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ABSTRACT

Volume 2 studies the operational feasibility of the diagnostic assessment of driver problems. Target groups for driver countermeasures are identified from research on diagnostic predictors and performance criteria. A diagnostic assessment model is presented which incorporates assessment techniques that were useful in an operational setting. The model is intended to serve as a practical guide for the operational assessor in the traffic enforcement/control system. The development of the diagnostic assessment model focuses on the interaction of the driver, the enforcement system, and social institutions which are concerned with remediation of the driver (courts, licensing agency, and social rehabilitation agencies). Guidelines for the operational implementation of the model are presented in the following areas: administrative procedures, operational requirements for assessment, sample driver assessment, and options for indepth diagnosis. State requirements for the implementation and validation of the technique are cited. An evaluation plan for the validation of the model is presented through a pilot study. Concurrent and predictive evaluation, and a long-term plan for integration and diagnostic approaches and countermeasures. Other measurement and assessment materials are appended. A glossary of technical terms and references are included. (Author/EC)

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DIAGNOSTIC ASSESSMENT OF DRIVER PROBLEMS:

Volume II. Assessment Techniques for Operational Users

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and
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16. Abstract

A state-of-the-art literature review was conducted to identify diagnostic assessment techniques for driver problems. This review is presented in Volume I. "State-of-the-Art in Driver Problem Diagnosis."

Volume II addresses the current operational feasibility of the diagnostic assessment of driver problems. A chapter entitled "Accident Liability Classes" is concerned with the integration of information from currently available research on diagnostic predictors and performance criteria to determine "target groups" for driver countermeasures. Based on the literature review, a prototype diagnostic assessment model is presented which incorporates assessment techniques which have been shown to be useful in an operational setting. This model is intended to serve as a practical guide for the operational assessor in the traffic enforcement/control system. The discussion includes the development of the model, and provides guidelines for operational implementation. State requirements for assessment and evaluation are also cited. A specific research plan for validation of the model is presented. Long-term research needs are identified.

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INTRODUCTION

A review of the traffic safety literature was conducted to evaluate the potential of assessment techniques for identifying driver problems (reported in Volume I of this report, entitled "State-of-the-Art in Driver Problem Diagnosis"). The ultimate objective of this review was to provide operational assessors with techniques which may currently be useful to identify specific driver problems.

Current systems generally employ some variation of "point count," or other criteria to define a driver as a problem or as negligent. Such an approach does not address the specific problems of the driver, nor does it provide guidelines for directing the driver to some form of treatment. A prototype model assessment system, based on the most useful techniques found in the research reviewed, was developed to provide these guidelines for assessment in operational settings. This model system and these techniques are the subject of this volume.

A critical analysis of the research literature identified several inherent methodological problems (e.g., rarity of accidents) which make it difficult to draw firm conclusions on the utility of various techniques. Much of the research had been conducted in an uncoordinated fashion; inadequate research methods and poor conceptual organization of assessment techniques limit current knowledge on the utility of assessment techniques.

The literature on the assessment of driver problems has demonstrated that although numerous variables are related to driving performance, overall prediction is nevertheless limited. Several multiple regression studies, which have been conducted on all types of driving populations, using a variety of predictor variables and criterion measures,[1] have shown the predictive capability to range from 1% to 40%. The 40% figure for explained variance probably represents the ceiling of expected prediction of accident criteria, since such high prediction can be observed only when extremely contrasted samples are used (e.g., Harano et al., 1973). Even if such a degree of prediction was obtainable using random populations, large errors of prediction (60%) would still occur. In view of the generally low validity of accident prediction, there does not appear to be a scientifically defensible basis upon which to either grant or deny an application for licensing, although socio-legal systems currently support such uses for restrictive purposes.[2] More appropriate

[1] For example, see Peck, McBride and Coppin (1971); Harano, McBride and Peck (1973); and Harrington (1971).

[2] It is equally true that such applications have not been proven invalid.

applications appear to be in the realm of driver problem assessment and rehabilitation among drivers who have come into contact with the courts and/or driver improvement agencies (post-licensing control). These points of intervention provide an opportunity to assess a driver beyond simply a "point system" criterion.

Since a major problem in diagnostic assessment has been locating sources of information, the state-of-the-art review was organized by types of data source, referred to as "levels of observation." Level I was defined as assessment variables primarily available from a driver licensing file; Level II included data from other agencies (e.g., mental health); and Level III contained information which was obtainable directly from the driver. These three levels were also the topics of the first three chapters of the state-of-the-art review. Each of these levels of observation were then further divided by conceptual area:

- Driver Performance and Ability
- Human Conditions and States
  - Biographical Variables
  - Psychological/Social/Attitude Variables
  - Medical/Physiological Variables
- Exposure Variables

This structure was found useful to organize the research, as well as to identify "gaps" in research. The levels of observation were used to specify the current data sources for assessment techniques or variables. (In this review, the terms "technique" and "variable" are often used interchangeably, since assessment techniques are simply methods for collecting variables.)

The first chapter of this volume will summarize the findings on the utility of assessment techniques within each level of observation by reproducing the summaries of each level of observation as discussed in Volume I. The final "Summary and Recommendations," Chapter 4 of the state-of-the-art review, is also included.

Chapter 2 of this volume discusses the current research findings on "target groups," or high accident liability classes of drivers, for whom treatment is indicated. Chapter 3 presents the prototype model diagnostic system. The remaining chapters discuss guidelines for implementing the model assessment system (Chapter 4), state requirements for evaluating such a model (Chapter 5), and an evaluation plan for validating the model (Chapter 6).

Chapter 1

SUMMARY AND RECOMMENDATIONS

SUMMARIES FROM VOLUME I: THE STATE-OF-THE-ART IN DRIVER PROBLEM DIAGNOSIS

CHAPTER 1. INFORMATION FROM PRIMARY SOURCES

Driver Performance and Ability

Driver record performance measures include traffic convictions, accidents, knowledge and performance testing, and driver improvement actions. Numerous studies have consistently demonstrated that prior accidents and particularly convictions are useful predictors of accident liability. Although specific types of convictions (a measure of particular driver errors) do not substantially increase prediction of accident liability, these measures are useful for diagnosing particular problems, such as recognition, risk-taking or alcohol.

Knowledge and performance testing may be useful for screening drivers with extremely poor performance, but have yet to demonstrate substantial predictive utility. Several methodological and practical issues (such as drivers eventually becoming licensed after several attempts) have rendered research results inconclusive.

Driver improvement actions and sanctions were found to be of some utility for predicting future accident liability. These variables are primarily a measure of an individual's prior accidents and convictions, but also may reflect the effectiveness of treatment (e.g., attendance at a traffic school may reduce future liability). As more vigorous evaluations of treatment programs are conducted, past attendance at such a program should become an increasingly useful assessment variable.

Human Conditions and States

Age, sex and marital status have consistently been shown to be strong predictors of accident liability. Although these biographical variables offer little to directly identify a driver's problem, they are useful for administrative purposes to isolate high accident liability classes of drivers. For each of these groups, more refined assessment approaches (many found at Level III) can then provide insight into the specific problems which produce accident involvement. Other biographical variables, sometimes available from Level I sources, include the driver's race, height, and weight. Completion of a driver education course can also sometimes be determined. None of these variables currently appear to have diagnostic utility. Race and driver education, in particular, are frequently related to socio-

economic status, which can be more specifically assessed using variables found in Level III.

Specific psychological, social or attitude measures seldom appear in Level I sources. Vehicle descriptions (e.g., weight, model, year) from registration files may reflect psychological factors, since certain individual characteristics may be associated with the ownership of particular types of automobiles (e.g., high-risk drivers may tend to purchase high performance vehicles). The research evidence, however, demonstrates only a slight relationship between vehicle type and accident liability. In addition, it is possible that these slight relationships only reflect socio-economic status.

Medical and physiological information often has high face validity for diagnostic purposes, but research studies have seldom produced results to substantiate this assumption. The research area is complicated by ethical limitations on reporting (e.g., confidentiality), inability to obtain adequate exposure information, and possibly, the confounding influence of individual compensating factors. Research results do suggest, however, that extremely deficient drivers (mentally ill, chronically ill, and hearing- or vision-impaired) have increased accident liability, although these sub-populations are very small in relation to the general population.

Vision testing, especially with recent developments (increasing the measurement dimensions), appears to have potential for general diagnostic assessment, primarily for screening older drivers. However, since older drivers are involved in relatively few accidents, the potential for reduction of the total accident problem by vision testing is slight.

Diagnosis of extreme cases of mental illness may also have some potential for accident reduction. However, as with other medical conditions, the population identified would be rather small. In addition, except for information received from other sources, the cost for extensive individual diagnosis in a licensing setting does not appear to be warranted.

Exposure Variables

Level I exposure information is also of little utility, since most is based on group rather than individual data. The most useful variable appears to be class of license, which can indicate excessive mileage among the professional driver groups. It may also merely reflect occupational and socio-economic factors. Ownership of a motor vehicle might also indicate higher mileage. Most of the remaining variables are group estimates.

CHAPTER 2. INFORMATION FROM SECONDARY SOURCES (OTHER AGENCIES)

Level II sources currently have limited utility for individual assessment. With the exception of police accident reports and citations, research possibilities are also limited, since socio-legal and ethical issues frequently prevent access to information from other government or private agencies. Studies using accident reports, particularly in-depth multi-disciplinary accident investigations, do provide an important link in interpreting data from other levels of measurement.

Future research may eventually suggest the addition of other techniques to Level II sources. For example, enforcement officers issuing citations might routinely administer assessment variables to drivers (using Level III techniques) to identify deficiencies. Variables from multi-disciplinary accident investigations might also be included in standard accident reports, if found to have predictive validity.

The most useful variable from Level II sources appears to be BAC level obtained from arrest and accident reports. This variable is currently employed in numerous operational and research programs throughout the United States for diagnosing individual problem drinking. Divorce information might also be especially useful for driver problem assessment, since recent divorces have been shown to be closely associated with alcohol-related driving errors. Such information could be routinely reported by divorce courts to licensing agencies.

The remaining Level II variables appear less promising. At present, it is difficult to obtain biographical, psychological, medical and exposure information from other agencies. As will be seen later, it is more feasible to obtain these kinds of variables directly from the driver. In driver control operational settings such information can usually be obtained through pre-sentence investigations or driver improvement meetings and hearings. Consequently, Level II sources do not appear essential to driver diagnosis, but in cases where information flow difficulties can be minimized, the use of other agency data sources might still provide more timely and accurate information.

CHAPTER 3. INFORMATION FROM DIRECT MEASUREMENT OF THE DRIVER

Driver Performance and Ability

Among the research studies examining driver perception, the measures of perceptual style (or the related concept of field-dependence vs. independence) have shown the most potential. The correlations of these measures with driving errors for the general driving population have usually been low. However, these measures apparently interact with biographical factors, such as age and sex, to produce decrements in driving performance. Thus, further research may demonstrate utility

for predicting certain types of driving errors among certain classes of drivers.

Research on driver decision problems has been almost exclusively limited to drivers' judgements about perceived hazards. To date, few of the results have been encouraging, although further validation is currently underway.

The Level III research has also developed numerous measures of overall driving performance. These include driving simulators, instrumented vehicles, observer ratings, and self-report techniques.

Of the many studies using driving simulators, few have demonstrated any valid relationship to subsequent actual driving behavior (accidents or convictions). None have demonstrated sufficient validity for operational prediction. The multivariate studies (e.g., Harano et al., 1973) have demonstrated that simulator performance variables have relatively low usefulness when variables from other levels and conceptual areas are available. However, simulator measures may still have some utility, particularly for inexperienced driver groups, for whom lack of adequate skills may be a more frequent accident causal factor.

The remaining Level III measures of overall driving performance suffer the same lack of predictive validity as the simulator measures. Additionally, the instrumented vehicles often present operational difficulties. The observer rating techniques often have poor inter-rater reliabilities. The self-report techniques have not yet been standardized.

Human Conditions and States

Biographical information obtained directly from the driver appears to have some useful predictive capability. Among the biographical areas reviewed, education, occupation, and socio-economic status clusters had the highest relationships with accident involvement. These measures may in part indicate exposure differences among occupational groups. Smoking cigarettes was found in a few studies to predict accident involvement for young males. Other life style variables such as school activities, social functions, and clubs showed some relationship with traffic convictions and accident involvement for younger drivers. Each of these appear to be one of many aspects of socio-economic status. When such socio-economic variables are combined into clusters (which increases reliability), their predictive utility becomes very high (Harano et al., 1973).

Biographical variables themselves offer little potential for directly describing a driver problem. However, they are useful for describing

sub-populations and clarifying interactions among other conceptual areas of study (e.g., attitudes, exposure).

Many psychological, social and attitude variables have also been examined. Among these, the more transient life stress factors (e.g., marital problems, financial problems, etc.) have the highest apparent relationship to accident involvement. However, life stress has been examined almost invariably by retrospective studies, which do not provide clear indications of utility for future prediction. For these life stress factors, a future predictive study collecting recent life stress data is needed.

To examine more stable personality characteristics and traits, investigators have employed hundreds of assessment instruments and individual items. While many of these have produced significant results, correlations have been uniformly low.

Among the assessment techniques developed in the area are several "second and third generation" instruments. The most predominant approach appears to be initial item analysis of batteries of standard personality tests (e.g., MMPI), and the selection of discriminating items for subsequent efforts. Other investigators have selected items on an a priori basis, which were considered to be related to driving behavior.

There are few marked differences in reliability among the personality tests, and most use similar scaling methods. Several current tests have either been derived specifically for drivers, or are general personality inventories based on items and concepts from previous inventories. The uniform application of two or three tests to a wider population base is needed, which would clarify appropriateness of certain techniques for subcultures, age groupings, etc. The current lack of standardized data on any one test limits generality of findings. A longitudinal follow-up combined with observation of driving behavior and the examination of the temporal influence of social stress should help determine the utility of personality assessment in traffic safety as well as in other social problem areas.

Attitudes, particularly attitudes toward driving, have also been extensively studied. Among particular sub-populations of drivers (e.g., younger drivers) most results have been encouraging. Further research is needed to determine the differential applicability of these kinds of measures across all sub-populations of drivers, particularly to predict various specific driving errors.

The medical and physiological variables in Level III included only alcohol and fatigue assessment, since most other medical assessment must be conducted by a physician, and was therefore included in Level I.

Much research has been directed toward the assessment of alcohol-related driver problems. Many of the studies focus on assessment techniques which have utility for the diagnosis of drinking problems in an operational setting such as the courts, or driver improvement licensing agencies.

While most early studies related single factors to alcohol involvement, current efforts generally use a "battery" approach, using data from several sources. This latter technique has provided a steady accumulation of alcohol-related information, within both the traffic safety countermeasures area and the general predictive assessment of drinking problems. The most widely-used assessment technique appears to be the Mortimer-Filkins Questionnaire/Interview. This instrument was reported to be in use by 15 of 23 ASAP programs in 1974 for assigning drivers to countermeasure programs. Unfortunately, a review of the 1974 programs did not reveal additional validity or reliability data.

Although most efforts attempted to relate drinking diagnosis to driving performance, the validity coefficients were low (concurrent). None of the studies reported predictive validity efforts.

The primary reason for low predictive validity is the unreliability and rarity of the criteria themselves (e.g., recidivism, accidents, etc.). Attempts to overcome the criterion deficiency problem are seen in efforts to "build" multiple criteria or combinations of several drinking (non-driving) and drinking (driving) indices (e.g., Mortimer et al., 1971, "CRIT"). The use of such indices appears to be a feasible and useful direction for developing a more reliable measure of both alcohol-related driver problems and alcohol-related problems in other social areas.

The studies reviewed indicate that the questionnaire/interview approach to diagnostic assessment is operationally feasible. In the MAST, originally intended as an interview, a self-report form has been developed and tested by non-professional personnel. The reliability results from the HSRI Protocol (M-F) indicate that only a small increase in reliability is gained by administering both the interview and questionnaire, although for research purposes it may be desirable to include both. Follow-up studies using the "Life Activities Inventory" will be useful for determining the effectiveness of rehabilitative efforts in changing drinking patterns as well as providing criteria for validating initial diagnoses based on such instruments as the HSRI Protocol.

Currently there appears to be good potential for the diagnosis of general drinking problems. The utility for predicting drinking and driving problems, however, remains to be proven.

The role of fatigue in accident causation is, at best, unclear, since accident investigations cannot routinely determine whether driver fatigue was a causal factor. Many studies have shown that driver performance deteriorates with sleep deprivation or task-related fatigue. However, since fatigue is both transient and difficult to detect, the potential applications of fatigue assessment are limited to predicting "propensity to drive while fatigued." As a result, only a limited amount of research has been directed toward the assessment of driver fatigue. These efforts to date have not been very successful. In the future, when more accurate and reliable physiological measures of fatigue (i.e., which can be administered on-site, similar to current BAC testing) can be developed, this area would appear to be a fruitful one for research, since the number of accidents caused by fatigue is unknown, but possibly very great.

Exposure Variables

In an attempt to predict accident liability or to control accident/violation ratios by exposure, several investigations have obtained test exposure estimates directly from study subjects. Both qualitative (e.g., driving at night) and quantitative (e.g., mileage) estimates have been used. The primary problem with the exposure estimates is that they are subject to biases and errors. Despite this problem, estimated exposure information has been found to be a relatively good predictor of accident involvement, similar to biographical variables found in Chapter 1 (e.g., age, sex, marital status). Generally, quantitative measures are better predictors than qualitative measures. However, for certain groups of drivers and driver-specific errors, qualitative measures could be combined with quantitative measures to further increase prediction.

Conclusion

A review of several different conceptual areas revealed that the study efforts have much in common. Several methodological problems appear consistently among the studies reviewed. Foremost among these problems is the fact that numerous small studies have used conceptually similar instruments which tend to confuse the role of person-centered factors. Few studies have analyzed the data for accident liability patterns, or clearly delineated concepts such as the interaction between person-centered variables and situational influences. Additionally, most studies employ only univariate comparisons on a series of variables. This approach does little to clarify interactions. Another difficulty has been the poor criteria (namely accidents) which are traditionally used to validate such techniques, rather than the psychometric properties of the test per se. Finally, most studies have been retrospective or concurrent, not "true predictive." While such studies are certainly useful to explore

relationships, they reflect the relatively primitive development in the research area of accident prediction.

There appears to be a general lack of theoretical framework and rigorous difinition of concepts for the construction of tests. Several investigators have suggested the need to define person-centered characteristics as they relate to driving behaviors (Case and Stewart, 1958; McFarland, 1968; and Lucas, 1970), recognizing that driving behavior is but one aspect of adjustment to society. McFarland (1968) suggests that personality characteristics, for example, interact with social stress to form a cluster of social behaviors or an "adjustment complex." These social stresses paired with adjustment problems can increase the frequency of maladaptive behavior. Lucas (1970) comments further:

> "If a wide variety of traits are involved in a wide variety of accidents there is a low possibility of correlation since accidents are rare . . . Possibly personality factors interact with attitude to cause excessive variance." (Lucas, 1970)

There is little doubt that maladaptive personality characteristics, interacting with transient stress or social problems, can be related to crashes. Combining these factors with performance deficiencies, alcohol consumption, other human conditions, and high exposure presents a very complex picture. Rarely have studies addressed the many human factor areas simultaneously to determine the relative importance and interaction among these areas.

Improvements in research methodology should help clarify the utility of techniques. Several questions were raised by the review. How well can results be verified by cross-validation? How reliable were the scales for different populations? If results had been analyzed in a multi-variate approach, would personality "types" or patterns have been more useful than simple univariate comparisons on each of the scales? How do the techniques compare in terms of reliability and validity? Do the conclusions generalize to other populations? Would exposure control result in different findings? Answers to all of these questions can be addressed in well-designed and controlled studies.

The 1966 review of traffic safety literature by A. D. Little[1] reached much the same conclusions:

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[1]Additional review articles which were useful in compiling the present review included Adams (1970) and Schuster (1970).

