and Stress in 96 Drivers Causing Fatal Accidents", Behavioral Science 14:1-10, 1967

37. Selzer, M. L., C. E. Payne, J. D. Grifford, and M.L. Kelly, "Alcoholism, Mental Illness and the Drunk Driver", Behavioral Science, Vol. 14, pp. 1-10, January 1963

38. Selzer, M. L., Marian Chapman, "Differential Risk Among Alcoholic Drivers", Proceedings of the 14th Annual Conference of the American Association for Automative Medicine, 1970

39. Selzer, M. L. and A. Vinokur, "Detecting the High Risk Driver: The Development of a Risk Questionniare", Final Report, DOT HS-801 099, U.S. DOT NHTSA, 1974

40. Selzer, M. L., A. Vinokur, "Life Events, Subjective Stress, and Accidents", American Journal of Psychiatry, 1974

41. Sterling-Smith, R. S., "Human Factor Variables and Fatal Vehicular Accidents: A Pilot Study", Final Report, DOT HS-800 921, U.S. Dept. of Transportation NHTSA, 1973

42. Stewart, J. Richard, B. J. Campbell, "The Statistical Association Between Past and Future Accidents and Violations", University of North Carolina Highway Safety Research Center, December 1972

43. Waller, Julian A., "Identification of Problem Drinking Among Drunken Drivers," JAMA, Vol. 200, April 1967

44. Waller, J.A., "Impaired Driving and Alcoholism: Personality or Pharmacologic Effect?" J. of Safety Research, Vol. 1:#4, December 1969

45. Waller, Julian A., "Administrative and Research Problems in Identifying Individuals with High Crash Risk", Behavioral Research in Highway Safety, Vol. 1, 1970

46. Yoder, R. D. and R. A Moore, "Characteristics of Convicted Drunken Driver", Q.J.S.A. 34: 927-935, 1973

47. Zylman, R., "Drivers Records: Are they a Valid Measure of Driving Behavior?" Accid. Anal. & Prev., Vol. 4, 333-349, 1972

48. Zylman, R., "Youth, Alcohol and Collision-Involvement," J. of Safety Research, Vol. 5, #2, June 1973

49. Hochstim, Joseph R. and Demetrios A. Athanasopoulous, "Personal Follow-Up in a Mail Survey: Its Contribution and its Cost," Public Opinion Quarterly, 34 (Spring 1970), 69-81.

APPENDIX A

STANDARD QUESTIONNAIRE

INSTRUCTIONS TO RESPONDENT

This questionnaire contains questions covering a broad range of subjects. Some of the questions regard tangible events whereas some deal with attitudes. No single question should take a long period of time. We are interested in your initial reaction to an attitudinal question and in approximately correct answers to questions about tangible events.

Sections of the questionnaire will not be appropriate to you; you will be directed to skip these sections.

We expect that it will take you about one-half hour to complete the questionnaire.

1. BIRTH DATE: ______ ______ ______
Month Day Year

2. SEX: Male ______ Female ______

3. MARITAL STATUS:

______ Married
______ Separated less than one year
______ Separated more than one year
______ Divorced
______ Widowed
______ Single

How many times have you been married? ______

4. NUMBER OF DEPENDENTS:

Not counting yourself, how many persons do you have to support partially or completely with your earnings? (Include spouse, children, parents, grandparents, brothers, sisters, etc.). ______ No. of Persons.

5. EDUCATION:

______ Graduate, professional
______ College, University graduate
______ Partial College training
______ High School graduate
______ Partial High School training
______ Junior High School
______ Less than 7 years schooling

6. INCOME: Please roughly categorize the total yearly income of yourself and your spouse. Include all sources.

______ Under $3,000.......................... Under $250/month
______ $3,000 up to $6,000 .... $250-$500/month
______ $6,000 up to $9,000.................... $500-$750/month
______ $9,000 up to $15,000...................$750-$1,250/month
______ $15,000 up to $21,000..................$1,250-$1,750/month
______ $21,000 or more .... $1,750 or more/month

7. RESIDENCE:

Zipcode	City	County	State

Number of people in this household excluding yourself: ______

How many of these people are your relatives: ______

Ownership:

- ______ Owned by you or your spouse
- ______ Owned by your parents
- ______ Rented
- ______ Other

Type of Structure:

- ______ Single family dwelling
- ______ Multi-family dwelling
- ______ Dormitory or hotel
- ______ Other

Years at Above Residence:

- ______ less than 1 year
- ______ 1 to 2 years
- ______ 2 to 3 years
- ______ 3 to 4 years
- ______ over 4 years

In less than 4 years, please list all other places of residence over the past four years.