"The studies reviewed here ..... used small samples, geographically limited samples, occupationally limited samples, or combinations of these. This fact alone, even if strong relationships were found, considerably limits the generality of the results. In addition to the lack of generality, the rather poor reliability of most of the tests, the possibility that an individual will have an accident and that these factors may vary from day to day, and the rarity of automobile accidents due to changing probabilities of many other factors reduce the chances of establishing a strong relationship between a factor and accidents, it is not justifiable to eliminate from the driving population a person who merely appears to possess the suspicious factor." (Little, 1966)

SUMMARY OF VOLUME I (Chapter 4)

The state-of-the-art review demonstrated that Level I data sources have the greatest current utility for diagnostic assessment in an operational setting, based on the relatively inexpensive means of data retrieval and the consistency of significant predictors found at this level. Level II data, although presumably less difficult to obtain than Level III information (i.e., other agencies may already have stored assessment data), presents several legal and logistical problems. Privileged information requirements and a lack of coordination between agencies represent some of the obstacles. Although generally low in present utility, Level II sources appear to have good potential for diagnostic assessment, since in-depth evaluations conducted by professionals (e.g., accident investigators, physicians, psychologists, etc.) could be made available. Level III data usually requires further research before its operational utility can be determined, since, by definition, it is currently not widely used for assessment in social control agencies. For general application to the driving public, the use of Level III sources is more costly, and often requires trained personnel. Operational applications appear to be limited to selected populations exhibiting a major problem at Level I, e.g., drivers suspected of having a drinking problem.

Since comparisons of the findings of different research studies are frequently complicated by differing methodologies, samples, and data collection procedures, Figure 1-1 presents some of the results from one of the more comprehensive studies, in which a broad range of assessment variables was administered to a single sample of drivers. These correlations demonstrate the magnitude of prediction which can be expected using many of the techniques discussed in the state-of-the-art review.[2] In general, prediction is highest for the driver record performance variables, and the variables at other levels measuring education, occupation, socio-economic status, and driving exposure (all of which are also interrelated).

The following section will summarize the findings on the utility of assessment techniques within conceptual areas.

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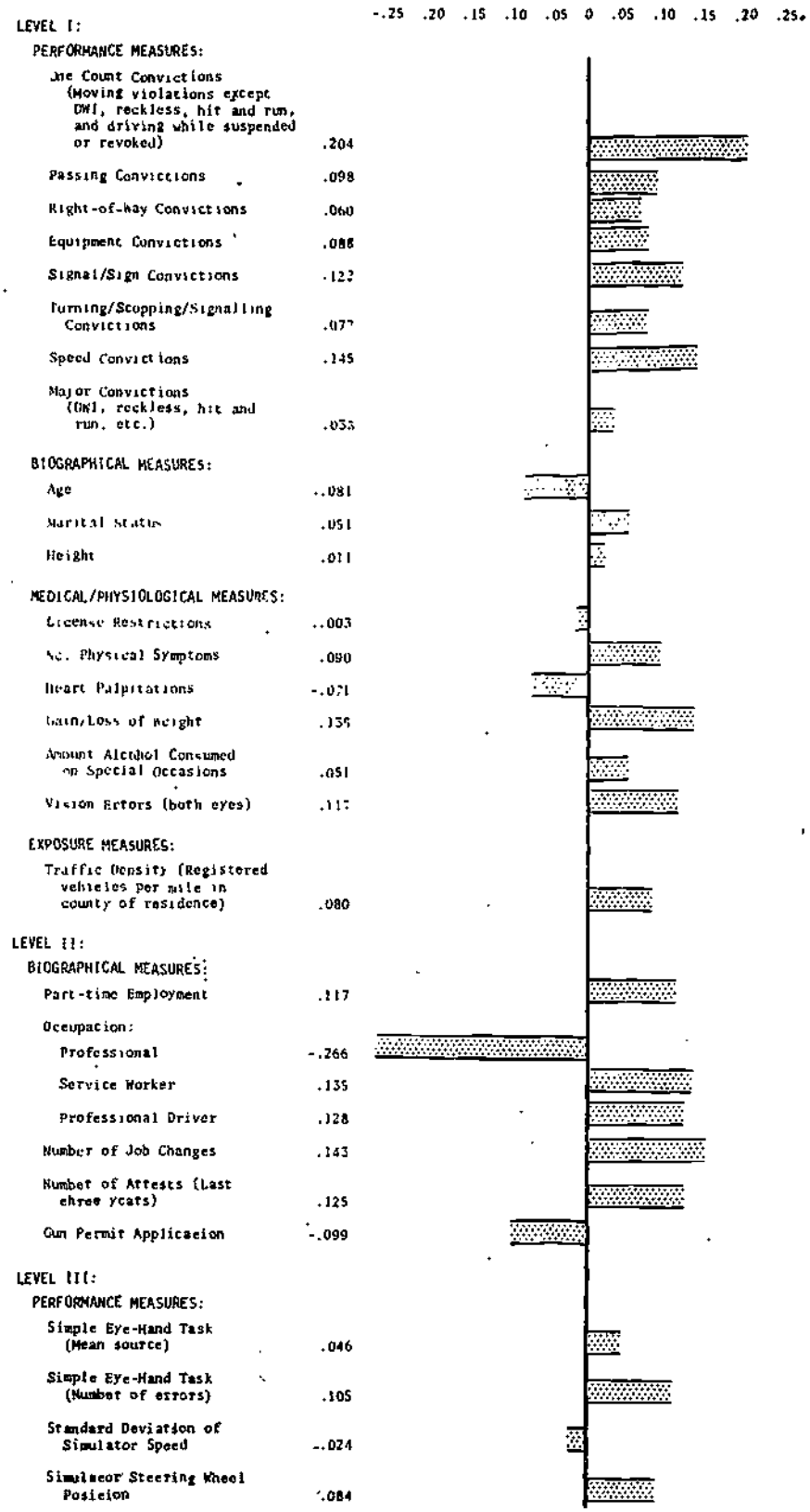
[2] Expected prediction would be somewhat lower, since this study employed a contrasted sample.

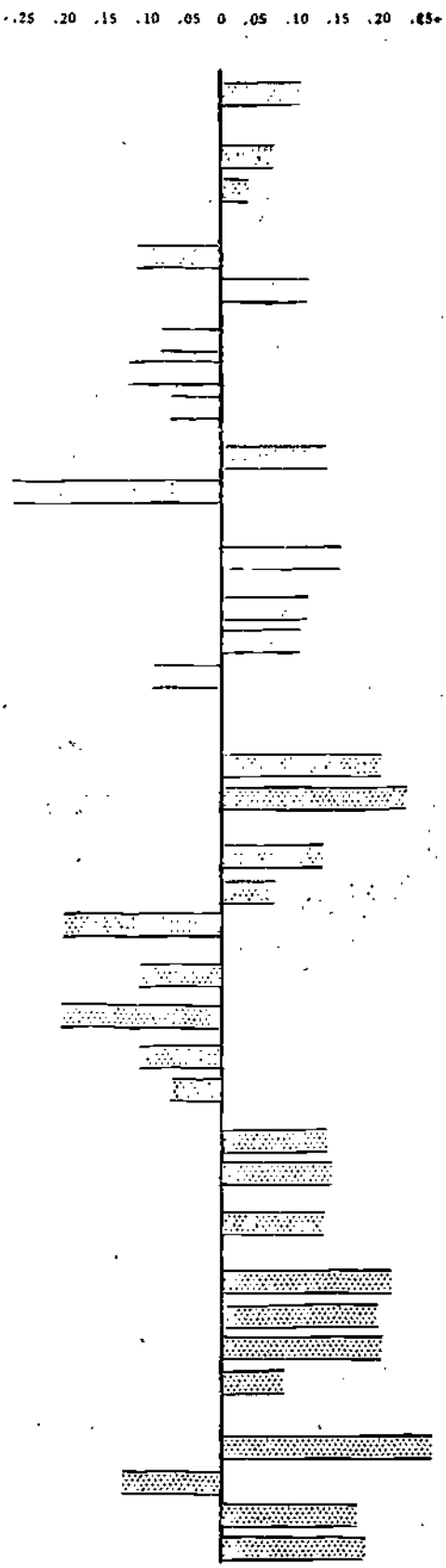


*Measure From Gordon Personal Profile (GPP) or Gordon Personal Inventory (GPI)

Source: All correlations from Harano, McBride, and Peck (1973). Three Year Record Predicting Concurrent, Non-Spurious Three Year Accidents

FIGURE 1-1. MAGNITUDE OF SELECTED ACCIDENT PREDICTORS BY LEVEL OF OBSERVATION

Figure 1-1 (Continued)



Simple Reaction Time Difference Score (Improvement)	.091
Complex Reaction Time Difference Score (Improvement)	.059
Embedded Figures Test	.058
BIOGRAPHICAL MEASURES:	
Number of Children	-.132
Number of brothers/sisters	.198
Number of Clubs/Organizations	.073
Clubs--Church-Related	-.118
Number of Recreations/Hobbies	-.066
Smoking Hazard Index (High for filtered cigarettes)	.122
Socio-Economic Cluster	[illegible]
Difference Between Ratings of Father and Mother as Good/Valuable	.[illegible]
Severity of Parental Punishment	.1
More Family Dissention	.[illegible]
Father Permissive	-.07[illegible]
PSYCHOLOGICAL MEASURES:	
Hours:	
Clean/Repair Car	.194
Driving for Fun	.228
Observer Rating:	
Driver Not Calm	.126
Driver Not [illegible]	.060
Emotional Driving Cluster	-.189
Emotional Stability (Gordon Personal Profile)	-.106
Cautiousness (GPP)*	-.195
Personal Relations (GPI)*	-.101
Vigor (GPP)*	-.064
Law Enforcement Attitude (High = Too Strict)	.124
Driver Self-Rating	.127
Driver Self-Rating Compared to Elderly Driver	.122
Low Satisfaction:	
Financial	.204
Life	.185
Total	.193
Drive to Feel Powerful	.072
EXPOSURE MEASURES:	
Mileage Cluster	.276
Rush-Hour Driving	-.118
On-the-Job Mileage	.159
Midnight Driving	.167

ASSESSMENT OF FINDINGS BY CONCEPTUAL AREA

Performance

Driver record performance data (Level I) are the most useful predictors of subsequent driving performance. Total traffic convictions appear to be the best single predictor, followed by prior accidents. Specific conviction types are especially useful to identify particular driver problems. However, several deficiencies were identified which reduce the utility of driver record variables, such as selective enforcement and court procedures (e.g., plea bargaining, reduced charges, etc.). More uniform enforcement and adjudication should improve the utility of driver record information. Although on-road testing is a direct measurement technique, it was considered a Level I variable since it is a driver record variable, but current validation studies have not determined its predictive utility. Prior sanctions, or attendance at driver treatment programs were also found to be of low utility, but may become more useful when the programs are more fully evaluated.

Level II performance variables may provide slightly improved qualitative description of driver errors, since the descriptive information on culpability and driver errors (e.g., BAC, deviation from speed limit) can provide predictive capability beyond Level I information.

Level III performance variables (e.g., simulators, instrumented vehicles, etc.) are primarily utilized in a research setting and provide little operational potential at this time. Computer simulation technology may eventually provide a partial answer for diagnostic problems within a dynamic testing environment.

Biographical

Most studies have shown that biographical variables are important predictors of driving records. Age, sex, and marital status are the most important at Level I. However, these variables provide little insight as to the nature of the driver problems. They are useful as a starting point in partitioning the driving population into accident liability classes, since accident rates vary markedly across different age, sex, and marital status groupings. Occupation and socio-economic status are generally more difficult to obtain, but demonstrate predictive capability paralleling driver record data. While these variables may be available at Level II (even occasionally at Level I), the availability is not uniform, and direct inquiry of the driver is generally required (Level III). Information on life styles (Level III) provides insight into underlying problems and characteristics of the driver within the age, sex, and marital status groupings of Level I. Job, financial, and marital stresses were often found to be associated with more severe crashes (and in those involving alcohol use). However, most studies on life stresses were retrospective, so the predictive utility of such variables is not known.

Psychological/Social/Attitude

Although numerous studies have employed psychological measures for driver assessment, overall utility relative to driving performance is low. Level I does not contain variables which would traditionally be labelled "psychological," but one potential indicator of underlying attitudes (as well as socio-economic factors) that is available at Level I is the year, weight, and model of the driver's vehicle. Level II sources can provide the most in-depth information (e.g., mental health agency records), but assessment is often restricted to a narrow population. Additionally, for legal and ethical reasons, agencies are frequently reluctant to disclose personal information. Level III techniques appear to have the most current utility for obtaining psychological and social data. For certain sub-populations, psychological and attitude factors appear to play a major role in driving, but applications to the general public have lower utility. Costs of mass test administration are also high. Retrospective studies of fatal drivers often demonstrate highly deviant life styles and situational stress. However, for predictive purposes (which is the primary concern in diagnostic assessment), these variables have yet to demonstrate high predictive utility.

Medical/Physiological

With the exception of alcohol problem assessment and perhaps visual testing, the assessment of medical factors does not appear to have general applicability in the prediction of accident liability. This may in part be the result of current restrictive screening procedures (self-imposed and administrative policy) in licensing which limit the driving exposure of those with major medical impairments. In addition, drivers more acutely aware of their medical limitations may compensate for their deficiencies. In fact, there is some evidence to suggest that certain sub-populations (e.g., physically handicapped) may have lower accident involvement rates than the general population (due, in part, to lower driving exposure). Level II could be a major source of medical information. Its utility is highly dependent on coordinated efforts between public health agencies, physicians, and licensing agencies. Some medical information is retained by licensing agencies, but it is not often complete or comprehensive.

Recent research has demonstrated some potential for diagnostic assessment of vision problems. Since vision testing is currently conducted on a large portion of the population (license examinations), it does provide an opportunity to identify driver problems. However, the relationship of vision to driving remains unclear. For certain groups, poor vision is related to poor driving performance, but for other groups, poor vision may indicate better performance. Further refinement of vision testing (including perceptual measures) is currently underway, which may clarify these contradictory findings.

Techniques to assess alcohol-related errors have been at least partially successful. A major problem has been the fact that the available criterion measures (alcohol-related accidents, or driving-while-intoxicated (DWI) arrests) are much less frequent events than total accidents or total convictions. However, both prior DWI convictions and Blood Alcohol Content (BAC) at time of arrest are still among the best available predictors of future alcohol-related driving problems. Most current Level III assessment efforts are directed toward the small population of drivers arrested for drinking and driving. These approaches are frequently confined to identifying the magnitude of a drinking problem (and usually include treatment). While some of these diagnostic efforts have been relatively successful, their potential impact on the accident problem is limited, since many alcohol-related accidents do not involve "problem" drinkers. No Level III diagnostic approaches to date have shown the ability to predict future drinking-and-driving problems, although a few appear useful to predict drinking problems. Further validation efforts will be required to judge the overall impact of current alcohol diagnostic procedures.

Exposure Variables

Many research studies have shown the relationship between increased driving exposure and increased accident potential. Exposure variables are those variables which do not assess intrinsic characteristics of the driver, but which do reflect the quantitative (e.g., mileage) and qualitative (e.g., rush-hour driving) hazards of his driving environment. Using information from Level I sources, accident rates and types have been found to vary markedly by geographical areas (urban vs. rural), and local traffic density. These kinds of (non-individual) variables are useful when, for example, different assessment procedures might be established for different (exposure) jurisdictions. Level II exposure variables appear to have the highest potential in the area of selective enforcement, since knowledge of high accident areas may result in optimum personnel allocation and driver error identification. For individual assessment, however, useful variables are again, not often available in a coordinated manner. The Level III assessment of amount and kinds of driving exposure holds the most promise for individual prediction. In those multiple regression studies employing reported mileage, most measures (e.g., on-job mileage, annual mileage, etc.) were highly significant in predicting accident involvement at a level parallel to driver record and biographical data. In general, the quantitative measures were found more useful than the qualitative measures. Further research is needed to determine accurate means of measuring both qualitative and quantitative exposure.

UTILITY OF CONCEPTUAL AREAS BY LEVEL

To provide some empirical estimate of the relative strength and importance of the various levels of observation and conceptual areas, several multiple regression studies were examined. Although the regression method does not take into account interactions,[3] and assumes linearity of relationships, the results are useful primarily to determine the relative importance of predictors.

Studies have been selected for presentation which provide relatively stable estimates of relationships (large samples), and which employed a wide range of assessment variables (by both level and conceptual area). These studies included Harano et al. (1973), Harrington (1971), and Peck et al. (1971).

To obtain an estimate of the strength of variables in predicting accident liability across the various studies, a relative index was derived. The index is simply the variable's rank order within the regression equation divided by the total number of significant variables in the equation.[4] This calculation provides a measure, ranging from 0 to 1, of a variable's relative importance in predicting accidents. The higher the index, of course, the greater the variable's relative strength in the equation. This provides some means of comparing variable strength, or utility, across various studies.

To then summarize the relative strengths of conceptual areas and levels of observation, the average index was computed (see Table 1-1). (In those cases where two or more related variables were significant in an equation, such as total convictions and one-count convictions, the lower-ranked value was omitted in computing the mean.) These results are grouped in decreasing order in Table 1-2 which shows that Biographical data (Level 1) and Exposure data (Level III) have the highest average index, followed by Socio-Economic Status (Level II) and Performance (Level 1). Since this analysis is somewhat primitive, and in part, a function of the variables included (in addition to idiosyncrasies of the sample and criterion), there is probably little "real" distinction in the relative strength of variables receiving the highest indices. The remaining variables appear to be less useful.

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[3] Interactions and curvilinear relationships can be built into the method via transformations during coding, but this approach is somewhat inefficient and rarely used.

[4] Other factors, such as the total number of initial variables, could have been included in this index. However, because of other methodological differences among studies (e.g., sample size, length of driving record, etc.) the inclusion of this factor was felt to be an undue complication.

TABLE 1-1. SUMMARY OF REGRESSION FINDINGS

LEVEL OF OBSERVATION	PERFORMANCE	BIOGRAPHICAL	PSYCHOLOGICAL/ SOCIAL/ATTITUDE	MEDICAL/ PHYSIOLOGICAL	DEMOGRAPHIC
I	Prior convictions, prior accidents, misc. driver actions Mean Index: $\bar{x} = .51$	Age, marital status, weight, age licensed Mean Index: $\bar{x} = .69$	Make of car, vehicle year, vehicle weight Mean Index: $\bar{x} = .28$	Variables present but not significant in relation to other variables.	Variables not included in analyses presented
II	Variables not included in analyses presented.	Socio-Economic statis, occupation, education Mean Index: $\bar{x} = .59$	Variables present but not significant relative to other variables.	Variables not included in analyses presented.	Variables not included in analyses presented.
III	Simulator performance, coordination Mean Index: $\bar{x} = .24$	Clubs, activities, home status Mean Index: $\bar{x} = .34$	Attitude and Personality factors Mean Index: $\bar{x} = .37$	Variables not included in analyses presented.	Mileage (annual, weekly, on-job Mean Index: $\bar{x} = .69$

TABLE 1-2. AVERAGE INDEX FOR CONCEPTUAL AREAS BY LEVEL

Level	Conceptual Area	Mean Rank Index
Level I	Biographical	.69
Level III	Exposure	.69
Level II	Socio-Economic	.59
Level I	Performance	.51
Level III	Psychological	.37
Level III	Biographical	.34
Level I	Psychological	.28
Level III	Performance	.24

METHODOLOGICAL LIMITATIONS

For the most part, traffic safety research has addressed total accident involvement as the primary criterion for predictive purposes. This approach has suffered from several methodological limitations. The largest single problem has been the fact that accidents, at least in the United States, are extremely rare events, occuring about once every ten years for the average driver. Statistical prediction of such a rare criterion, especially using correlational methods, is necessarily limited. To overcome this problem, researchers have frequently attempted to use traffic convictions rather than accidents as a criterion measure. However, the relationship between convictions and accidents is unclear. Correlations between the two measures are low (approximately .05 - .12), suggesting that prediction of convictions may have little relevance to accident causation.

To overcome the criterion deficiency problem (rarity of accidents/violations), investigator have frequently resorted to retrospective research designs using intact groups of accident repeaters or traffic violators. While this approach may increase the probability of significant results, it suffers from a lack of generality to other populations.

In defense of the efforts to date, accident research is a very complex and difficult area of investigation. Most studies have been concurrent rather than predictive, since:

- Generally, study subjects can be easily located and tested within, for example, an operational licensing agency setting, rather than resorting to random population selection;
- Concurrent prediction can be accomplished without waiting for long time periods; and,
- Retrospective studies, especially when contrasted groups (e.g., accident repeaters vs. accident-free drivers) are used for comparison, tend to circumvent the "rare-event" problem. However, since deviant individuals are highly over-represented in the sample for comparison, the relationships are also inflated and non-generalizable.