From (Year)	To (Year)	City	County	State

At any time during the past four years did you live away from the above mentioned residence(s) for as long as two consecutive months (for example, military service, college away from home, or extended vacation)?

_____ YES _____ NO

If YES, please fill in the following table.

Period				City	County	State	Brief Explanation (college, military, etc.)
From		To					
Month	Year	Month	Year				

8. DRIVING HISTORY: Please answer all questions for each year in the following table. Approximate answers are sufficient.

	1971	1972	1973	1974
AUTOMOBILES: For how many cars were you the owner or principal operator?				
Total Miles: How many thousands of miles did you personally drive?				
DISTRIBUTION BY PURPOSE: How many of those miles were: — work related? (in thousands)				
— vacation related? (in thousands)				
DISTRIBUTION BY TIME OF DAY: During which time of the day did you drive the most? (Circle the single best answer)				
1. in the morning (6 AM - 10 AM)	1	1	1	1
2. at mid-day (10 AM - 4 PM)	2	2	2	2
3. early evening (4 PM - 10 PM)	3	3	3	3
4. late evening (10 PM - 6 AM)	4	4	4	4
DISTRIBUTION BY ROAD TYPE: On what type of road did you drive the most? (Circle the single best answer)				
1. limited access highways	1	1	1	1
2. major thoroughfares	2	2	2	2
3. city streets	3	3	3	3
4. rural roads	4	4	4	4
How many tickets did you receive for moving traffic violations such as speeding, going through stop sign, etc.?				
How many suspensions/revocations of your operator's license did you receive?				
In how many accidents were you involved as a driver (whether or not you were responsible?				

Have you ever been arrested for driving while under the influence of alcohol?

_____ YES _____ NO

Over the past four years, roughly what percent of your driving was done during the following time of day intervals?

- in the morning (6 AM - 10 AM) _____%
- at mid-day (10 AM - 4 PM) _____%
- early evening (4 PM - 10 PM) _____%
- late evening (10 PM - 6 AM) _____%

100%

Over the past four years, roughly what percent of your driving was done on the following types of roads?

- on limited-access highways _____%
- major thoroughfares _____%
- on city streets _____%
- on rural roads _____%

100%

9. EMPLOYMENT:

Do you regularly work at a job for which you are paid?

_____ YES _____ NO

If NO, please skip to question 10.

What kind of work do you do in your primary job (machinist, accountant, sales clerk, etc.)?

____

How many hours do you work at that job in an average week?

_______________ hours

Do you currently hold a second job for which you are paid?

_____ YES _____ NO

If YES, what kind of work do you do in that job?

____

Are you looking for additional work?

_____ YES   _____ NO

How often do you feel the following things about your primary job? (Circle one number per item).

	Often	Fairly Often	Some-times	Occas-sionally	Rarely or Never
My work is interesting to do	5	4	3	2	1
I dislike the amount of work I am expected to do	5	4	3	2	1
I have too much responsibility for the welfare and lives of others	5	4	3	2	1
I cannot tell what others expect of me	5	4	3	2	1
I have too much responsibility for seeing that various projects are carried out properly	5	4	3	2	1
People give me things to do which conflict with one another	5	4	3	2	1
People doing my kind of work in other places make more money or are better appreciated.	5	4	3	2	1

How much do you participate with others in helping to set the way things are done on your job? (Check one).

_____ A great deal
_____ A lot
_____ Same
_____ A little
_____ Very little

Knowing what you know now, if you had to decide all over again whether to take the type of job you now have, what would you decide? (Check one).

I would:

_____ Take without hesitation the same type of job
_____ Have second thoughts
_____ Definitely not take the same type of job

All in all, how satisfied would you say you are with your job? (Check one).

_____ Very satisfied
_____ Somewhat satisfied
_____ Not too satisfied
_____ Not at all satisfied

How would you say your satisfaction with your job has changed over the last four years compared to earlier years? (Check one).

I am presently:

_____ Dramatically more satisfied
_____ Somewhat more satisfeid
_____ About as satisfied
_____ Somewhat less satisfeid
_____ Dramatically less satisfied

10. HOME MANAGEMENT:

Do you have prime responsibility for the day-to-day running of your home?

_____ YES _____ NO

If NO, please skip to Question 11.

How often do you feel the following things about your position as homemaker? (Circle one number per item).

	Often	Fairly Often	Some-times	Occas-sionally	Rarely or Never
My work is interesting to do	5	4	3	2	1
I dislike the amount of work I am expected to do	5	4	3	2	1
I have too much responsibility for the welfare and lives of others	5	4	3	2	1
I cannot tell what others expect of me	5	4	3	2	1
I have too much responsibility for seeing that various projects are carried out properly	5	4	3	2	1
People give me things to do which conflict with one another	5	4	3	2	1
People doing my kind of work in other places make more money or are better appreciated.	5	4	3	2	1

How much do you participate with others in helping to set the way things are done around home? (Check one).

______ A great deal
______ A lot
______ Same
______ A little
______ Very little

All in all, how satisfied would you say you are with your position as homemaker? (Check one).

______ Very satisfied
______ Somewhat satisfied
______ Not too satisfied
______ Not at all satisfied

How would you say your satisfaction with that part of your life has changed over the last four years compared to earlier years? (Check one).

I am presently:

______ Dramatically more satisfied
______ Somewhat more satisfied
______ About as satisfied
______ Somewhat less satisfied
______ Dramatically less satisfied

11. SCHOOL:

Are you a student?

_____ YES _____ NO

If NO, please skip to question 12.

What kind of school do you attend?

_____ High School
_____ Trade school (carpenter, auto mechanic, etc.)
_____ Technical or Semi-Professional school (draftsman, computer programmer, etc.)
_____ Undergraduate college
_____ Graduate college
_____ Professional school

Are you:

_____ Full-time student
_____ Part-time student
_____ Evening or weekend student

How often do you have the following feelings about your school work? (Circle one number per item).

	Often	Fairly Often	Some-times	Occas-sionally	Rarely Never
The work in school is dull	5	4	3	2	1
I am dissatisfied with the pace of my classes	5	4	3	2	1
I cannot decide why I am in school	5	4	3	2	1
I have too much responsibility on the projects I have been assigned	5	4	3	2	1
My professors place conflicting demands on me	5	4	3	2	1
Students at more prestigious schools neither work harder or learn more than me	5	4	3	2	1

How much chance do you have to plan with advisors your course of studies?

______ A great deal
______ A lot
______ Same
______ A little
______ Very little

Knowing what you know now, would you voluntarily choose to attend this type of school with your current field of emphasis?

I would:

______ Elect the same type of school and program
______ Have second thoughts
______ Definitely not elect the same school and program

All in all, how satisfied are you with your school program?

______ Very satisfied
______ Somewhat satisfied
______ Not too satisfied
______ Not at all satisfied

12. DISPOSITION:

	YES	NO
Do you like plenty of excitement and bustle around you?		
Does your mood often go up and down?		
Are you rather lively?		
Do you ever feel "just miserable" for no good reason?		
Do you like mixing with people?		
When you get annoyed do you need someone friendly to talk to about it?		
Would you call yourself happy-go-lucky?		
Are you often troubled about feelings of guilt?		
Can you usually let yourself go and enjoy yourself a lot at a party?		
Would you call yourself tense or "highly strung"?		
Do you like practical jokes?		
Do you suffer from sleeplessness?		
Do you have a good appetite for food?		

13. FAMILY ENVIRONMENT:

The following section contains statements about families. You are to decide which of these statements are true of your family and which are false.

TRUE - Check True when you think the statement is True or mostly True of your family.

FALSE - Check False when you think the statement is False or mostly False of your family.

You may feel that some of the statements are true for some family members and false for others. Check True if the statement is True for most members. Check False if the statement is False for most members. If the members are evenly divided, decide what is the stronger overall impression and answer accordingly.

Remember, we would like to know what your family seems like to you. So do not try to figure out how other members see your family, but do give us your general impression of your family for each statement.

	TRUE	FALSE
We fight a lot in our family		
Family members rarely become openly angry		
Family members sometimes get so angry they throw things		
Family members hardly ever lose their tempers		
Family members often keep their feelings to themselves		
We say anything we want to around home		
It is hard to "blow off steam" at home without upsetting somebody		
We tell each other about our personal problems		

14. ALCOHOL CONSUMPTION: Please answer all questions for each year in the following table. Approximate answers are sufficient. Do not spend a long time on any one question. (Circle the best single answer to each question).