Although these retrospective studies are useful for exploratory purposes, the general paucity of predictive studies limit conclusions as to operational utility of assessment techniques, since in predictive applications, the magnitudes of relationships generally shrink to much lower levels.

The second problem that arises from the use of total accident involvement as the primary criterion for accident prediction has been the fact that the indiscriminate grouping of different types of accidents (or convictions) diminishes the utility of assessment techniques for particular driver problems. Few studies in the review attempted to differentiate

between the many types of accidents or violations. Relationships between specific assessment techniques and specific drivers may be especially relevant, since different types of individuals may be involved in different types of accidents. However, further fractionating accidents into error categories does reduce criterion stability by increasing the rarity of the criterion event.

Researchers have usually recognized the need for a stable measure of driving behavior which describes the entire driving task. Intermediate criterion measures, such as observation of the driver in test situations, have been offered as one alternative, but predictive validity has not been demonstrated. Additionally, the alternatives usually present a host of other problems (such as the effect of the artificiality of the test situation), which in turn reduce validity. None of these intermediate criteria presently show useful relationships with numbers of accidents, injuries and fatalities, or dollar damage. Finally, costs and operational infeasibility also limit most alternative criterion measures.

Recent efforts, such as the multidisciplinary accident investigations, should improve our knowledge of accident causal factors and identify variations among driver sub-populations. However, the limitations of making causal inferences from after-the-fact data should be considered.

Test reliability is an issue rarely addressed in current studies. Although reliabilities are often reported elsewhere for standardized tests, questions invariably arise concerning the appropriateness of tests for various sub-populations. The extent to which background characteristics interact with test reliability raises additional questions about the relevance of tests and devices for specialized sub-populations. There is a definite need to conduct more extensive reliability studies. This is especially important in operational settings, where respondents can be expected to "fake" their responses, rather than admit to a problem. For example, Schuster et al. (1962) demonstrated that "surface" safety attitudes can be faked in a socially-desirable direction.

Retrospective designs were overwhelmingly represented in the studies reviewed. The influence of prior driving experience on responses directly dealing with driving items would also be expected to affect both reliability and validity of a measurement device.

Despite these problems, the lack of a stable criterion measure of driving behavior, rather than the psychometric properties of the tests themselves, seems to be the primary reason for the generally low utility. The low frequency of accidents, combined with multiple causal factors, environmental and vehicular factors, and other characteristics of the driver not related to person-centered variables (e.g., transient factors, hazards, etc.), all contribute to the low utility of diagnostic assessment techniques.

The lack of adequate conceptual development of assessment techniques often leaves unanswered the question of how test items or measures relate to each other or to driving behavior. The inter-relationships among areas of observation (e.g., performance, biographical, psychological) have not been adequately examined to trace the interactions of person-centered characteristics and driving errors.

For the most part, research has not comprehensively applied assessment techniques, employing only a few assessment areas at a time, such as personality, or prior driving record, as predictors. This approach has unfortunately resulted in much confusion as to the relative usefulness and importance of assessment techniques.

Additionally, the majority of studies reviewed employed significance tests on numerous single variables within a study. Such an approach (in addition to being inefficient) does not account for inter-relationships or interactions among predictor variables. Multivariate approaches (factor analysis, cluster analysis, regression, etc.) are much more powerful and appropriate techniques.[5] Another criticism of the research reviewed is the lack of intercorrelation data on tests and variables--either not reported or not computed--especially in studies reporting only univariate comparisons of several variables.

Most of the studies reviewed did not report cross-validation results; this failure has been a major reason (in addition to small samples) for conflicting findings. The use of a large number of tests (sometimes larger than samples used) increases the probability of achieving significant findings purely by chance.

Many of the methodological issues discussed here are summarized in Table 1-3.

[5] These techniques are relatively "robust," and using large samples, violations of assumptions (e.g., non-normal distributions) are mitigated. At any rate, predictive estimates tend to be conservative.

TABLE 1-3. SUMMARY OF RESEARCH/METHODOLOGICAL PROBLEMS

APPROACH	RESULT
RESEARCH DESIGN:	
• Small samples	• Unreliable results; low statistical power
• Retrospective design/ Contrasted groups	• Possibility for criterion contamination, over-inflated results, not generalizable
• Large number of tests Small number of subjects	• Significant results occuring by chance
• No cross-validation	• Results may be inflated or due to chance
• No provision for reliability	• Lack of knowledge concerning precision of instrument
DATA ANALYSIS:	
• A series of univariate statistical analyses	• Does not take into account interactions or colinearity of variables; inefficient, similar concepts treated differently
• Tests of significance (function of sample size)	• Fail to point out magnitude of difference, or measure or association
CRITERIA:	
• Total accidents/violations	• Do not differentiate between types of behaviors
• Accidents	• Multi-causal portion attributable to human factors not delineated; rare, unstable events--need reliable measures of driving behavior
• Exposure data lacking	• Failure to test hypothesis of "exposure proneness" either as a criterion variable or as a moderator variable
THEORETICAL CONCEPTUAL:	
• Lack clear definition of personality traits/risk-taking, etc.	• Measures at different levels of meaning
• Univariate concepts	• Disregard patterns, constellations of patterns or types of problems; do not consider interaction of different levels of measurement

SHORT-TERM EVALUATION REQUIREMENTS [6]

Based on the findings of this review, a prototype model assessment system using currently available techniques was developed. (This model is described in Volume II, "Assessment Techniques for Operational Users.") The model was developed in response to the question, "What can operational assessors do now to identify driver problems?" It includes those variables (and techniques) at each level of observation within all conceptual areas which appear most promising. Short-term evaluation will require application of the assessment approach in an operational setting to verify the utility of the assessment techniques and to refine the scoring procedures. Both reliability and validity (concurrent and predictive) evaluations of the assessment technique will be required. Sequentially, the evaluation would first address both internal and temporal consistency of the assessment variables, as well as concurrent validity. An empirical scoring system would then emerge from these analyses to permit more accurate diagnosis of driver problems.

Validation must then address the predictive validity of diagnostic assessment. Detailed follow-up information on subsequent driver errors (not solely total accidents) are required to validate initial problem area diagnoses. In addition to the collection of detailed driver error data, accurate severity and cost information would help to identify cost-effective applications. Because of the requirement for detailed follow-up data, very large samples and lengthy follow-up periods would be required to obtain stable criterion estimates. (Specific plans for the conduct of these evaluations are presented in Volume II.)

DIRECTIONS FOR FUTURE RESEARCH

There are several directions which must be taken in future "long-term" assessment research. There is a definite need to conduct a large-scale effort to evaluate the utility of variables and/or conceptual areas in predicting both accident liability and specific driver problems over an extended time period. It is recommended that researchers concentrate their efforts on long-term validation of selected assessment techniques. The consistent application of fewer instruments using adequate research methodologies may help to clarify many of the unresolved issues. A more comprehensive data collection effort is also recommended

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[6] Both "short-" and "long-term," as employed here, do not necessarily reflect a time dimension. The primary distinction is the level of effort and the nature of the questions to be answered.

to avoid much of the confusion resulting from past "piecemeal" approaches to the problem. The most feasible approach for driver assessment is to select promising techniques and validate them in an operational setting. Once valid techniques have been established and evaluated through a comprehensive research program, more complex applications can then be developed.

Evaluations should provide answers regarding the utility of assessment techniques for particular accident liability classes (differential assessment), effective "life span" of predictor variables, and the cost-effectiveness of assessment. The need for differential assessment is related to the previously-mentioned concept of change. It would be expected that for accident liability classes composed of young people, there would be a need for frequent assessment of status because of rapid life style changes. The operational implication is that license renewal or intervention based on driving problems for these groups might occur at shorter intervals than for middle-aged groups. In addition, for the population over 65 years old, some states have proposed shorter renewal periods. The above factors have important implications for the research design employed. After selection and refinement of all variables from short-term evaluation, the long-range efforts can proceed.

We will tentatively suggest that these efforts include mandatory assessment of a very large population (perhaps new license applicants and re-licensees), a long-term longitudinal follow-up, and an evaluation on a wide range of predictive criteria (possible including on-site, in-depth accident investigations).

The possibility exists that variables may be useful predictors for different time periods. Long-term research designs should allow for evaluation of the possibility that variables initially collected will have a different effect over time. For example, an attitude or personality measure may be less useful for long-term prediction than more stable characteristics, such as perceptual style or chronic illness. Long-term assessment evaluations should be designed to examine the "effective life-span" of all predictor variables.

Of particular importance to the administrator would be the prediction of some sort of severity scale. Data for creating such a scale can be found in accident records in most states. Prediction of a severity scale would give the administrator a rough idea of the amount of damage or "societal cost" which will be produced by different accident liability classes, rather than simply the probability of their having an accident. This will allow better estimates of countermeasure cost-effectiveness.

The ultimate value in assessment, of course, lies in the referral of the driver to the program best suited to modify his particular problem, or alternatively, in the imposition of administrative sanctions which limit his risk exposure. Therefore, diagnostic assessment of driver problems must become an integral part of the treatment process.

Long-term evaluation should be concerned with the evaluations of assessment methods and treatment programs (neither of which can currently be considered adequately refined). Subsequent efforts could then include the evaluation of combined assessment and treatment, commonly referred to as "tailored treatment programs."

The lack of continuity in research applications was a primary reason for the relatively few refined instruments found in the literature. Although basic research should parallel an evaluation of an operational assessment approach, very rigid criteria should be imposed on operational evaluations to ensure continuity.

Assessment must be optimized through an iterative process, i.e., the technique development-refinement cycle. Optimization is a process of tracing the interactions of techniques (concepts) with driving problems, and determining their relevance to particular accident liability groups. Improvement in criterion description (e.g., causal factors, accident types) for research and operational programs should result in improved prediction of driver problems. Technique development can then move toward more refined procedures for evaluating performance in a testing environment.

Chapter 2

ACCIDENT LIABILITY CLASSES

The review of diagnostic assessment research literature has revealed numerous variables (and techniques for collecting these variables) which may be useful for predicting future accident liability. For diagnostic purposes, the primary concern is to identify types of drivers with differential accident risk, as well as differential types of errors. The identification process will then, hopefully, lead to suggested accident liability classes, or "target groups," as well as suggested countermeasures for reducing traffic deaths and injuries. For many years, investigators have attempted to define these target groups, since countermeasures might be more appropriately applied when they are tailored to the specific problems of drivers.

This chapter will describe some of the empirical efforts to define target groups or accident liability classes. We will refer to groups of drivers as accident liability classes rather than "target groups," since the term represents a continuum of "good" to "bad" drivers rather than the narrower definition of "high-risk drivers" often implied by the term "target groups."

At present, multivariate statistical approaches to data analysis appear to be most useful for defining accident liability classes. In particular, cluster analytic approaches are useful for determining how people group together on several dimensions. The resultant clusters represent "types" of people with several characteristics in common. When these dimensions include driver behavior errors such as accident types, culpability, severity, etc., useful descriptions emerge for defining accident liability classes.

To date, only a few research studies have included such approaches to statistical analysis. These studies and their relationship to accident liability classes are discussed in the next section.

THE CLUSTER ANALYSIS APPROACH

Cluster analysis is a technique to empirically describe populations of homogeneous groups. The resultant clusters (i.e., groups of people) contain scores (means or percentiles) for the cluster on each variable. A cluster may have either average or extreme scores on a particular variable. Thus, any given cluster may reflect a broad age grouping, may represent both sexes, or may not be descriptive of high accident risk (assuming, of course, that these variables are used in the analysis). In addition, each variable score must be viewed in relation to those of the whole sample. If the entire sample has an extreme score on one variable, then a high score for the cluster on that variable means little.

Similar to regression analysis, the outcome of cluster analysis depends on the number and types of variables included. Inferences are also confined to variations found within the study sample, so results cannot be generalized to the total driving population with a high degree of confidence. For comparative purposes, however, it is possible to present the profile results in a partially standardized form. Therefore, for those studies reviewed, the means for each variable or dimension (standardized) were rank ordered across cluster groups. The ranks were then used to describe the sub-population, e.g., "low," "medium," or "high" on a variable. The ranks for describing a dimension were evenly divided (e.g., 1, 2, 3 = low; 4, 5, 6 = average; and 7, 8, 9 = high) depending on the number of profiles generated in a particular study.

Four studies were found which employed useful samples, extensive data collection, and appropriate statistical techniques to isolate accident liability classes. Harano et al. (1973) studied a sample of accident-free and accident-repeating drivers. After preliminary analysis, several dimensions were used to generate driver profiles. Included in these dimensions were such variables as socio-economic status, age, parental relationships, personal adjustment, perceptual-motor skill tests, and driving exposure. Eight empirical clusters emerged from this analysis.

The Institute for Research in Public Safety (IRPS, 1975) studied the relationships between accident-causal factors (from multidisciplinary accident investigations) and driver characteristics. A sub-population of accident-involved drivers was administered a battery of tests. Information on biographical background, driver knowledge and psycho-social factors resulted in: (1) recognition errors; (2) decision errors related to environmental conditions; (3) decision errors (general); and (4) human conditions and states (alcohol, drugs). Accident causal and personal data were then merged and cluster analysis performed.

A third study, Didenko et al. (1972), described the characteristics of drivers involved in fatal accidents using a factor analysis approach. The procedure is similar to (although usually precedes) cluster analysis, since descriptive characteristics of drivers are generated by each factor. Driver record variables and socio-economic status were employed in this analysis.

The final study reviewed generated profiles of negligent drivers who had been contacted by the California Department of Motor Vehicles (Finkelstein and McGuire, 1971). Since this group, as a whole, represents a deviant population (approximately 1% of the total driver population), the results should be interpreted in that perspective. That is, several factors, such as a lower socio-economic status, young drivers, and general social behaviors are characteristics of this population as a whole. Thus, descriptions such as "high socio-economic status" for this group may represent "average" when compared with random populations.

The following section describes some of the similar driver profiles which emerged from these four studies. The variable dimensions have been collapsed and similar variables grouped for comparative purposes. Only those profiles are included that appear to have common characteristics across the studies reviewed.

YOUNG/HIGH-RISK/MOSTLY MALE DRIVERS

Four similar profiles of young risk-taking drivers were generated from the four studies. These are shown in Table 2-1. Harano et al. (1973) presented one profile comprised of young drivers with high conviction and accident rates. This group frequently reported driving to "cool down after an argument" and other emotions related to driving, which comprised the dimension "Emotional Driving." The group also tended to be low on socioeconomic status, average on mileage, and average on parental relationship, ascendency, and perceptual-motor skills.

Among negligent drivers, Finkelstein and McGuire (1971) presented a similar group. The group was young, high on convictions, but average on accidents. In contrast to the Harano et al. findings they drove fewer miles, and were higher on social class, ascendency and dexterity. However, the groups are probably not markedly different on these dimensions, since the negligent drivers are generally more deviant than part of the sample studied by Harano et al. (half of this sample were accident-free drivers). Reported alcohol use was moderate.

The Institute for Research in Public Safety (1975) study resulted in a young driver group, involved in accident errors such as poor decision-making (with environment factors). Overall the group was average on social class, social and personal adjustment, knowledge and useage of alcohol. Relative to other groups, however, they did have a worse prior driving record.

In describing sub-populations involved in fatal accidents, Didenko et al. (1972) found a factor which described young drivers as having a high number of prior speeding violations, some alcohol use (BAC),

TABLE 2-1. YOUNG/RISK-TAKING/MOSTLY MALE DRIVER PROFILES

VARIABLE DIMENSION	STUDY			
	Harano et al. (1973)	Finkelstein and McGuire (1971)	Institute for Research in Public Safety (1975)	Didenko et al. (1972)
AGE	Young	Young	Young (Mostly Male)	Young (Single Males)
SOCIO-ECONOMIC/SOCIAL CLASS	Low Socio-Economic Status	Average Social Class	Average Social Class	Low Occupation
ASCENDENCY (SOCIAL)	Average Ascendency	High Ascendency	-	-
RESPONSIBILITY	-	Average Responsibility	Average Social Adjustment	No Driver License
PERSONAL ADJUSTMENT/TEST REACTION/STRESS	Frequent Emotions and Driving; Average test Reactions	Average Test Reaction/ Average Stress	Average Personal Adjustment	-
PARENTAL RELATIONSHIP	Average Parental Relationship/Discipline	-	-	-
PERCEPTUAL/MOTOR SKILL	Average Perceptual/ Motor Skills	High Dexterity	-	-
KNOWLEDGE	-	-	Average Knowledge	-
ALCOHOL/DRUG USE	-	Moderate Alcohol	Average Alcohol/Drugs	Some Alcohol (Fatals)
PRIOR RECORD/CONVICTIONS	High Convictions	High Convictions	High Prior Record	High Number Speeding
ACCIDENTS AND TYPE	High Accidents	Average Accidents	Decision and Environment	Fatal Accident
EXPOSURE	Average Mileage	Low Mileage	-	Weekend/Evening

and lower occupations. They tended not to have a driving license. The fatal accident generally occurred on a weekend or during the evening.

Admittedly, the study samples differ in the four projects as do some of the variables. However, by fitting together the "pieces" from each of these studies, a liability class of young drivers emerges. We will borrow from Didenko et al., who aptly described this class:

> "The pattern of the young, single joyrider, driving too fast and recklessly, usually on the weekend, is well known, but the presence of the factor in the non-drinking group indicates that alcohol is not always part of the pattern."

The description becomes more complete with "frequent emotional driving" and average-to-high perceptual motor skills.

HIGH EXPOSURE MIDDLE-AGED DRIVERS

Three studies describe similar characteristics for middle-aged drivers. Harano et al. (1973) report one profile composed of middle-aged drivers who are average on all dimensions except for high mileage. Finkelstein and McGuire (1971), in examining negligent drivers, found a middle-aged group having higher socio-economic status, moderate alcohol use and also high mileage. Their lower accident and conviction rates are lower relative to other negligent drivers, but higher than the general driving population. In an absolute sense, the group is higher than indicated in Table 2-2. The Institute for Research in Public Safety (1975), through their investigations of accidents, found a relatively large proportion of drivers described as not directly causing the accident or not-at-fault. The majority of these drivers were middle-aged and mostly males. The groups tended to be high on socio-economic status, but lower on social and personal adjustment relative to other profiles in the study. Reported alcohol use was moderate. Similar to the Harano et al. study, the group had an average prior record.

In summary, the common elements of these profiles appear to be middle aged, high exposure and average-to-high on socio-economic status. The Institute for Research in Public Safety Profile (1975) tended to be less socially and personally adjusted. One might speculate that the Harano et al. (1973) profile contained some professional drivers because of the high reported mileage. Further analyses of the data could provide more details on drivers' occupations.

TABLE 2-2. HIGH EXPOSURE/MIDDLE-AGED MALE DRIVER PROFILES

VARIABLE DIMENSION	STUDY		
	Harano et al. (1973)	Finkelstein and McGuire (1971)	Institute for Research in Public Safety (1975)
AGE	Middle-Aged	Middle-Aged	Middle-Aged Males/ Some Females
SOCIO-ECONOMIC/SOCIAL CLASS	Average Socio-Economic Status	High Social Class	High Socio-Economic Status
ASCENDENCY (SOCIAL)	Average Ascendency	Average Ascendency	-
RESPONSIBILITY	-	Average Responsibility	Low Social Adjustment
PERSONAL ADJUSTMENT/TEST REACTION/STRESS	Positive Test Attitude	Negative Reaction to Test/Average Stress	Low Personal Adjustment
PARENTAL RELATIONSHIP	Average Relationship Parents Strict	-	-
PERCEPTUAL-MOTOR SKILL	Average Skills	Low Dexterity	-
KNOWLEDGE	-	-	Average Knowledge
ALCOHOL/DRUG USE	-	Moderate use of Alcohol	Moderate Use of Alcohol
PRIOR RECORD/CONVICTIONS	Average Convictions	Low Convictions	Average Prior Record
ACCIDENTS AND TYPE	Average Accidents	Low Accidents	Not at Fault Accidents
EXPOSURE	High Mileage	High Mileage	-

ALCOHOL/MIDDLE-AGED MALE DRIVERS

The profiles presented in Table 2-3 have certain characteristics in common and tend to demonstrate the elements of high stress, alcohol use, and other life style situations as associated with higher accident rates and fatal accidents involving alcohol.

The Harano et al. (1973) profile appears to typify the "average driver," while the Finkelstein and McGuire (1971) represents a profile of lower socio-economic status, high stress, relatively high accident rates, and moderate alcohol use. Few characteristics are provided in the Didenko et al. (1972) study, but drivers tend to have lower socio-economic status and more prior convictions, including DWI arrests.