	1971	1972	1973	1974
How often did you drink any alcoholic beverage?				
— 3 or more times per day	1	1	1	1
— 1 - 2 times per day	2	2	2	2
— daily	3	3	3	3
— 3 - 4 times a week	4	4	4	4
— 1 - 2 times a week	5	5	5	5
— weekends only (Friday evening, Sat., & Sun.)	6	6	6	6
— 1 - 2 times a month	7	7	7	7
— a few times a year	8	8	8	8
— never	9	9	9	9
When you drink, what type of beverage do you usually consume?				
— beer	1	1	1	1
— wine	2	2	2	2
— hard liquor	3	3	3	3
When you drink that beverage, how many drinks do you generally have in one day? We mean by a drink: [a 12-ounce bottle or can of beer, a 4-ounce glass of wine, or a mixed drink with 1-2 one ounce shots of hard liquor]				
— 1 - 2 drinks	1	1	1	1
— 2 - 3 drinks	2	2	2	2
— 3 - 4 drinks	3	3	3	3
— 4 - 5 drinks	4	4	4	4
— 6 - 10 drinks	5	5	5	5
— 10 - 15 drinks	6	6	6	6
— 15 - 20 drinks	7	7	7	7
— 20 or more drinks	8	8	8	8
Generally, where are you when you are drinking?				
— home	1	1	1	1
— friend's or relative's house	2	2	2	2
— party or social gathering	3	3	3	3
— bar or restaurant	4	4	4	4
— other (please specify) ______________	5	5	5	5

14. ALCOHOL CONSUMPTION (Continued)

Circle the best single answer to each question.	1971	1972	1973	1974
With whom did you drink most often?				
— with friends	1	1	1	1
— with family members	2	2	2	2
— by yourself	3	3	3	3
How often do you drink by yourself?				
— fairly often	1	1	1	1
— once in a while	2	2	2	2
— almost never	3	3	3	3
Generally, how do you get home after drinking?				
— at home already	1	1	1	1
— walk	2	2	2	2
— public transportation	3	3	3	3
— ride from other driver	4	4	4	4
— drive myself	5	5	5	5
— other (please specify) ____________				

People drink wine, beer, whiskey or liquor for different reasons. Here are some statements people have made about why they drink. How important would you say that each of the following is to you as a reason for drinking--very important, fairly important, or not at all important?

	Very Important	Fairly Important	Not at all Important
I drink because it helps me to relax			
I drink to be sociable			
I like the taste			
I drink because the people I know drink			
I drink when I want to forget everything			
I drink to celebrate special occasions			
A drink helps me to forget my worries			
A small drink improves my appetite for food			
I accept a drink because it is the polite thing to do in certain situations			
A drink helps cheer me up when I am in a bad mood			
I drink because I need it when tense and nervous			

Some people worry about their drinking even though they may not be really heavy drinkers. How much do you worry about your drinking ?

_____ A lot
_____ Some
_____ A little
_____ Not at all

15. SOCIAL SUPPORT:

How much does each of these people go out of their way to do things to make your life easier for you? (Circle one number per item)

		Very Much	Some What	A Little	Not At All	Do Not Have Any Such Person
A.	Your immediate supervisor at work or school	4	3	2	1	0
B.	Other people at work or school	4	3	2	1	0
C.	Your wife or husband	4	3	2	1	0
D.	Other relatives and friends	4	3	2	1	0

How much can each of these people be relied on when things get tough for you? (Circle one number per item)

A.	Your immediate supervisor at work or school	4	3	2	1	0
B.	Other people at work or school	4	3	2	1	0
C.	Your wife or husband	4	3	2	1	0
D.	Other relatives or friends	4	3	2	1	0

How much is each of the following people willing to listen to your personal problems?

A.	Your immediate supervisor at work or school	4	3	2	1	0
B.	Other people at work or school	4	3	2	1	0
C.	Your wife or husband	4	3	2	1	0
D.	Other relatives or friends	4	3	2	1	0

How easy is it to talk with each of the following people?

A.	Your immediate supervisor at work or school	4	3	2	1	0
B.	Other people at work or school	4	3	2	1	0
C.	Your wife or husband	4	3	2	1	0
D.	Other relatives or friends	4	3	2	1	0

16. HEALTH:

How would you describe your health in the last twelve months?

___ Excellent ___ Fair
___ Good ___ Poor

The general trend of my health over the past four years has been......