In summary, lower socio-economic status, lower responsibility, high stress, and moderate-to-high alcohol usage increases accident liability. Middle-aged drivers with lower exposure were also represented in two of the profiles.

HIGH ALCOHOL/HIGH SOCIO-ECONOMIC STATUS/ HIGH EXPOSURE DRIVER

A rather unique set of profiles emerged from two studies, Finkelstein and McGuire (1971) and the Institute for Research in Public Safety (IRPS) (1975). The distinctive characteristics of these profiles are high socio-economic status, reported high alcohol consumption and high exposure, as can be seen in Table 2-4.

The first profile from Finkelstein and McGuire was described as a "unique" profile since there was not a clear pattern of characteristics relative to other profiles from the study. However, some variables tended to set this group apart from others. Interestingly, on age, both young and older drivers are represented. Their second profile is similar to the first on several variables. The second group tends to have more accidents but fewer convictions. This finding, however, may in part be a result of the sample studies since negligent operators are defined by a point count criteria. Thus, those driving with fewer accidents will tend to have more violations and vice versa (concurrent relationships). The Institute for Research in Public Safety (1975) profile is very similar to Finkelstein and McGuire's second profile. It includes young males with high socio-economic status, high social and personal adjustment, and reported alcohol use. Their accidents involved alcohol or other human conditions (e.g., fatigue).

TABLE 2-3. HIGH ALCOHOL/MIDDLE-AGED MALE DRIVER PROFILES

VARIABLE DIMENSION	STUDY		
	Harano et al. (1973)	Finkelstein and McGuire (1971)	Didenko et al. (1972)
AGE	Middle-Aged	Middle-Aged	Middle-Aged
SOCIO-ECONOMIC/SOCIAL CLASS	High Socio-Economic Status	Low Social Class	Low Socio-Economic Status
ASCENDENCY (SOCIAL)	High Ascendency	Average Ascendency	-
RESPONSIBILITY	-	Low Responsibility	-
PERSONAL ADJUSTMENT/TEST REACTION/STRESS	Average Test Reaction	Average Test Reaction/ High Stress	-
PARENTAL RELATIONSHIP	Negative Relationship Parents Strict	-	-
PERCEPTUAL-MOTOR SKILLS	High Skills	Average Dexterity	-
KNOWLEDGE	-	Low Knowledge (from Socio-Economic Cluster)	-
ALCOHOL/DRUG USE	-	Moderate Alcohol Use	High BAC (Time of Fatal)
PRIOR RECORD/CONVICTIONS	Average	Low	Some DWI Arrests
ACCIDENTS AND TYPE	Average Number of Accidents	High Number of Accidents	Above Average Accidents and Fatals
EXPOSURE	Low Mileage	Low Mileage	-

TABLE 2-4. HIGH ALCOHOL/HIGH SOCIO-ECONOMIC STATUS/HIGH EXPOSURE DRIVER PROFILES

VARIABLE DIMENSION	STUDY		
	Finkelstein and McGuire (1971)[a] (Group 1)	Finkelstein and McGuire (1971) (Group 2)	Institute for Research in Public Safety (1975)
AGE	Mostly Young (Some Older) Males	Young Males	Young Males
SOCIO-ECONOMIC/SOCIAL CLASS	High Social Class	High Social Class	High Socio-Economic
ASCENDENCY (SOCIAL)	-	High Ascendency	High Social Adjustment
RESPONSIBILITY	High Responsibility	High Responsibility	High Social Adjustment
PERSONAL ADJUSTMENT/TEST REACTION/STRESS	Positive Test Reaction	Positive Test Reaction/Low Stress	High Personal Adjustment
PARENTAL RELATIONSHIP	-	-	-
PERCEPTUAL-MOTOR SKILL	-	High Dexterity	-
KNOWLEDGE	-	-	Average Knowledge
ALCOHOL/DRUG USE	High Alcohol Use Reported	High Alcohol Use Reported	High Alcohol/ Drug Use
PRIOR RECORD/CONVICTIONS	High Convictions	Average Convictions	Average Prior Record
ACCIDENTS AND TYPE	Average Accidents	High Accidents	Accidents Involving Alcohol
EXPOSURE	High Exposure	High Exposure	-

[a] Unique Cluster

LOW PERCEPTUAL-MOTOR SKILLS/OLDER MALE DRIVERS

Three profiles describe older drivers with lower perceptual-motor skills (as shown in Table 2-5). Harano et al. (1973) and Finkelstein and McGuire (1971) used reaction time and coordination devices to assess perceptual-motor skill levels. Skill level is implied in the IRPS (1975) study by accidents involving decision errors.

Harano et al. (1973) report that older drivers tended to have lower socio-economic status and lower mileage relative to other profiles. The group was average on most other dimensions but did have a relatively high number of accident repeaters.

Older males in the Finkelstein and McGuire (1971) study were also lower on a dexterity test but average on most other dimensions. The exceptions were a relatively high self-reported alcohol use and high stress.

The profile from the IRPS (1975) study tended to represent drivers from lower socio-economic levels and having worse prior driving records. Reported alcohol use was low. They were average on most other dimensions.

RECOGNITION ERRORS/MOSTLY FEMALE DRIVERS

Most of the studies reviewed were not able to generate profiles of female drivers, since the number of females in their samples was usually too small to obtain reliable estimates. IRPS (1975) presents the only profile that appears useful for describing a sub-population of females. This profile (see Table 2-6) indicated fairly average characteristics of the drivers on most dimensions. The drivers tend to be middle-aged and mostly females. The distinguishing characteristic is the relatively high number of recognition errors judged to be related to the accident. Some of the recognition factors include failing to observe, inattention, distractions, and improper lookout. This is consistent with the findings of several other studies (e.g., Harrington and McBride, 1970) that female drivers more frequently commit recognition-related errors which generally result in less severe accidents.

TABLE 2-5. LOW PERCEPTUAL-MOTOR SKILLS/OLDER MALE ORIVER PROFILES

VARIABLE DIMENSION	STUDY		
	Harano et al. (1973)	Finkelstein and McGuire (1971)	Institute for Research in Public Safety (1975)
AGE	Older Males	Older Males	Older Males
SOCIO-ECONOMIC/SOCIAL CLASS	Low Socio-Economic Status	Average Social Class	Low Socio-Economic Status
ASCENDENCY (SOCIAL)	Average Ascendency	Average Ascendency	Average Social Adjustment
RESPONSIBILITY	-	Average Responsibility	Average Social Adjustment
PERSONAL ADJUSTMENT/TEST REACTION/STRESS	Average Test Reaction	Positive Test Reaction/High Stress	Average Personal Adjustment
PARENTAL RELATIONSHIP	Positive Relationship Average Discipline	-	-
PERCEPTUAL-MOTOR SKILL	Low Perceptual Skill	Low Dexterity	-
KNOWLEDGE	-	-	Average Knowledge
ALCOHOL/DRUG USE	-	High Alcohol Use	Low Alcohol Use
PRIOR RECORD/CONVICTIONS	Average Convictions	Above Average Convictions	High Prior Record
ACCIDENTS AND TYPE	High Number of Accidents	Average Number of Accidents	Accidents Involving Decision Errors
EXPOSURE	Low Mileage	Average Mileage	-

TABLE 2-6. RECOGNITION ERRORS/ MOSTLY FEMALE DRIVER PROFILES

Variable Dimension	Institute for Research in Public Safety (1975)
AGE	Middle-Aged (High % Female)
SOCIO-ECONOMIC/SOCIAL CLASS	Average Socio-Economic Status
ASCENDENCY (SOCIAL)	-
RESPONSIBILITY	Average Social Adjustment
PERSONAL ADJUSTMENT/TEST REACTION/STRESS	Average Personal Adjustment
PARENTAL RELATIONSHIP	-
PERCEPTUAL-MOTOR SKILL	-
KNOWLEDGE	Average Knowledge
ALCOHOL/DRUG USE	Average Alcohol/ Drug Use
PRIOR RECORD/CONVICTIONS	Low Prior Record
ACCIDENTS AND TYPE	Accidents Involving Recognition Errors
EXPOSURE	-

SUMMARY

A review of findings of four research studies which employed cluster (or factor) analysis to provide profiles of driver "target groups" has revealed six apparently distinct classes of drivers. These groups can be summarized as follows:

Group 1. Young/High-Risk/Mostly Male Drivers

"Risk-taking" behaviors by males, and associated poor driving attitudes, occur among all but the oldest males. Generally, they are most frequent among the youngest male drivers, declining with age thereafter. Frequent driving patterns include a high number of convictions, mostly speeding. Drivers frequently state that they use the car to express emotions, e.g., "driving to blow off steam." Generally perceptual-motor skills are above average.

Group 2. High Exposure/Middle-Aged Drivers

This group, average on most characteristics, has high driving exposure. The group may contain a high proportion of commercial drivers and higher socio-economic status drivers such as sales representatives. Lower social and personal adjustment may tend to increase liability, but they are often judged to be not-at-fault in the accidents in which they are involved.

Group 3. Alcohol/Middle-Aged Male Drivers

Middle-aged males low on exposure tend to have average accident rates if they are average to above average on social status and personal adjustment. Increased liability occurs with lower social status and personal adjustment. Moderate to high alcohol consumption increases both accident and fatal accident rate for this group.

Group 4. High Alcohol/High Socio-Economic Status/High Exposure Driver

This group tends to have most of the characteristics which have been found to be associated with lower accident liability (at least on a univariate basis). However, certain outstanding features tend to increase accident liability. Although these drivers appear to be above average on social status and personal adjustment, the combination of high alcohol consumption and exposure define the drivers' problem. The group tends to contain highly-mobile male drivers, mostly young, although older drivers are also represented.

Group 5. Low Perceptual-Motor Skills/Older Male Drivers

This group is defined by older males, generally from lower to average socio-economic groups. They are average on social and personal adjustment. Their primary deficiency tends to be low perceptual-motor skills ability, as indicated by perceptual-motor tests and decision errors associated with accidents. Alcohol may be a factor in increasing liability. Poor visual ability may also be a factor.

Group 6. Recognition Errors/Mostly Female Drivers

This group contains mostly middle-aged females involved in accidents with recognition errors--failure to observe, inattention, and improper lookout. Since the profile analysis did not contain more specific measures, it cannot be determined if these errors were associated with visual problems, perceptual abilities, or other driving skill deficiencies.

AN ALTERNATIVE APPROACH

For both research and administrative purposes, accident liability classes have been defined from a number of vantage points. Most previous classification systems have employed driver descriptions similar to those discussed above. These have included such descriptions as "younger drivers," "alcohol problem drivers," "older drivers," "multiple violators," "inexperienced drivers," "young drinking drivers," etc.

It is important to note the types of variables upon which these categorizations are based. For example, "younger drivers" is defined only by a single biographical variable. "Multiple violators" is defined by a performance criterion. "Young drinking drivers" is defined by both performance and biographical variables. Any of these methods can be an appropriate description of an accident liability class, or "target group." From an operational assessment viewpoint, however, accident liability classes are most useful to initially subdivide the driving population. This allows a preliminary estimate of the driver's risk potential, which can then be refined by further assessment. The biographical variables mentioned above are useful for this purpose, since they represent distinct classes of people. Groups based on performance variables (which represent problems, not people) are operationally less useful since a driver could easily belong to more than one such group.[1] As a result our proposed accident liability classes are based entirely upon biographical variables. Within these groups, different types of problems are addressed.

CHARACTERISTICS OF THE DATA

While current research does offer a starting point in the driver problem identification process, there are several dimensions and issues which, due to methodological research limitations, cannot currently be addressed. The major difficulties which limit the development of an "ideal" accident liability class system for presentation here are: the lack of detail on causal factors; the general lack of exposure data; and the use of primarily univariate methods of data analysis. The problems of causal factors and exposure control can be partially resolved, but data are currently so sparse that conclusive statements must be infrequent. The third problem, inadequate methods of data

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[1] A set of liability classes which include performance measures as group definers, such as the results of the profile analyses, would also be useful for examining the magnitude and distribution of the various driving problems, although less useful for individual diagnosis.

analysis, is the most serious obstacle for identification of patterns of driver characteristics which can define "target groups." For this purpose, research must (1) examine all relevant predictor variables simultaneously; (2) determine degree of overlap among these variables; (3) relate these variables to all applicable criteria; and (4) examine all potential interactions among these variables.

Much of the current research consists largely of univariate comparisons, and does not address any of these issues. Many of the remaining studies address only the first two issues--multiple prediction and overlap among predictors. (These include most correlational and multiple regression studies.) Relatively few studies address the third issue--multiple criteria--which appears especially relevant to target group analysis, since many predictors are differentially related to various kinds of driving errors (e.g., recognition errors for older drivers, risk-taking errors for young males). Prediction of total accidents will, therefore, not necessarily be the same as prediction of risk-taking accidents, or recognition problem accidents. (However, using specific errors will further fractionate the criterion, aggravating the rare-event problem.)

Finally, the issue of interactions among predictors is crucial to any attempt at delineation of accident liability classes. For example, there is a well-known interaction between a driver's marital status, and two other biographical predictors: age and sex. For most groups of drivers, being married is an indicator of lower future accident liability. For the young (under 20) males, however, the reverse is true. For these drivers, being married indicates greater accident potential.

Interactions such as this preclude the use of additive statistical models of accident liability. An additive model is essentially any statistical formulization in which the criterion measured is assumed to be predicted by "adding up" the effects of various predictors. It is conceptually a linear approach to the problem, in which predictors are considered serially. Such an approach appears in most research using multiple regression methods.[2]

Aside from a very few studies which employed complex multivariate interactive techniques, such as automatic interaction detection, the relatively few studies which even consider the interaction issue examine only the primary biographical variables of age, sex, and marital status. (Even for these three, analyses have not been conducted on all useful criteria.) Thus, there is no currently avail-

[2]Although it is difficult and seldom done, it is possible to include interaction effects in regression models.

able body of research on the many, and possibly very complex, interactions which determine accident probabilities among various liability classes.

METHOD OF PRESENTATION

We will begin by examining the variables which appear useful in a preliminary sub-division of the driving population. Due to the lack of interaction data, these will be limited to age, sex, and marital status. These variables do, however, provide a starting point for development of accident liability classes. For example, using five age categories, and dividing each by sex, would result in ten sub-groups. Each group may differ on at least one dimension of accident liability. Any of these groups or classes exhibiting a higher than average liability could be considered a "target group" for a countermeasure program. Marital status will provide a third sub-division of the population, although less useful interaction data, particularly by specific criteria, are available.

It makes little difference conceptually which variables are selected first. We could have just as well started with "personality," but the current state-of-the-art simply does not lend itself to "personality" as an initial dimension, since personality data are presently unavailable in operational settings, and research on personality has not reached a level of sophistication where specialized criteria or interactions have been examined.

The development of accident liability classes, then, is viewed as examining the relative importance of the various available measures in the estimation of future probabilities of specific driver problems; providing empirical support for any divisions which can be made within the population based on differential error probabilities,[3] and finally, to the extent possible, specifying the parameters of the driver problems within each group.

DEVELOPMENT OF ACCIDENT LIABILITY CLASSES

For practical reasons, we have chosen three variables (age, sex, and marital status) to make the initial "cut" or sub-division of target populations. The age variable was selected because driving performance has been demonstrated to vary markedly by age, reflected by differential rates for different types of driving errors. Secondly,

[3]Ideally, if data were available, the best approach would be to empirically generate all divisions rather than arbitrarily selecting dimensions.

a host of other intervening variables appear to change by age (e.g., attitudes, life style, and exposure, which has been demonstrated with Level III data). Variation over age may also suggest different countermeasure approaches. Age groupings also may be more administratively feasible than other criteria at present.[4] Finally, much current research addressed sub-populations by age.

For similar reasons, sex as a second division seems useful. Types of driving errors vary widely by sex. Females are over-represented in recognition-related errors, while males contribute disproportionate numbers of risk-taking errors, and represent almost all alcohol errors. Numerous other predictor variables, such as attitudes, personality factors, etc., have been shown to vary widely by sex. Much current research has also divided analyses by sex. Although males generally are over-represented in the magnitude of the traffic safety problem (males are involved in some 84% of all types of accidents), exposure-controlled studies show that female accident rates may be even greater than those of males.

For most kinds of driving problems, marital status is less significant, although still useful as a predictor. For alcohol-related driving problems, however, it is an extremely useful predictor. In addition, it is the only other predictor for which useful interaction data are available.

A breakdown of general accidents by age, sex, and marital status is presented in Table 2-7 (adapted from California Department of Motor Vehicles, 1964-1967). This breakdown results in 24 sub-groups or accident liability classes with "times as many" ratios (percent of total accidents divided by percent of total drivers) ranging from a low of 0.43 (for the oldest married females) to a high of 3.30 (for the youngest married males), demonstrating the usefulness of these three biographical variables for initial division of the driving population.

At this point, the distributions of error types within these sub-groups should be examined. The presently available data for this purpose are not entirely appropriate. As a useful indicator, we have selected the general traffic conviction distributions presented by Harrington and McBride (1970). These data are presented in Table 2-8. As probable indicators of risk-taking, recognition, and alcohol-related errors, we have selected speed, turning, and "major" violations, respectively.

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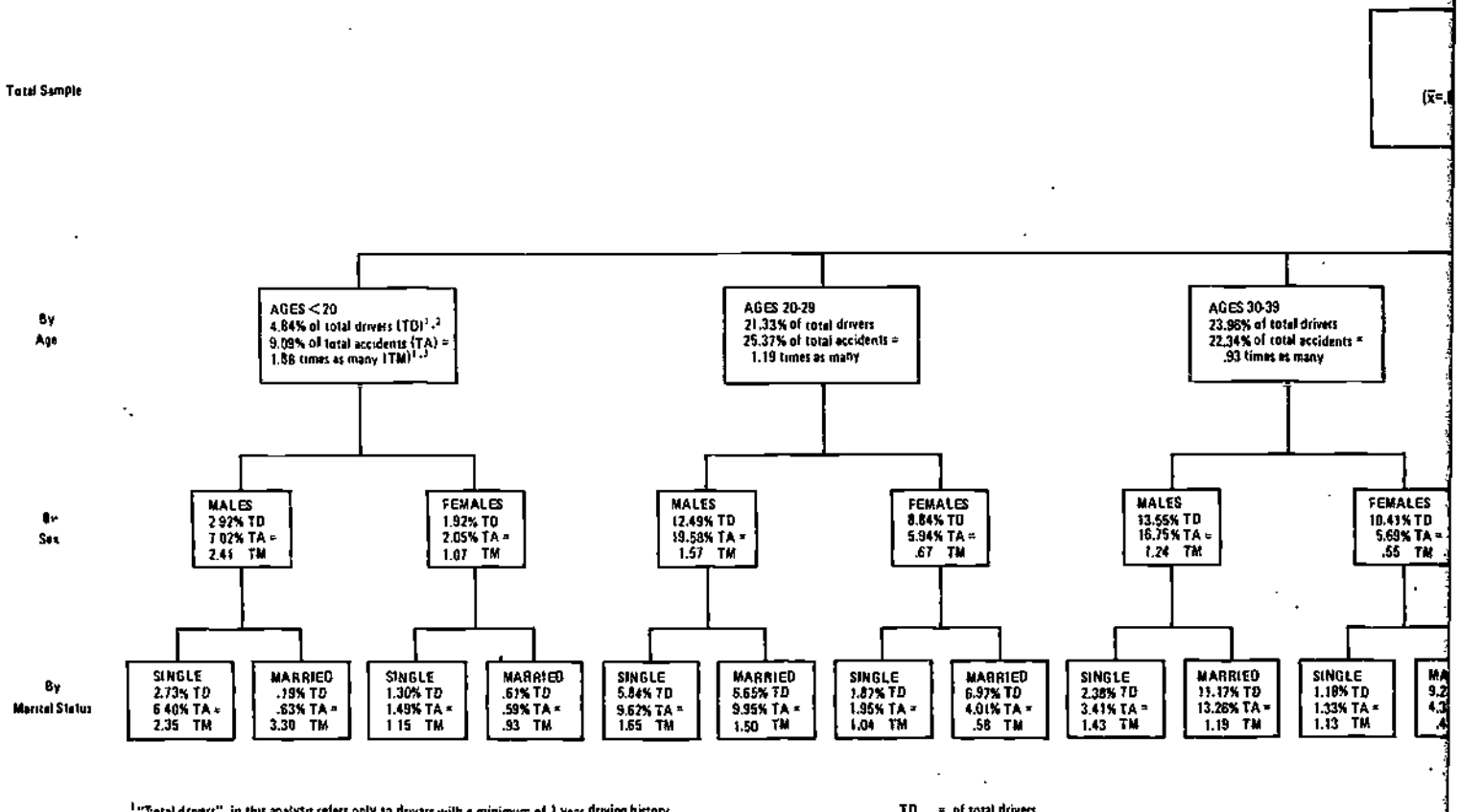
[4] In fact current programs, as a function of driving performance, often indirectly result in age grouping (e.g., negligent drivers are generally young; ASAP attendees are young to middle-aged).

Accident Distribution



[1] "Total drivers", in this analysis refers only to drivers with a minimum of 1 year driving history, thus excluding newly licensed drivers. Actual distribution of valid licenses showed that drivers under age 20 represent 7.16% of valid licenses.

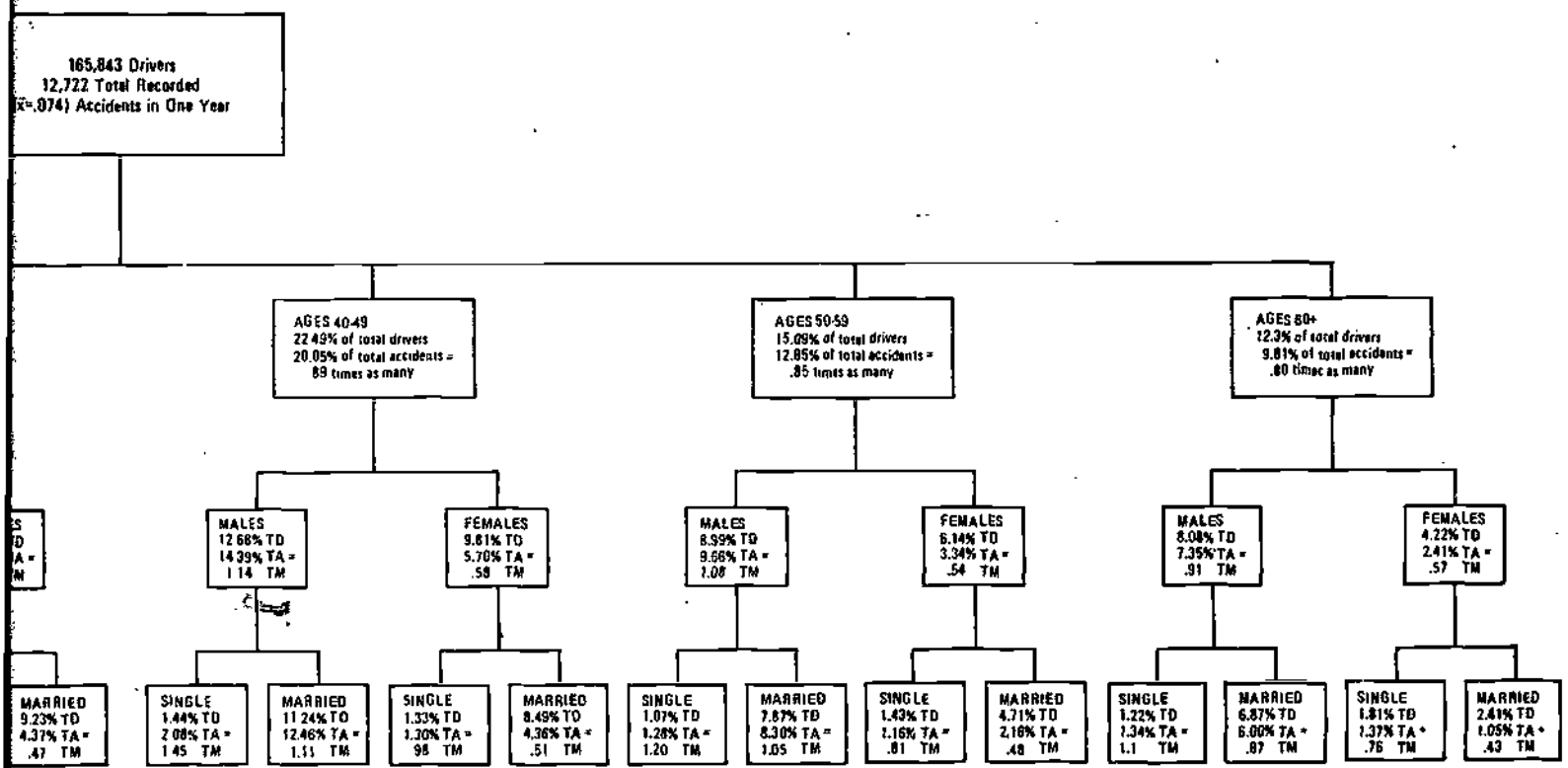
[2] Other percentages may be slightly unaccurate due to rounding error.

[3] "Times as many" here indicates simply percent of all accidents divided by percent of all drivers.

TD = of total drivers
TA = of total accidents
TM = "Times as many"

Table 2-7

ons by Age, Sex and Marital Status



Source: Adapted from: California Department of Motor Vehicles (1964-1967).

Tabl

Traffic Convictio
Age, Sex and

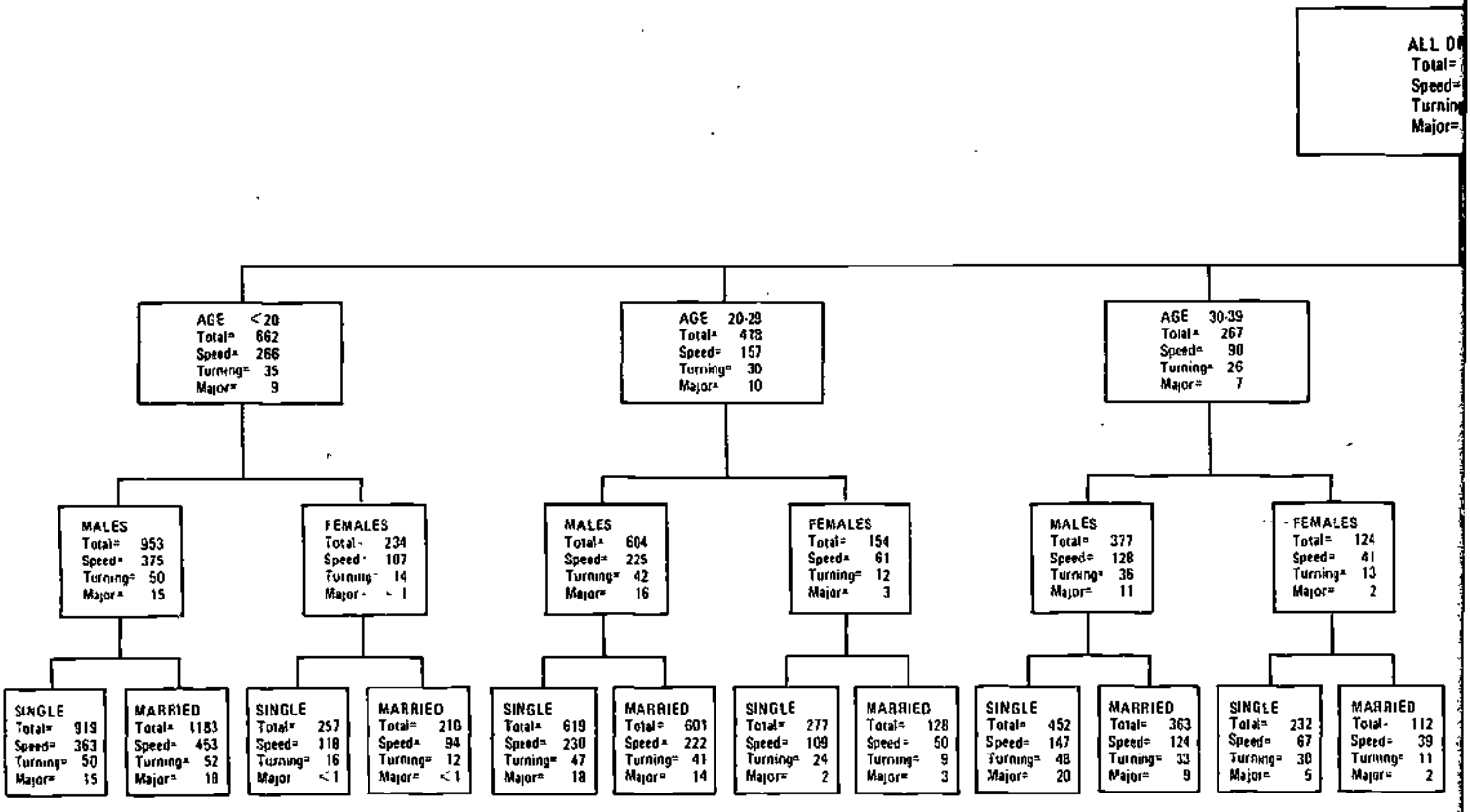
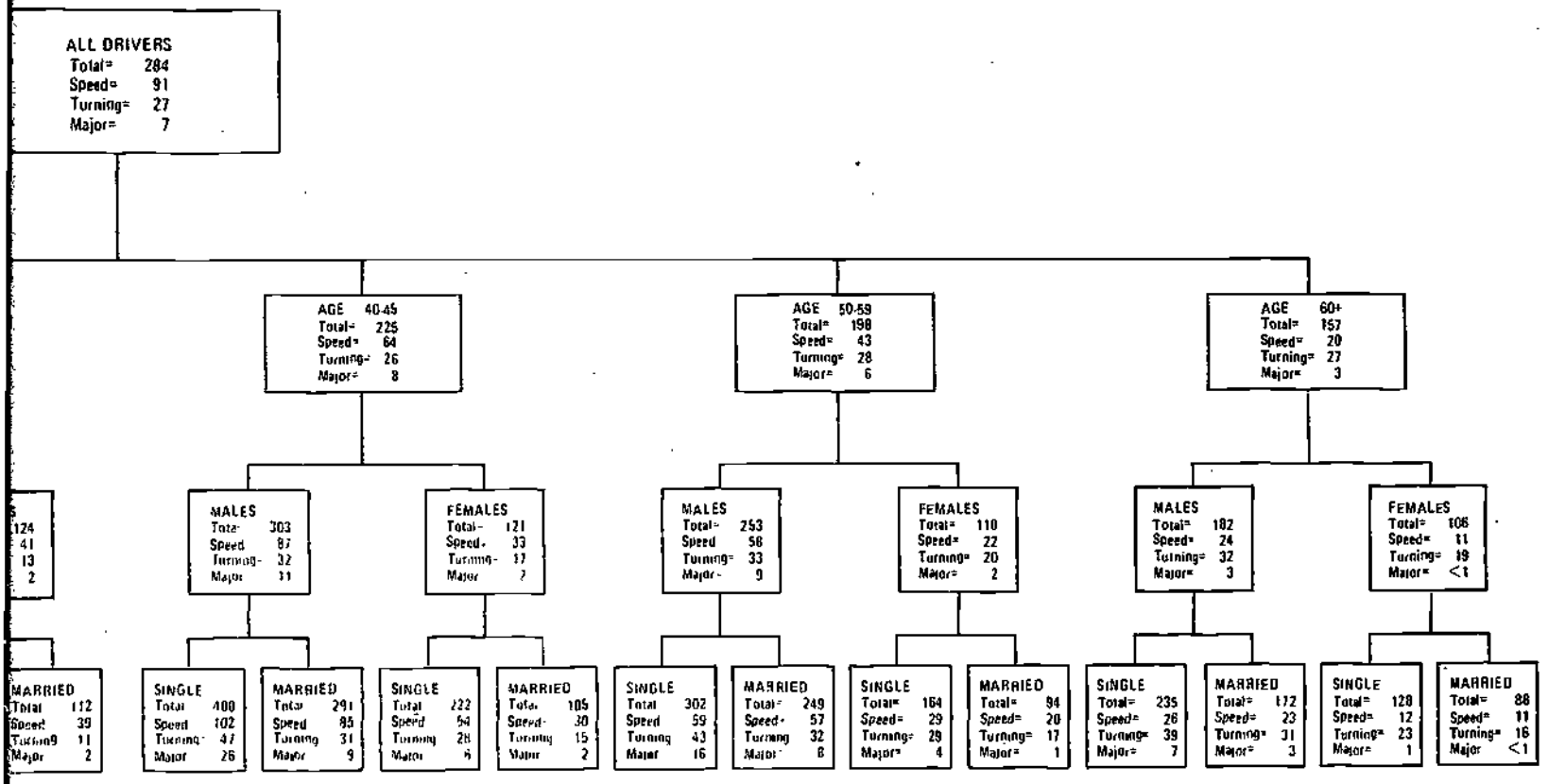


Table 2-8

Conviction Distributions by Sex and Marital Status



Source Adapted from Harrington and McBride (1970)

The interactions of driving errors by biographical variables are very frequent, but occur primarily for age and sex. There are no apparent interactions with marital status, except that already noted for the youngest males. In addition, marital status data which are available at licensing agencies are not usually very recent or accurate. For these reasons, marital status is not especially useful to define liability classes. It is, of course, still useful as a predictor, and any proposed assessment system should account for the one significant interaction.

By examining error types within the age and sex groups, and combining groups where no interactions are revealed, these twelve groups can be further reduced to seven "target groups." These seven are presented in Table 2-9. They represent the minimum number of biographical groupings which appear to differentially vary by specific types of driver problems. There is, of course, some within-group variation on types of driving errors that occur. One particular error-type usually predominates within a group, but all groups exhibit other problems. Since there is, at present, little evidence to document further fractionation of these classes, we shall focus primarily upon the predominant and most severe error of the group (e.g., recognition errors must be considered less severe than either alcohol or "risk-taking" errors, since societal costs are lower for accidents involving this type of error).

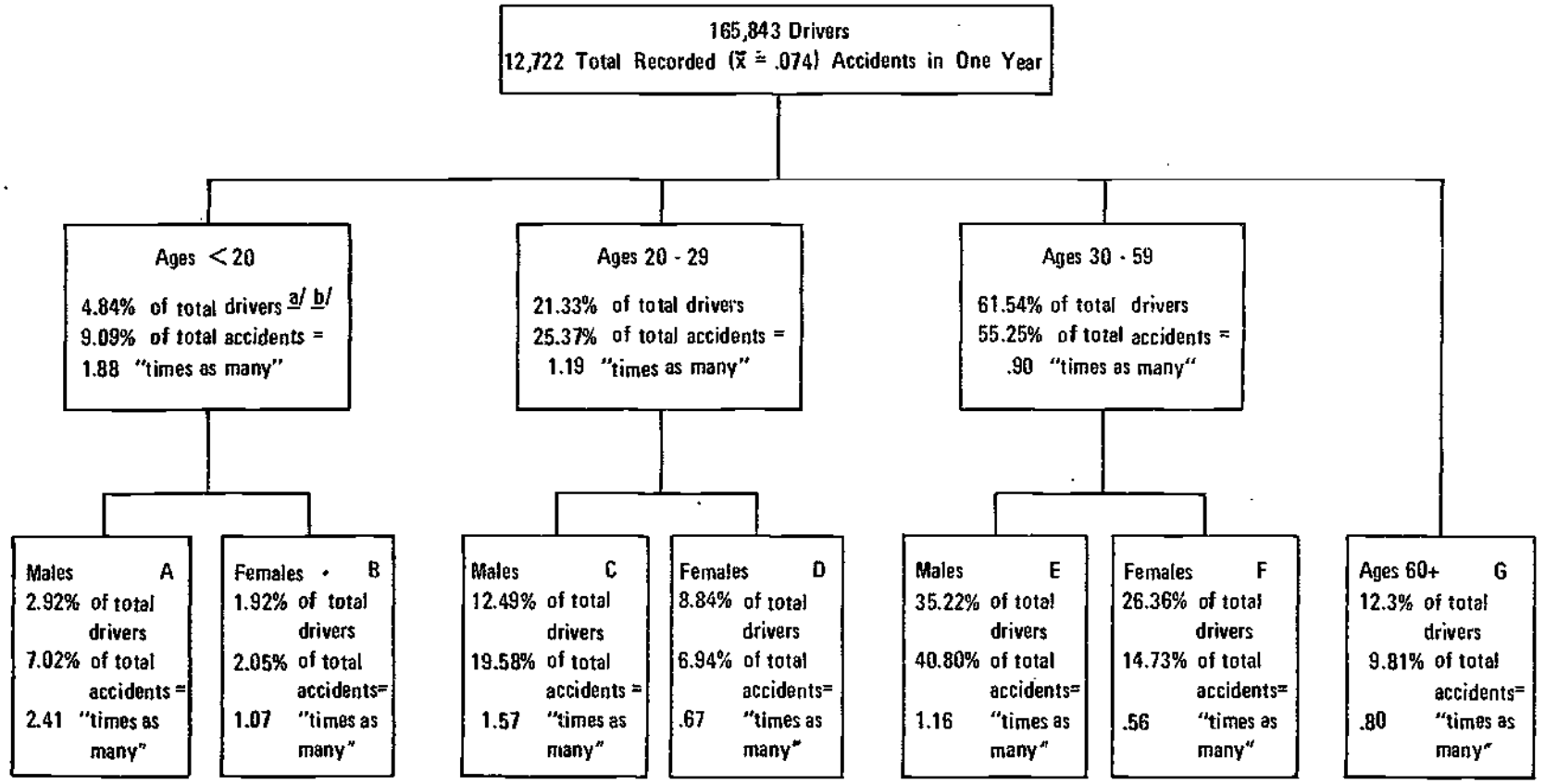
The following paragraphs describe the prominant personal and driver error characteristics for each of the seven accident liability classes that were defined by age and sex. Although few of these groups have been independently examined in current research, the following descriptions are based on a synthesis of findings from the state-of-the-art which consistently demonstrated a particular trait(s) of high-risk drivers.

Group A: Young (under 20) Males

Considering only those with a one-year or more driving history, the group represents 2.92% of total drivers, but 7.02% of total accidents (2.41 "times as many" as expected). Driving errors consist primarily of "risk-taking" errors, e.g., speed, reckless driving, passing, etc., reflected by the group's generally poor safety attitudes, although an unknown proportion of the group's errors may result simply from inexperience with driving. "Risk-taking" young male drivers can be identified by greater time elapsed since licensing, often lower socio-economic status (income of family, level of education, occupational goal, etc.), attitude indicators (owns "high-performance" vehicle, poor safety attitudes, poor attitudes toward authority, low emotional stability, high impatience/impulsiveness, high rating or opinion of himself as a driver), as well as relatively severe or frequent traffic infractions. Profiles of individuals with alcohol-related violations

Table 2-9

The Distribution of High Accident Groups with Differential Error Types



Source: Adapted from data presented in: California Department of Motor Vehicles (1964 - 1967).

a/ "Total drivers", in this analysis refers only to drivers with a minimum of 1 year driving history, thus excluding newly licensed drivers. Actual distribution of valid licenses showed that drivers under 20 represent 7.16% of valid licenses.

b/ Other percentages may be slightly unaccurate due to rounding error.

c/ "Times as many" here indicates simply percent of all accidents divided by percent of all drivers.

are very similar to those without, suggesting that such a violation may be more a function of patterns of alcohol detection by enforcement personnel, rather than an indicator of a pattern of alcohol consumption which elevates future driving risks (i.e., alcohol appears to be a secondary, but important problem for all members of this group, regardless of violation history). Group members drive an average (not high) number of miles per year, and usually possess an operator's or motorcycle class license. This is the only group for which being married indicates greater accident risk.

Group B: Young (Under 20) Females

Considering only those with a one-year or more driving history, the group represents 1.92% of total drivers, but 2.05% of total accidents (1.07 "times as many" as expected). While this over-involvement figure (1.07) is not particularly excessive, the group must be considered poor drivers because their annual mileage is very low, yet they remain well-represented in accident statistics. Errors consist of recognition problems (a consistent pattern among female drivers), "risk-taking" errors (similar to those for young males), as well as an unknown proportion of errors attributable simply to inexperience with driving (common to all young drivers). The most serious accident risks within this group can be identified by a "risk-taking" profile similar to that of young male drivers (low socio-economic status, hostility, poor attitudes, etc.) with the exception that for young females, being married indicates lower accident risk.