1	2	3	4	5
strong improvement	some improvement	no change	some worsening	definite worsening

How often do you use the following medications? (Check the appropriate box).

	Every Day	More Than Once a Week	Once a Week	Less Than Once a Week	Never
aspirin or headache medicine					
antacids					
laxatives					
cough and cold medicine					
medication to give you pep					
sleeping pills					
tranquilizers					
other medicines					

Everyone lives under some amount of stress at all times. However, stress levels do change over time. Please fill in the following table to indicate the change (if any) in your overall level of stress over the past four years. (Circle one number in each year).

Example: If 1973 was slightly less stressful than 1974 you would circle the number 3 in the column marked 1973.

My Overall Stress Level Was:	1971	1972	1973	1974
Much less than in 1974	1	1	1	1
Less than in 1974..............	2	2	2	2
Slightly less than in 1974.......	3	3	3	3
About the same as in 1974	4	4	4	(4)
Slightly higher than in 1974	5	5	5	5
Higher than in 1974	6	6	6	6
Much higher than in 1974	7	7	7	7

Do you smoke?

_____ YES _____ NO

If you smoke, how much do you smoke per day on the average? Enter number.

How many cigarettes per day _____
How many cigars per day _____
How many pipes of tobacco per day _____

Regarding your blood pressure:

_____ I have been diagnosed as having low blood pressure
_____ I have been diagnosed as having high blood pressure
_____ My blood pressure has been checked recently and it is normal
_____ My blood pressure has not be checked recently

The following is a list of things people say they find helpful when they are depressed or nervous. (Circle the best descriptor of the helpfulness of each activity for you).

	Very Helpful	Fairly Helpful	Not at all Helpful	Never Tried It
Smoking	1	3	5	7
Eating	1	3	5	7
Having a drink such as a highball or cocktail or some wine or beer	1	3	5	7
Working harder than usual, either around the house or on the job	1	3	5	7
Taking a tranquilizer	1	3	5	7
Taking some other kind of pill or medicine	1	3	5	7
Going to church or saying a prayer	1	3	5	7
Talking it over with a friend or relative	1	3	5	7
Just trying to forget about it	1	3	5	7
Going for a drive	1	3	5	7
Going for a walk	1	3	5	7

17. LIFE EVENTS: Please check YES or NO for each of the following events in each year in the table.

	1971		1972		1973		1974	
	YES	NO	YES	NO	YES	NO	YES	NO
MARITAL STATUS								
Got married								
Got separated								
Filed for divorce								
Became divorced								
Loss of spouse through death								
Marital reconciliation								
FAMILY								
Pregnancy (wife, self, girlfriend)								
Gained new family member								
Disturbing troubles with family member								
Spouse started or stopped job								
Son or daughter left home								
Son or daughter got married								
Death of close family member								
Serious illness in family								
EDUCATION								
Started school (college or trade)								
Left school (college, trade, or high school) without graduation								
Graduated from school (college, trade, or high school)								
Academic trouble in school								
EMPLOYMENT								
Got promotion								
Got demotion								
Job responsibilities changed or new job								
Had trouble with boss or other employee								
Got fired								
Got laid-off								
Quit a job								
Retired								
Had trouble finding a job								

17. LIFE EVENTS (Continued)

	1971		1972		1973		1974	
	YES	NO	YES	NO	YES	NO	YES	NO
FINANCES								
New loan or mortgage								
Involvement in lawsuit								
Considerable improvement in financial condition								
Considerable worsening in financial condition								
OTHER								
Changed residence								
Changed church membership								
Arrest or conviction for non-traffic offense								
Alcohol-related arrest or conviction								
Detention in jail								
Disturbing troubles with close friend								
Death of close friend								
Major personal injury or illness								
Started or broke up an engagement								
Started or stopped going steady with someone								
Serious accident at work								
Serious accident elsewhere								

18. ACTIVITIES: Please indicate whether the following statements are True or False.

	TRUE	FALSE
I often go to movies, plays, etc.		
I often am a spectator at sporting events		
I often participate in sporting or recreational activities (bowling, hiking, jogging, exercising, canoeing, etc.)		
I have one or more arts or crafts which I thoroughly enjoy (carpentry, painting, gardening, etc.)		
I often engage in intellectual pastimes (reading, debating, etc.)		
In addition to my job, I have many outside interests		
I am an active member in a church, school or social organization (e.g., Kiwanis, PTA, Elks, etc.)		
Overall I am happy with my life		

GPO 888-136