Group C: Males (Age 20-29)

This group represents 12.49% of all drivers, but has 19.58% of all accidents (1.57 "times as many" as expected). The group appears to have many of the "risk-taking" problems of the younger males, indicated by a similar "risk-taking" profile (socio-economic status, poor attitudes, etc.). In addition, the group incurs a significant number of alcohol-related problems. Social stress factors, and separation or divorce, indicates high alcohol risk. Pre-alcoholic behaviors such as heavy social drinking, excessive holiday drinking, and binge drinking appear in this group. Being married lowers accident risk. Professional drivers in this group also have high liability, primarily due to high mileage. Since their "per-mile" accident rate is low, they are relatively unamenable to countermeasures, except perhaps suspensions or driving restrictions.

Group D: Females (Age 20-29)

Females in this age group represent 8.84% of all drivers, and have 5.94% of all accidents (.67 "times as many" as expected). Errors are primarily those of the recognition type. Both alcohol and "risk-taking" errors do occur, but much less frequently than for males of the same age. Low accident rate is due primarily to low mileage. Marriage reduces accident risk.

Group E: Males (Age 30-59)

This group represents 35.22% of all drivers, and has 40.80% of all accidents (1.16 "times as many" as expected). This group is heavily represented in both alcohol and "risk-taking" accidents. Since these are the most severe accidents, the group is especially useful as a "target" population. The "risk-taking" problem drivers can be identified by the recognizable "risk-taking" profile (hostility, poor attitude, etc.). The group, which commits a large majority of all alcohol-related errors, also demonstrates an alcohol/driving problem profile, characterized by low socio-economic status, social stresses, family problems, separation or divorce, and financial problems. Mileage is often high. This group also contains its share of professional drivers, whose accident risks may result only from mileage, not driving problems.

Group F: Females (Age 30-59)

Females, ages 30-59, represent 26.36% of all drivers, and 14.73% of all accidents (.56 "times as many" as expected). Again, this low result reflects primarily lack of exposure control. Members of this group drive relatively few miles. The group is quite similar to their younger counterparts (Group D), with the exception of "risk-taking" errors, which tend to increase slightly with age for women during this period. (This increase does not occur for men.)

Group G: Older Males and Females (Over 60)

This group represents 12.3% of all drivers and has 9.81% of all accidents (.80 "times as many" as expected). While older drivers have a relatively low accident rate, they also drive very few miles. They are thus very high "per-mile" accident risks. Numerous visual and medical deficiencies, as well as lapses in attention, characterize the group. They are, almost by definition, "poor drivers." However, potential countermeasures are limited, since the group has relatively few accidents, and these are often minor.

The general characteristics of these groups, broken down by conceptual areas, are presented in Table 2-10.

TABLE 2-10. ACCIDENT LIABILITY CLASSES

LIABILITY CLASS	PERFORMANCE	BIOGRAPHICAL	PSYCHOLOGICAL, SOCIAL/ATTITUDE	MEDICAL/PHYSIOLOGICAL	DEMOGRAPHIC
A	·"Risk-Taking"Errors -speed -reckless driving ·Prior Violations ·Some Recognition Errors -sign violations -signal violations -right-of-way violations -turning violation -right-of-way violations ·Prior Accidents	·Age -Under 20 ·Male ·Lower Socio-economic Status ·Usually Employed (not student) ·Often Married ·Often Criminal Record ·Less Social Activities ·Family Problems ·Usually Smokes Cigarettes	·Owns "Performance" Auto ·"Risk-taking" Attitudes ·More Hostility/ Non-conformity ·Less Emotional Stability ·Greater Impatience ·High Self-rating as Driver ·Family Problems	·No Medical or Visual Problems ·Some Alcohol Consumption	·Moderate Mileage ·Operator or Motor-cycle License ·Driving Inexperience
B	·Recognition Errors -sign violations -signal violations -right-of-way violations -turning violations ·Some "Risk-Taking" -speed -reckless driving	·Age - Under 20 ·Female ·Lower Socio-economic Status ·Often Unmarried ·Non-student	·Usually Drivers Older Vehicle ·Evidence of Hostility/ Non-conformity ·Less Emotional Stability ·Family Problems	·No Medical or Visual Problems	·Low Mileage ·Driving Inexperience
C.	·"Risk-Taking"Errors ·Alcohol-Related Errors	·Age 20-29 ·Male ·Frequently Divorced or Separated ·Lower Socio-economic Status ·Often Criminal Record	·Impulsive ·Less Emotionally Stable ·Greater Depression ·Social Stress Factors ·"Risk-taking" Attitudes	·Social Drinking ·Pre-alcoholic Stage ·Binge Drinking	·High Mileage ·Operator or Profes-sional Driver Class License
D.	·Recognition Errors ·Some "Risk-Taking" Errors ·Infrequent Alcohol related Errors	·Age 20-29 ·Female ·Often Unmarried ·Lower Socio-economic Status ·Not Employed	·Impulsive ·Less Emotionally Stable ·Social Stress Factors	·No Medical or Visual Problems	·Lower Mileage ·Operator License
E.	·Alcohol-related Errors	·Age 30-59 ·Male ·Divorced or Separated ·Lower Socio-economic Status ·Unemployed ·Often Criminal Record ·Low Credit Rating	·Impulsive ·Less Emotionally Stable ·Greater Depression ·Social Stress Factors ·Family Problems ·Occupational/Financial Problems	·Social Drinking ·Binge Drinking ·Chronic Alcoholism	·High Mileage ·Operator or Profes-sional Class License
F.	·Recognition Errors ·"Risk-taking"Errors ·Infrequent Alcohol related Errors	·Age 30-59 ·Female ·Often Unmarried ·Lower Socio-economic Status ·Not Employed	·Impulsive ·Less Emotionally Stable ·Greater Hostility ·Greater Depression ·Family Problems ·Poorer Safety Attitudes	·No Medical or Visual Problems	·Low Mileage ·Operator License
G.	·Recognition Errors	·Age 60+ ·Male or Female ·Often Unmarried ·Lower Socio-economic Status ·Not Employed	·Drives Older Vehicle	·Declining Visual Ability ·Numerous Medical Problems	·Low Mileage ·Operator License

RECOMMENDATIONS

Cluster analysis approaches appear to have a great deal of potential for driver problem analysis. It is a useful aide to identify a "constellation" of factors associated with accidents and accident types. To date, applications have been limited.[5] Applications using the multidisciplinary accident data seem particularly useful when assessment techniques are used in conjunction with accident causal data.

Further efforts using detailed accident descriptions, accident severity information, and class of license (e.g., professional driver) should result in a clear delineation of driver problems. Such a refined analysis will be useful for the development of remediation approaches and determination of where resources should be focused.

For diagnostic purposes, however, a system of accident liability classes (target groups) based entirely upon biographical variables would be preferable, since these variables define people, rather than problems. One such system, based primarily on a synthesis of univariate research studies, has been proposed here. Further research using more complex multivariate techniques will be especially useful to create a similar empirically-based model.

[5] Through wider availability of computer programs and exposure of researchers to the techniques, application should increase.

Chapter 3

MODEL DIAGNOSTIC ASSESSMENT SYSTEM

OPERATIONAL ISSUES IN DIAGNOSTIC ASSESSMENT

Currently many types of driver problems may go undetected by the traffic enforcement/control system. To counteract these problems, a valid and reliable assessment system is essential.

At various levels of sophistication, driver problem assessment currently exists throughout both driver licensing agencies and court systems. Diagnostic approaches range from an informal evaluation by a judge or driver improvement analyst, to more objective means such as a point system. In some situations, in-depth diagnosis of driver problems (generally alcohol-related) and subsequent referral for treatment have been operationally implemented. However, such sophisticated approaches are currently the exception rather than the rule, and have usually been implemented on an experimental or trial basis.

Within operational settings, there is a need to translate current research efforts into an objective and uniform assessment system, which is compatible with current operational constraints. Such an approach is the objective of this chapter.

DIAGNOSTIC ASSESSMENT IN THE TRAFFIC ENFORCEMENT/DRIVER CONTROL SYSTEM

Figure 3-1 gives a generalized conception of the interaction of the driver, the enforcement system, and the social institutions which are concerned with remediation of the driver--the courts, the licensing agency, and other social rehabilitation agencies. Driver problem assessment is usually directed toward drivers who enter the driver control/enforcement system by committing a driver error--either a traffic violation, an accident, or both. Assessment can occur at either the courts or the driver licensing/improvement agency, or under a coordinated effort, where assessment functions are shared.

In most cases, the licensing agency is dependent upon information from the courts, enforcement agencies and public health agencies. The licensing agency then usually becomes the central depository for information integrated from other sources. There are, however, some assessment functions performed directly by the licensing agency, including vision, knowledge, and on-road performance testing. The licensing agency may also refer drivers for in-depth testing when a problem is suspected (e.g., medical examination), or when other agencies are equipped to perform in-depth assessment of a driver problem.

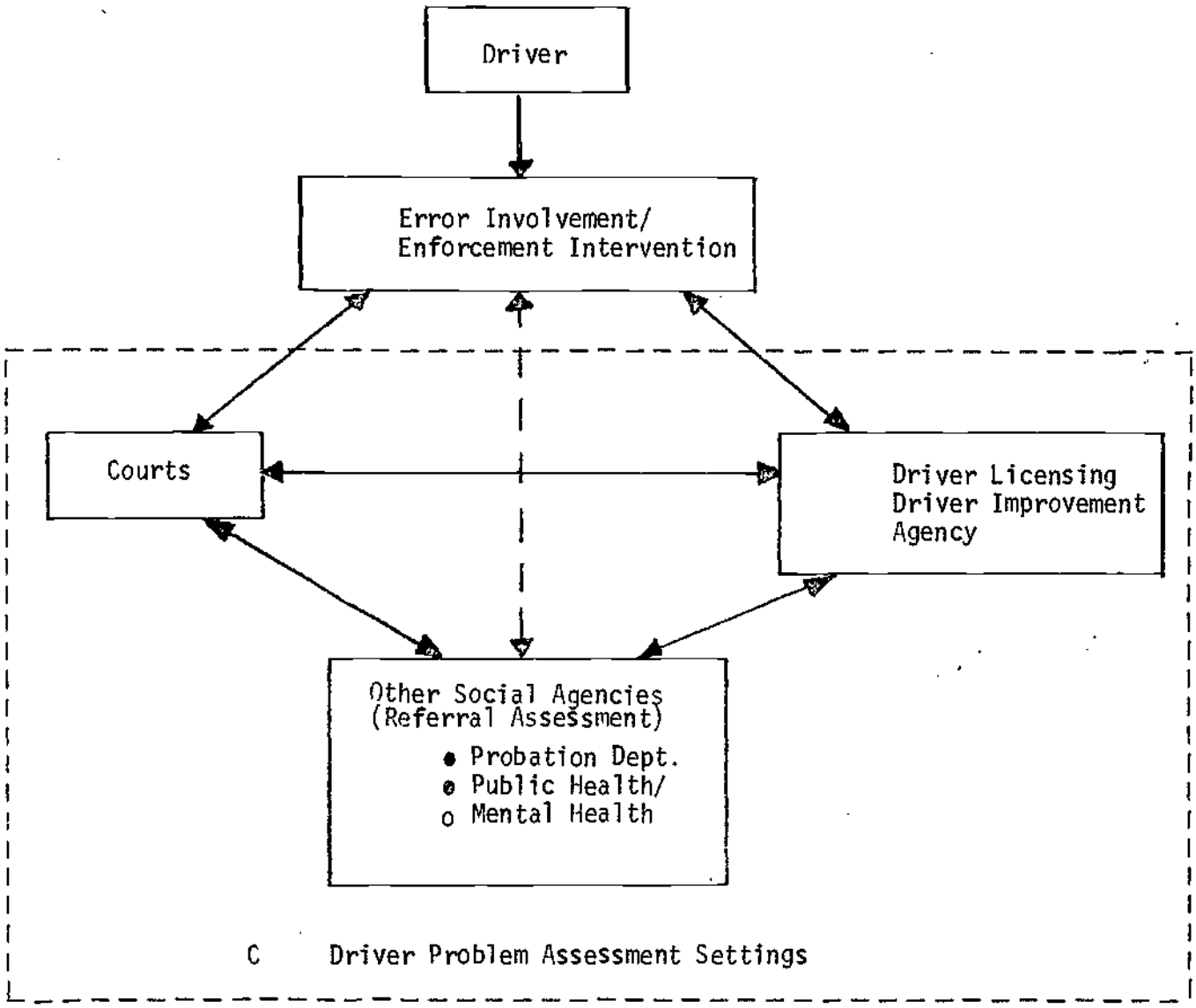


FIGURE 3-1. DRIVER CONTROL/ENFORCEMENT SYSTEM

The courts, in turn, generally rely on the centralized information from the licensing agency, primarily for sentencing purposes. They also provide much of this information, through traffic conviction abstracts. Courts perform assessment of certain driver problems through in-depth investigations before sentencing (e.g., pre-sentence investigations by the probation department).

The initial assessment by the courts or the licensing agency may indicate a need for further diagnosis. For the courts, this may mean a referral to a mental health or other social agency for in-depth diagnosis. For a driver improvement agency, the same referral process may apply, or assessment may be conducted by trained departmental personnel.

There are numerous instances in which additional assessment can clarify driver problems. For example, a recent separation or divorce has been found to be associated with high accident risk, especially involving alcohol. In such cases, perhaps both the courts and the Department of Motor Vehicles would request information from the divorce court records to obtain clearer insight into the driver's predisposing problems.

Currently research does not provide strong scientific support for the use of diagnosis to either deny or grant a license. Assessment may eventually become more appropriate for the new license applicant (or license renewal applicant), but does not appear to be warranted until reliability and validity of performance techniques (e.g., simulator, on-road tests, instrumented vehicles, etc.) have been further refined. Assessment approaches in post-licensing control appear to offer the greatest potential at this time, since in this context, past driver error (accidents and convictions) are reflected in the driving record. These are among the best available predictors of accident liability.

As a tool then, the assessment process consists of collecting appropriate information which may eventually be used to direct a driver to some form of rehabilitative effort, or impose some form of sanction (perhaps to temporarily limit total or high risk driving exposure). A diagnostic approach should be flexible enough to be useful to a judge or driver improvement analyst with limited resources, yet should contain provisions for more in-depth assessment. The confidence that can be placed in driver problem assessment, of course, is parallel to the comprehensiveness and sensitivity of the measures employed. Increasingly detailed assessment will require additional resources, but confidence in the outcome of that assessment should increase accordingly.

Social control agencies are concerned with in-depth diagnosis and treatment of those problems which affect the individual's social functioning. Driver control agencies, in particular, are interested in the diagnosis and treatment of any of these problems which result in an increase in a driver's accident potential. However, since in-depth assessment of all drivers is not currently practical, a diagnostic approach

should emphasize preliminary assessment to identify drivers for whom in-depth assessment would be most cost-effective. A test or validation of diagnostic assessment in an operational setting will be required to determine the overall utility (reliability and validity), and determine the point beyond which assessment is no longer cost-effective.

In summary, an operational diagnostic system should be:

- Useful in several operational settings (e.g., courts, driver licensing/driver improvement).
- Sufficently flexible to be useful within the resources available in the operational setting (based on the degree of specific assessment desired).
- Capable of providing referral options for in-depth assessment by professional assessors (psychologist, license examiner).

COMPONENTS OF THE MODEL ASSESSMENT SYSTEM

The following section will discuss the development of a proposed diagnostic assessment model which is responsive to the needs of current operational users. The four primary components of the assessment model are:

1. The Driver Profile: a diagnostic assessment data collection instrument;
2. Scoring Keys: for the Driver Profile;
3. Problem Assessment Guide which enables determination of the type and extent of driver problem based on the scored responses; and
4. Potential Countermeasure Assignment Guide which allows selection of the most appropriate treatment.

The Driver Profile

Exhibit 3-1 presents the data collection instrument for driving assessment--the Driver Profile. A general discussion of the Driver Profile will be provided here, while specific user guidelines are presented in Chapter 4.

The Driver Profile contains 24 items. The first five examine the individual's driver record (Form A). The remaining items include personal, biographical and attitude information (Form B). Assessment variables were selected from conceptual areas--Performance, Biographical, Psychological/Social/Attitudes, etc.--as outlined in the state-of-the-art

EXHIBIT 3-1

Form A

Align with arrow on Scoring Key →

DRIVER PROFILE

DATE __ __/ __ __/ __ __

NAME _____

DRIVER LICENSE NUMBER _____

AGE: Driver less than 20. . . [ ]
Driver 20-29 . . . . . [ ]
Driver 30-59 . . . . . [ ]
Driver over 60 . . . . . [ ]

SEX: Male . . . . . [ ]
Female . . . . . [ ]

DRIVER RECORD INFORMATION: (If records unavailable, this information can be obtained from driver.)

1. Number of moving violations during last three years. ____
   If 2 or more, check . . . . . [ ]

2. Type of violations: (Check all that apply)

   a. Speeding . . . . . 1 violation [ ]
      2 or more [ ]

   b. Right-of-way . . . . . 1 violation [ ]
      2 or more [ ]

   c. Signs, signals and markings. . . . . 1 violation [ ]
      2 or more [ ]

   d. Major (DWI, reckless driving). . . . . 1 violation [ ]
      2 or more [ ]

Align with arrow on Scoring Key →

→

e. All others (excluding equipment) . . . . 1 violation [ ]
2 or more [ ]

3. If driver has been put on probation or has had his license suspended or revoked by the Department of Motor Vehicles in the last three years, check . . . . . [ ]

4. If any of the above Motor Vehicle Department actions were related to a conviction for driving while intoxicated, check . . . . . [ ]

5. Number of reported accidents in the last three years (regardless of "at-fault") _____. If 1 accident, check. . . . . [ ]
If 2 or more accidents, check . . . . . [ ]

DATE __ __/ __ __/ __ __

NAME _____

PERSONAL INFORMATION:

6. Please indicate your marital status by checking the appropriate box:

   a. Married. . . . . [ ]
   b. Married, but recently separated. . . . . [ ]
   c. Divorced . . . . . [ ]
   d. Single (never been married). [ ]

7. Did you complete high school? . . . . . YES [ ]
   NO [ ]

8. Please indicate your occupation by checking the appropriate box:

   a. Unemployed . . . . . [ ]
   b. Skilled laborer/housewife. . [ ]
   c. Unskilled laborer/service worker . . . . . [ ]
   d. Professional/technical . . . [ ]
   e. Professional driver (cab, truck, delivery) . . . . . [ ]
   f. Student (half-time or more). [ ]

9. If you have changed jobs more than two times in the last three years, check. . . . . [ ]

10. If you smoke cigarettes, please indicate how many packs you smoke every day:

    a. Less than two packs. . . . . [ ]
    b. Two packs or more. . . . . [ ]

11. Please indicate the type of vehicle you drive most often:

    a. Passenger vehicle. . . . . [ ]
    b. Sportscar. . . . . [ ]
    c. Motorcycle . . . . . [ ]
    d. Truck/commercial vehicle . . [ ]

12. Do you own your own car? . . . . . YES [ ]
NO [ ]

13. Do you use seatbelts most of the time? . . . . . YES [ ]
NO [ ]

14. Do you like to drive for fun? . . . . . YES [ ]
NO [ ]

15. Do you feel that enforcement officers are too strict? . . . YES [ ]
NO [ ]

16. When you are upset or angry do you like to get in the car and take a ride in order to cool down? . . . . . YES [ ]
NO [ ]

17. Have you had any of the following problems lately? (Check as many as apply to you.)

a. Money worries. . . . . [ ]
b. Problems with your wife or girlfriend. . . . . [ ]
c. Problems on the job. . . . . [ ]
d. Problems with friends. . . . [ ]
e. Problems at school . . . . . [ ]

18. Have you been troubled with any of the following medical problems recently? (Check as many as apply to you.)

a. Loss of consciousness. . . . [ ]
b. Heart or circulatory problems . . . . . [ ]
c. Problem drinking . . . . . [ ]
d. Conditions affecting motor coordination . . . . . [ ]
e. Diabetes . . . . . [ ]
f. Vision problems. . . . . [ ]

* * * * * * * * * *

IF YOU DRINK ALCOHOLIC BEVERAGES. . . . .

19. How often do you drink in the morning?

a. Often. . . . . [ ]
b. Once in a while. . . . . [ ]
c. Seldom . . . . . [ ]
d. Never. . . . . [ ]

20. Has your spouse or a close friend ever said anything about your drinking or been worried or upset about your health or money problems because of it?

a. Yes, many times. . . . . [ ]
b. Yes, sometimes . . . . . [ ]
c. Yes, but not very often. . . [ ]
d. No, never. . . . . [ ]

21. How often do you usually drive after drinking a couple of drinks of alcohol or three or more beers?

a. Daily. . . . . [ ]
b. Several times a week . . . . [ ]
c. About once a week. . . . . [ ]
d. Less than once every two weeks. . . . . [ ]
e. 5 or 6 times a year or less. [ ]
f. Never. . . . . [ ]

* * * * * * * * * * *

22. About how many miles do you drive every day, on the average?

a. More than 100 miles. . . . . [ ]
b. 70 - 100 miles . . . . . [ ]
c. 40 - 70 miles. . . . . [ ]
d. 15 - 40 miles. . . . . [ ]
e. Less than 15 miles . . . . . [ ]

23. Please check as many of the following statements as you think are true about your own driving. (Check as many as apply to you.)

a. I don't have any problems with my driving and I'm a better driver than most people . . . . . [ ]

b. I've been in a hurry a lot lately and haven't been paying as much attention to my driving as I should . . . . . [ ]

c. Everybody makes mistakes sometimes--I've just been unlucky enough to get caught. . . . . [ ]

d. Sometimes I have to drive after I've had a couple of drinks. . . . . [ ]

e. I've had a lot of personal problems lately, and it's hard to concentrate on driving . . . . . [ ]

f. I've been having some medical problems that sometimes affect my driving . . . . . [ ]

g. I just need a little more experience behind the wheel . . . [ ]

h. I have trouble seeing other cars at intersections . . . . . [ ]

i. I have trouble making quick decisions in tight spots. . . . [ ]

[FOR ADMINISTRATIVE PURPOSES ONLY]

If you have ever received treatment or service from any of the following agencies, please indicate which one(s).

a. Department of Public Health. [ ]

b. Department of Mental Health. [ ]

c. Department of Alcoholism . . [ ]

d. Department of Rehabilitation [ ]

e. Referred to a physician by the Department of Motor Vehicles . . . . . [ ]

review.[1] The selection of techniques (variables) for the model was based on predictive utility of the variable, as well as operational and legal considerations. Only the most prominantly useful items identified in the state-of-the-art review were selected for the model. Alternate techniques have also been suggested for those operational assessors who have the resources to conduct further assessment within their particular operational setting. However, strong recommendations cannot be made for adding assessment techniques beyond those identified, except for basic research purposes.

The items in the Driver Profile are designed to measure three types of driver errors--recognition, alcohol-related, and risk-taking errors. These dimensions were selected since:

- The relationship and magnitude of these problems within the traffic safety context appears high;
- Basic research has to some degree empirically supported these general problem categories;
- Level of specificity beyond these rather broad groupings cannot be supported by current research; and
- This level of specificity appears to be responsive to practical and operational constraints.

There are numerous driver problem dimensions which can potentially be assessed. The largest restriction at present is the lack of basic research to support techniques for identifying a particular driver problem. Further, an increase in the number of dimensions would increase the complexity of the assessment model--possibly to the extent that implementation would not be feasible. A summary of each assessment dimension found to be currently useful is provided below.

Recognition Errors

Recognition errors include a broad array of driving problems, which may result from visual, psycho-perceptual, and performance skill deficiencies. Using only driver record variables, a pattern of recognition errors may be detected, but the causes of the problem remain unclear. As the number and extent of assessment techniques become more specific, the nature of the problem should be more explicitly defined.

[1] Definitions of the items in the Driver Profile, as well as additional items and instruments are provided in Appendix A.

The Driver Profile includes some indicators which reflect this general problem category (e.g., types of driving violations). There are several other indicators which could be used to specify the nature of the recognition problem, such as perceptual style measures, vision testing, and psychomotor coordination measures. However, since research has not demonstrated any of these to be a reliable and valid measure, the Driver Profile does not include these more specific indicators.

There is clearly a need for more basic research to clarify the extent to which recognition errors are due to visual problems, ineffective perceptual patterns, inattention associated with situational stress, or simply inexperience in maneuvering a vehicle in a complex situation.[2]

Alcohol-Related Errors

Alcohol-related problems refer to the relative probability that a driver's alcohol consumption pattern will impair his or her driving ability. The most obvious assessment variables from driver record sources are prior DWI offenses or alcohol-related crashes. Further assessment will help determine the extent of a drinking problem, and whether or not the drinking problem is also a driving problem.

Risk-Taking Errors

This dimension is intended to measure driver problems associated with specific risk-taking behaviors, rather than general accident risk. Examples of variables from driver records which increase the likelihood of this problem are traffic violations involving reckless driving, speeding, and passing errors. Examples from direct assessment include measures of immaturity, emotional stability, and social behaviors such as driving to "show off," and use of a vehicle to express feelings.

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[2] Further assessment development may also allow future diagnostic systems to include these very specific driver problem categories, e.g., inexperience, perceptual deficiency, etc. rather than a broad category such as "recogniton" problems.

The Scoring Keys

One task in the development of the model assessment system was the derivation of an objective measure to quantify the extent of an individual driver problem. For the most part, actual data for deriving an index reflecting accident potential associated with specific problems are not currently available. Previous studies using many of the same variables (e.g., regression) have derived variable weights in predicting total accident liability. However, for our purposes (driver problem analysis), a differentiated weighting system is essential. For this purpose, judgments were necessary to assign scores for responses on the Driver Profile. These judgments were supported by a synthesis of studies which consistently demonstrated relationships of a particular technique with general accident liability and specific error types. That is, specific driver error classification (recognition, alcohol, and risk-taking) weights were assigned to items on the basis of (1) the likelihood that the assessment variable was associated with a particular problem (e.g., prior DWI would be a high alcohol problem indicator); and (2) the likelihood that the assessment variable presents a particular problem for a specific "target group" of drivers.

Exhibit 3-2 provides the scoring key for male drivers under 20 years of age. Scoring keys for remaining liability classes are provided in Appendix B. To score the Driver Profile, the key is simply placed adjacent to the Profile (arrows aligned). The assessor then circles values on the key which correspond to an item checked on the Profile. Adding the values of the circled items by column then produces a total score for each problem area.

Since a given assessment variable may indicate an entirely different problem for one group of drivers than another (e.g., a right-of-way violation may indicate "risk-taking" among younger drivers and "recognition" errors among older drivers), or may be completely inappropriate for a particular group, separate scoring keys were developed for different target groups, or accident liability classes. These accident liability classes are the same as those discussed in Chapter 2 (Classes A-G), using only age and sex to categorize drivers into groups reflecting varying driving problems and accident likelihood. Each driver can easily be assigned to his "liability class." A refined analysis of accident potential can then be made from driver records and administration of a questionnaire based on useful assessment variables and techniques, as identified in the state-of-the-art review.

In the scoring procedures, older drivers receive a higher score on the recognition dimension for a right-of-way violation than younger drivers, who receive a higher score on the risk-taking dimension for the same violation. Empirical research has to some extent supported this concept--that two groups may commit the same error for different reasons. Further assessment beyond driving records should help to clarify this issue. That is, assessment of "risk-attitudes and other factors should clarify the initial gross estimate of the meaning of a right-of-way violation.

EXHIBIT 3-2

Form A

← Align with arrow on Driver Profile

SCORING KEY--DRIVER PROFILE
(Males Under 20)

DATE __ __/__ __/__ __

NAME _____

DRIVER LICENSE NUMBER _____

[ ] Driver less than 20
[ ] Driver 20-29
[ ] Driver 30-59
[ ] Driver over 60

[ ] Male
[ ] Female

	RISK-TAKING	RECOGNITION	ALCOHOL
1.	1	1	1
2.			
a.	3		1
	4		2
b.	3	1	
	4	2	
c.	3	1	
	4	2	
d.	2		2
	3		3

← Align with arrow on Driver Profile

	RISK-TAKING	RECOGNITION	ALCOHOL
e.	1/2	1/2	1/2
3.	2	1	1
4.			4
5.	1	1	1
	2	2	2

Form B

DATE __ __/__ __/__ __

NAME _____

	RISK-TAKING	RECOGNITION	ALCOHOL
6.			
a.	2		3
b.	2		2
c.	2		1
d.			
7.			
	2		1
8.			
a.	1		1
b.	1		
c.	1		
d.			
e.	1	1	
f.	1		
9.			
10.			
a.	1	1	1
b.	2	2	2
11.			
a.			
b.	2		
c.	2	1	
d.	1		

	RISK-TAKING	RECOGNITION	ALCOHOL
12.	1		
13.	1	1	
14.	2		
15.	2		
16.	3		
17.			
a.	1		
b.	1		
c.	1		
d.	1		
e.	1		
18.			
a.		1	
b.			
c.			3
d.		2	
e.			
f.			

	RISK-TAKING	RECOGNITION	ALCOHOL
19.			
a.			3
b.			2
c.			1
d.			
20.			
a.			3
b.			2
c.			1
d.			
21.			
a.			5
b.			4
c.			3
d.			2
e.			1
f.			
22.			
a.	4	4	4
b.	3	3	3
c.	2	2	2
d.	1	1	1
e.			

	RISK-TAKING	RECOGNITION	ALCOHOL
23.			
a.	1		
b.	1		
c.	1		
d.			1
e.	1		1
f.			
g.		1	
h.		1	
i.	1		
TOTAL	Sum of Points: ____	Sum of Points: ____	Sum of Points: ____

Problem Assessment Guide

Finally, scores for each problem area can be compared with group norms, such as those provided in Exhibit 3-3, to determine whether a particular score represents a limited or a major problem. (Similar assessment guides for the remaining accident liability classes are presented in Appendix C.) For each of the assessment dimensions the levels indicated are: (1) Average; (2) Slight Problem; or (3) Major Problem.

Once an initial assessment of a driver's potential problem(s) has been made, there are several options for additional assessment. These options are highly dependent upon the operational resources available. Some of these potential options for additional problem assessment are discussed in Chapter 4.

Potential Countermeasure Assignment Guide

Any jurisdiction could create the final component in an operational diagnostic system--a referral chart such as the example presented as Exhibit 3-4. Options for countermeasures will thus be determined by availability of treatment alternatives and evaluations supporting their effectiveness.

It should be noted that the Driver Profile contains an item concerning the individuals' driving exposure (mileage). This item is used to increase driver problem scores, since higher mileage has been shown to be related to higher accident probability. Thus, mileage must be considered in any assessment of the driver's problem. However, since most current treatment programs do not attempt to modify exposure, the effects of this variable might be subtracted before implementing a countermeasure assignment guide such as Exhibit 3-4.

Alternatively, since high mileage (especially in combination with other problems) can greatly increase accident potential, future assessment systems might add a separate problem category labelled "exposure." When an "exposure problem" is detected along with other problems, a practical treatment might then be a limited driver license. To implement an assessment system addressing "exposure problems" would necessitate the addition of more mileage items. This, in turn, would increase both administration time and complexity of scoring of this instrument. For these practical reasons, the Driver Profile presented here does not assess a separate "exposure problem."

EXHIBIT 3-3

DRIVER PROBLEM ASSESSMENT GUIDE

(Cutoff Scores for Males under 20)

	RISK-TAKING	RECOGNITION	ALCOHOL
AVERAGE	SCORE: Less than 10 points	SCORE: Less than 10 points	SCORE: Less than 10 points
SLIGHT PROBLEM	SCORE: 10 to 20 points	SCORE: 10 to 15 points	SCORE: 10 to 20 points
MAJOR PROBLEM	SCORE: Greater than 20 points	SCORE: Greater than 15 points	SCORE: Greater than 20 points

EXHIBIT 3-4

SAMPLE COUNTERMEASURE ASSIGNMENT GUIDE

	RISK-TAKING	RECOGNITION	ALCOHOL
AVERAGE	No action	No action	No action
SLIGHT PROBLEM	Warning letter	Pamphlet on driving tips	Pamphlet and discussion with assessor
MAJOR PROBLEM	Suspension	Re-examination by licensing agency	Alcoholism clinic and restricted license

Chapter 4

GUIDELINES FOR OPERATIONAL USERS

This section will provide the operational assessor with guidelines for implementing the diagnostic assessment model. This discussion will include:

A. Administrative procedures.

B. Operational requirements for assessment.

C. A sample driver assessment--procedures for scoring and determining a driver problem

D. Options for in-depth diagnosis.

ADMINISTRATIVE PROCEDURES

Driver problem diagnosis is conducted by (1) administering the Driver Profile to drivers, (2) scoring responses on three driver problem dimensions and (3) determining the extent of a problem(s) by referring to a table of cutoff scores.

Figure 4-1 outlines the operational steps for driver assessment within a court system, although the same basic steps should apply to other operational systems, such as assessment in a driver improvement setting.[1]

For judicial applications, drivers must first be issued a citation for traffic offenses. Drivers who contest a citation and/or who are required under mandatory statutes, are those who appear at traffic court. Upon appearance drivers are administered Form B of the Driver Profile. Form A (Driver Record) should have been completed prior to the driver's appearance by court personnel, who request the driver record information from the licensing agency. This pre-scoring of both Forms A and B

[1] The primary distinction is that a driver may appear before a driver improvement analyst or hearing officer. Generally drivers requested to appear have met a "point system" criteria; thus these drivers may have poorer records than the population appearing in court.

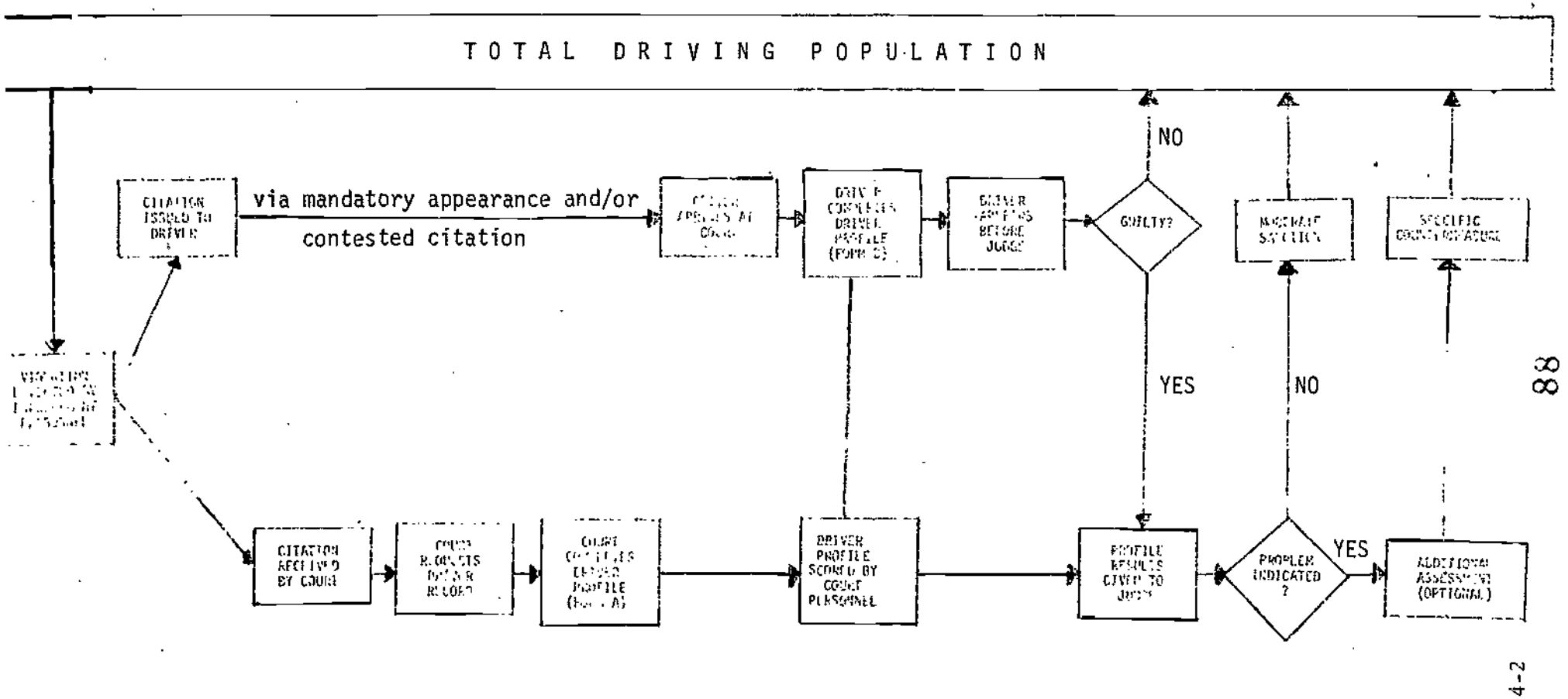

FIGURE 4-1. FLOW CHART FOR COURT DIAGNOSTIC ASSESSMENT PROCEDURES

eliminates delays and provides the judge with immediate guidelines in the event that a driver is convicted. Post-conviction administration of Form B is also possible, but would necessitate a second appearance by the driver for sentencing, which may be impractical. In addition, drivers may be more reluctant to provide candid information subsequent to adjudication. In the final step, the judge can refer the driver for more in-depth assessment (depending on the availability of community services), impose a sanction, or assign the driver to an appropriate countermeasure, guiding his decision by the diagnosis provided by the Driver Profile.

Specific Administrative Procedures include the following:

- Form A--Upon receipt of citations (non-forfeiture), driver records are requested from the licensing agency, and this information is entered on Form A. (The current citation would be considered a conviction. In the event that the individual is found "Not Guilty" of the current citation, then neither Form A or B would be used, since the driver would be returned to the driving population without further action.)

- Form B--Upon appearance at court, drivers will be directed to a conference room and requested to complete Form B. Court personnel will provide instructions for completion of Form B and will also provide the driver with an explanation of the purposes of the form.

OPERATIONAL REQUIREMENTS FOR ASSESSMENT

Specific operational requirements are highly dependent upon court volume and scheduling procedures in a particular jurisdiction. Optimization of assessment in a court setting will require an analysis of a particular court system to determine if additional court personnel will be required for scheduling, scoring, etc. Basic requirements and parameters to be considered in implementing an assessment system will be discussed in this section.

FACILITIES

Form A will require some means to access individual driving records. In higher volume courts, this may necessitate computer facilities.

Form B will require only a conference room, or other area suitable for test administration (size is, again, dependent on volume).

TIME REQUIREMENTS

Entry of information from Driver Record Abstracts and scoring of Form A is estimated to require from 2-6 minutes per case.

Completion of Form B is estimated to require from 5-15 minutes. The administrator will be required to read items to those drivers with language problems and/or deficient reading skills. Scoring Form B is estimated to take from 3-6 minutes per case.

Consolidation of Forms A and B and computation of final diagnosis is estimated to require another 2-4 minutes, resulting in a total estimated time for court personnel of between 7-16 minutes. Time for completion of the Driver Profile (Form B) by the driver himself is not included since administration time would vary widely depending on court volume and scheduling and whether group or individual administration procedures are utilized.

PERSONNEL

Since procedures are standardized (instructions, forms, and scoring procedure), non-professional personnel can conduct the assessment.

SCHEDULING

The profile can be administered individually or to groups of drivers. Again, scheduling procedures will depend on the court schedule and volume. In high volume courts, group administration appears most feasible. Scoring the Driver Profile so that it will be available to the judge on a timely basis appears to be the most difficult scheduling problem in the total assessment process. The logistical problems associated with scoring, however, can be reduced by staggered, optimum scheduling and temporary support for scoring the initial group of drivers. Almost immediate scoring would be required for this "first group" because they would be scheduled for appearance before a judge. Thereafter the Driver Profile could be administered to remaining "groups" and scored while the first group of drivers was appearing before the judge. Temporary assignment of court personnel and early scheduling of drivers (e.g., 30 minutes prior to court appearance) are alternatives for reducing this problem in high volume courts.

COSTS

Costs would be expected to vary widely, depending on a particular jurisdiction. The primary cost factors are additional personnel requirements. In turn, personnel requirements are dependent upon court volume and scheduling. The cost of the instrument (Driver Profile) is nominal (printing costs).

TRAINING

Minimal training would be required to implement the assessment model. Familiarity with countermeasure options and possibilities for additional assessment within the community are the primary requisites for the judge to successfully complete the assessment/treatment cycle. Non-professional test administration personnel would require minimal practice of administration and scoring procedures.

INSURING ACCURACY OF DATA

The quality or accuracy of data obtained from the driver is very important for valid assessment of driver problems. There are several factors which might reduce the usefulness of the data. Some of these factors are:

- The driver may perceive the assessment as a threat to his or her driving privilege and misrepresent facts.
- Reduced reliability of the items may result from misinterpretation. Consistency of responses (reliability) can be improved by clarification of the items in question, as well as by increasing the number of items associated with a concept.
- External distractions such as loud noises, interruptions, or environmental conditions (stifling room, etc.,) can all have an effect on the way a subject responds to a questionnaire item.

Some of these problems can be circumvented by establishing a test facility that minimizes distractions and maintains an atmosphere which is non-threatening to the driver. Minimization of perceived threat can be accomplished through the establishment of rapport with the driver. Regardless of whether assessment is concerned solely with operational aspects or combined with evaluative research, confidentiality of information provided by the driver must be maintained. Thus, the basic elements of the instructions to the driver should include:

- Assurance of confidentiality of information.
- Assurance that information does not relate to decisions regarding guilt or innocence of a traffic citation.
- Assurance that information is used by the judge to more uniformly determine driver problems, and to help the driver to modify these problems in the best possible manner.

The specific instructions should be tailored to the operational setting and the scope of the assessment program.

A SAMPLE DRIVER ASSESSMENT

This section will describe the Driver Profile scoring procedures, as well as procedures for determining the extent of a driver problem.

PROCEDURES FOR SCORING DRIVER PROFILE

Exhibit 4-1 presents a sample Driver Profile as it might be completed by a male driver under 20 years of age, along with a completed Scoring Key based upon the responses of this fictitious young male driver.[2] The circled values on the Scoring Key are scored responses for the sample driver. (Values have been assigned for each response along the three assessment dimensions--Risk-Taking, Recognition and Alcohol. Values are not necessarily provided for every response to the Driver Profile, nor are values necessarily found on each of the driver problem dimensions.)

To score the Driver Profile, follow these steps:

1. Place the Scoring Key for the accident liability class (in this case males under 20) to the right of the Driver Profile, making sure that the arrows are aligned.

2. For each checked response noted on the Driver Profile, circle each value that appears on the Scoring Key adjacent to that checked response. For example, on Item 8 (page 4- of Exhibit 4-1) of the Profile, the driver has indicated that he is "unemployed" by checking box 8:a. This response has been scored by circling the values ("1" on the Risk-Taking dimension; "1" on the Alcohol dimension) on the Scoring Key that appear opposite response 8.a. Note that for Item 9, the driver has indicated that he has changed jobs more than two times in the last three years, but since that factor does not indicate a potential driver problem for this accident liability class (males under 20), no values have been assigned--thus, no values are circled for that response.

3. After all the responses have been scored by circling the appropriate values, add the circled values in each column of the Scoring Key to obtain a total score for each assessment dimension. As indicated on page 4-19, Exhibit 4-1, the sample driver accumulated scores on the Risk-Taking, Recognition, and Alcohol dimensions of 25, 6, and 14 respectively.

---

[2] A set of scoring keys is provided for all other accident liability classes in Appendix

EXHIBIT 4-1: SAMPLE DRIVER PROFILE AND COMPLETED SCORING KEY FOR A MALE DRIVER UNDER 20 YEARS OF AGE

Form A

Align with arrow on Scoring Key →

DRIVER PROFILE

DATE __ __/ __ __/ __ __

NAME _____

DRIVER LICENSE NUMBER _____

AGE: Driver less than 20. . . [✓]
Driver 20-29 . . . . . [ ]
Driver 30-59 . . . . . [ ]
Driver over 60 . . . . . [ ]

SEX: Male . . . . . [✓]
Female . . . . . [ ]

DRIVER RECORD INFORMATION: (If records unavailable, this information can be obtained from driver.)

1. Number of moving violations during last three years: 2
   If 2 or more, check . . . . . [✓]

2. Type of violations: (Check all that apply)

a. Speeding	1 violation	[ ]
	2 or more	[✓]
b. Right-of-way	1 violation	[✓]
	2 or more	[ ]
c. Signs, signals and markings.	1 violation	[ ]
	2 or more	[ ]
d. Major (DWI, reckless driving).	1 violation	[ ]
	2 or more	[ ]

Align with arrow on Scoring Key →

← Align with arrow on Driver Profile

SCORING KEY--DRIVER PROFILE

(Males Under 20)

DATE __ __/__ __/__ __

NAME _____

DRIVER LICENSE NUMBER _____

[✓] Driver less than 20
[ ] Driver 20-29
[ ] Driver 30-59
[ ] Driver over 60

[✓] Male
[ ] Female

	RISK-TAKING	RECOGNITION	ALCOHOL
1.	(1)	(1)	(1)
2.			
a.	3		1
	(4)		(2)
b.	(3)	(1)	
	4	2	
c.	3	1	
	4	2	
d.	2		2
	3		3

← Align with arrow on Driver Profile

→

e. All others (excluding equipment) . . . . 1 violation [ ]
2 or more [ ]

3. If driver has been put on probation or has had his license suspended or revoked by the Department of Motor Vehicles in the last three years, check . . . . . [ ]

4. If any of the above Motor Vehicle Department actions were related to a conviction for driving while intoxicated, check . . . . . [ ]

5. Number of reported accidents in the last three years (regardless of "at-fault") 1 . If 1 accident, check. . . . . [✓]
If 2 or more accidents, check . . . . . [ ]

	RISK-TAKING	RECOGNITION	ALCOHOL
e.	1	1	1
	2	2	2
3.	2	1	1
4.			4
5.	(1)	(1)	(1)
	2	2	2

DATE __ __/ __ __/ __ __

NAME _____

PERSONAL INFORMATION:

6. Please indicate your marital status by checking the appropriate box:

   a. Married. . . . . [ ]
   b. Married, but recently separated. . . . . [ ]
   c. Divorced . . . . . [ ]
   d. Single (never been married). [✓]

7. Did you complete high school? . . . . . YES [ ]
   NO [✓]

8. Please indicate your occupation by checking the appropriate box:

   a. Unemployed . . . . . [✓]
   b. Skilled laborer/housewife. . [ ]
   c. Unskilled laborer/service worker . . . . . [ ]
   d. Professional/technical . . . [ ]
   e. Professional driver (cab, truck, delivery) . . . . . [ ]
   f. Student (half-time or more). [ ]

9. If you have changed jobs more than two times in the last three years, check. . . . . [✓]

10. If you smoke cigarettes, please indicate how many packs you smoke every day:

    a. Less than two packs. . . . . [✓]
    b. Two packs or more. . . . . [ ]

11. Please indicate the type of vehicle you drive most often:

    a. Passenger vehicle. . . . . [✓]
    b. Sportscar. . . . . [ ]
    c. Motorcycle . . . . . [ ]
    d. Truck/commercial vehicle . . [ ]

Form B

DATE __ __/__ __/__ __

NAME _____

	RISK-TAKING	RECOGNITION	ALCOHOL
6.			
a.	2		3
b.	2		2
c.	2		1
d.			
7.			
	2		1
8.			
a.	1		1
b.	1		
c.	1		
d.			
e.	1	1	
f.	1		
9.			
10.			
a.	1	1	1
b.	2	2	2
11.			
a.			
b.	2		
c.	2	1	
d.	1		

12. Do you own your own car? . . . . . YES [ ]
NO [✓]

13. Do you use seatbelts most of the time? . . . . . YES [✓]
NO [ ]

14. Do you like to drive for fun? . . . . . YES [✓]
NO [ ]

15. Do you feel that enforcement officers are too strict? . . . YES [✓]
NO [ ]

16. When you are upset or angry do you like to get in the car and take a ride in order to cool down? . . . . . YES [✓]
NO [ ]

17. Have you had any of the following problems lately? (Check as many as apply to you.)

a. Money worries. . . . . [✓]
b. Problems with your wife or girlfriend. . . . . [ ]
c. Problems on the job. . . . . [ ]
d. Problems with friends. . . . [✓]
e. Problems at school . . . . . [ ]

18. Have you been troubled with any of the following medical problems recently? (Check as many as apply to you.)

a. Loss of consciousness. . . . [ ]
b. Heart or circulatory problems . . . . . [ ]
c. Problem drinking . . . . . [ ]
d. Conditions affecting motor coordination . . . . . [ ]
e. Diabetes . . . . . [ ]
f. Vision problems. . . . . [ ]

* * * * * * * * * *

	RISK-TAKING	RECOGNITION	ALCOHOL
12.	1		
13.	1	1	
14.	2		
15.	2		
16.	3		
17.			
a.	1		
b.	1		
c.	1		
d.	1		
e.	1		
18.			
a.		1	
b.			
c.			3
d.		2	
e.			
f.			

IF YOU DRINK ALCOHOLIC BEVERAGES. . . . .

19. How often do you drink in the morning?

a. Often. . . . . [ ]
b. Once in a while. . . . . [ ]
c. Seldom . . . . . [✓]
d. Never. . . . . [ ]

20. Has your spouse or a close friend ever said anything about your drinking or been worried or upset about your health or money problems because of it?

a. Yes, many times. . . . . [ ]
b. Yes, sometimes . . . . . [ ]
c. Yes, but not very often. . . [ ]
d. No, never. . . . . [✓]

21. How often do you usually drive after drinking a couple of drinks of alcohol or three or more beers?

a. Daily. . . . . [ ]
b. Several times a week . . . . [ ]
c. About once a week. . . . . [✓]
d. Less than once every two weeks. . . . . [ ]
e. 5 or 6 times a year or less. [ ]
f. Never. . . . . [ ]

* * * * * * * * * * *

22. About how many miles do you drive every day, on the average?

a. More than 100 miles. . . . . [ ]
b. 70 - 100 miles . . . . . [ ]
c. 40 - 70 miles. . . . . [ ]
d. 15 - 40 miles. . . . . [✓]
e. Less than 15 miles . . . . . [ ]

	RISK-TAKING	RECOGNITION	ALCOHOL
19.			
a.			3
b.			2
c.			(1)
d.			
20.			
a.			3
b.			2
c.			1
d.			
21.			
a.			5
b.			4
c.			(3)
d.			2
e.			1
f.			
22.			
a.	4	4	4
b.	3	3	3
c.	2	2	2
d.	(1)	(1)	(1)
e.			

23. Please check as many of the following statements as you think are true about your own driving. (Check as many as apply to you.)

a. I don't have any problems with my driving and I'm a better driver than most people . . . . . [ ]

b. I've been in a hurry a lot lately and haven't been paying as much attention to my driving as I should . . . . . [ ]

c. Everybody makes mistakes sometimes--I've just been unlucky enough to get caught. . . . . [✓]

d. Sometimes I have to drive after I've had a couple of drinks. . . . . [✓]

e. I've had a lot of personal problems lately, and it's hard to concentrate on driving . . . . . [✓]

f. I've been having some medical problems that sometimes affect my driving . . . . . [ ]

g. I just need a little more experience behind the wheel . . . [✓]

h. I have trouble seeing other cars at intersections . . . . . [ ]

i. I have trouble making quick decisions in tight spots. . . . [ ]

[FOR ADMINISTRATIVE PURPOSES ONLY]

If you have ever received treatment or service from any of the following agencies, please indicate which one(s).

a. Department of Public Health. [ ]

b. Department of Mental Health. [ ]

c. Department of Alcoholism . . [ ]

d. Department of Rehabilitation [ ]

e. Referred to a physician by the Department of Motor Vehicles . . . . . [ ]

	RISK-TAKING	RECOGNITION	ALCOHOL
23.			
a.	1		
b.	1		
c.	(1)		
d.			(1)
e.	(1)		(1)
f.			
g.		(1)	
h.		1	
i.	1		
TOTAL	Sum of Points: 25	Sum of Points: 6	Sum of Points: 14

PROCEDURES FOR DETERMINING THE EXTENT OF A DRIVER PROBLEM

The next step in the assessment process is to determine whether these scores are indicative of a driver problem. Exhibit 4-2 presents a sample Driver Problem Assessment Guide[3] which has been marked to indicate the extent of the driver problem based on the scores obtained for the fictitious male driver referred to in Exhibit 4-1. Reference to Exhibit 4-2 shows that our sample driver has a major Risk-Taking problem, no problem indicated for Recognition, and a slight problem on the Alcohol dimension.

OPTIONS FOR FURTHER ASSESSMENT/COUNTERMEASURE ASSIGNMENT

Once the extent of the driver problem has been determined there are two possible courses of action. If the resources, facilities and personnel are available within a jurisdiction, the driver may be referred to another agency for more in-depth diagnosis of his problem as discussed in the next section of this Chapter. If these resources are not available, the driver may be assigned a countermeasure based upon the extent of the problem indicated.

Exhibit 4-3 presents a sample Countermeasure Assignment Guide. A chart similar to Exhibit 4-3 could be developed by an operational assessor to correspond with the legal and operational requirements of the particular jurisdiction.

OPTIONS FOR IN-DEPTH DIAGNOSIS

There are numerous possibilities for conducting in-depth diagnostic assessment. As previously stated, the degree to which further diagnosis is feasible depends mainly on the resources, facilities, and personnel available within a particular jurisdiction. An attempt was made to select representation assessment techniques/variables for inclusion in the Driver Profile. However, there are situations where more in-depth diagnosis would appear useful. For example, a driver having a high score on the Alcohol dimension may be referred to another agency for in-depth diagnosis to determine the extent of his alcohol problem (since most driver control/enforcement systems are not currently equipped to conduct intensive assessment of driver problems), as well as to provide the most appropriate treatment alternative. Through support

[3] As stated in Chapter 3, the Driver Problem Assessment Guide provides cutoff scores associated with each driver problem dimension for a particular accident liability class.

EXHIBIT 4-2. DRIVER PROBLEM ASSESSMENT GUIDE
(Males Under 20)

	RISK-TAKING	RECOGNITION	ALCOHOL
AVERAGE	Score: Less than 10 points	Score: Less than 10 points	Score: Less than 10 points
SLIGHT PROBLEM	Score: 10-20 points	Score: 10-15 points	Score: 10-20 points
MAJOR PROBLEM	Score: Greater than 20 points	Score: Greater than 15 points	Score: Greater than 20 points

EXHIBIT 4-3. SAMPLE COUNTERMEASURE ASSIGNMENT GUIDE

	RISK-TAKING	RECOGNITION	ALCOHOL
AVERAGE	No Action	No Action	No Action
SLIGHT PROBLEM	Warning Letter	Pamphlet on driving tips	Pamphlet and discussion with assessor
MAJOR PROBLEM	Suspension	Re-examination by licensing agency	Alcoholism clinic and restricted license

of NHTSA demonstration projects, some in-depth investigation and/or treatment programs have been conducted both in judicial (primarily probation referral) and driver improvement settings. In other jurisdictions, certain in-depth diagnostic options are frequently at the disposal of the assessor. The following paragraphs discuss some of these options in general terms for each of the problem assessment dimensions posed in the model.

RECOGNITION PROBLEMS

The general class, Recognition Problems, includes a wide array of specific problem areas, such as inexperience with driving, habitual inattention, vision deficiency, etc. More in-depth assessment has some potential to provide this more specific diagnosis. The driver's age and sex (accident liability class) may suggest the specific type of driver problem, but, as indicated in the state-of-the-art review, this level of generalization reflects only general trends, and is seldom useful on an individual basis. A critical review of in-depth diagnostic techniques revealed that, for the most part, further research is required to establish scientifically acceptable reliability and validity of these techniques. The selection of techniques for further assessment should be based on the following criteria: (1) quality of research methodology employing these techniques (reliability and validity studies); and (2) techniques which appear to be administratively feasible as an adjunct to operational assessment.

Some experimental studies have addressed recognition from a perceptual point of view (search, detect, identify, etc.), but none of the techniques have yet demonstrated high operational utility. Other studies have looked at the total performance of the driver in a simulated situation to measure the overall psycho-physical characteristics of the driver. The results of these studies have been highly qualified, and the element of driver compensation for certain deficiencies adds further complexity to generalizations about the relationship of deficiencies and driving behaviors. Therefore, these kinds of in-depth testing of driver problems cannot be considered highly operational based on the assessment literature review. Several research projects are currently in progress to address the scientific validity and operational feasibility of such in-depth approaches (e.g., vision, perceptual style). Until more conclusive evidence supporting their use is presented, the recommendations for in-depth testing will be confined to approaches commonly available in current operating systems. For practical purposes, diagnostic approaches to recognition errors can be described as a function of:

- Vision problems - e.g., acuity, glare recovery
- Skill level - includes perceptual style and coordination of internal/external events as well as simply inexperience.

It is important to emphasize that there are apparently many additional specific sub-factors, and interactions of sub-factors, which at present cannot be feasibly assessed. For example, a perceptual problem (assuming adequate visual capability) may be due to a lack of experience in perceiving relationships in the driving environment. The source of the problem for an experienced driver may be due to inattention relating to psychological factors (inattention due to stress) or a more basic deficiency in perceptual style, regardless of experience. Practical referral options for further assessment of recognition errors are identified below.

	In-depth Diagnostic Techniques	Referral Assessor
Vision Problems	- Comprehensive vision examination (e.g., acuity, dynamic visual acuity, glare recovery)	• Licensing Agency • Ophthalmologist • Optometrist
Skill Level	- On-road driving test	• License re-examination • Driver education

ALCOHOL RELATED ERRORS

In-depth diagnostic applications for drinking problem identification have been extensive in recent years. Diagnostic approaches have been most widely used in Alcohol Safety Action Projects (ASAP's). There is little comparative data on the differential utility of the instruments used for problem drinker assessment, nor does the current data strongly support the ability of these techniques to predict alcohol-related crashes. However, the research has demonstrated some utility for identifying the extent of a drinking problem, which in turn may be useful for selecting appropriate treatment programs.

Perhaps the most comprehensive in-depth approach to alcohol problem assessment has been the pre-sentence investigation, usually conducted by a court probation department or driver improvement analyst in a driver licensing agency. These investigations generally include administration of an objective inventory (e.g., Mortimer-Filkins, MAST), interview with the client's family, friends, and employer, as well as supporting data from alcohol treatment agencies (i.e., Level II). In-depth options for alcohol problem identification include:

In-depth Assessment Techniques	Referral Assessors
Administration of standardized assessment instrument	• Probation Department, or
Standardized interview	• Driver improvement analyst, or
Interview family, friends, and employer	• Mental Health Alcohol Center.

RISK-TAKING BEHAVIOR

Risk-taking behaviors as outlined in the Driver Profile are implied by driver errors such as speeding, improper passing, and reckless driving. One area of in-depth assessment for individuals demonstrating these types of errors is the assessment of psycho-social adjustment. Several psychological and attitude instruments are currently available for assessing "high-risk" attitudes. However, based on the current research literature, the application of these instruments can only be recommended on an experimental basis, rather than operational, due to the high costs associated with administration, and the need for further instrument refinement. In-depth options for risk-taking behavior assessment include:

In-depth Assessment Techniques	Referral Assessors
Driver specific inventories (e.g., California Inventory of Driver Attitudes and Opinions, Driver Attitude Survey, Safe Driver Inventory, etc.)	• Probation Department, or • Driver improvement analyst, or • Psychologist, or
General personality (e.g., MMPI)	• Mental Health Agency.

Chapter 5

STATE REQUIREMENTS FOR IMPLEMENTATION AND VALIDATION OF DIAGNOSTIC ASSESSMENT TECHNIQUES

With adequate resources, diagnostic assessment of driving problems can be implemented in any driver control setting. All state licensing agencies currently have the potential to conduct diagnostic assessment. Diagnostic assessment evaluation, however, imposes rather rigid requirements which all operational settings cannot easily meet. This section will describe diagnostic assessment system requirements and identify system problems which can interfere with effective diagnostic assessment evaluation.

Driver problem assessment can be conducted in either a court or a driver licensing agency setting. In a court setting, assessment is most cost-effectively conducted after conviction and prior to sentencing. In a licensing agency setting, assessment can be conducted during any personal appearance by the driver. Here again, application to drivers who have already been defined by current standards as "negligent" would be more cost-effective. Of course, for research purposes, there are many reasons to justify the assessment of a more broadly-based general driving population (e.g., license and renewal applicants). However, for the immediate implementation and validation of the assessment model, the device can be administered to a more limited population of drivers who have come to the attention of authorities either through a single or repeated traffic conviction. For this purpose, administration of the device will be virtually the same in either the court or driver licensing setting, so that the remaining discussion will not distinguish between the two. In either case, the setting selected must meet certain criteria. The following section will discuss the criteria for implementation and evaluation of a diagnostic assessment system.

DATA INFORMATION SYSTEMS

Rapid access to individual driver records will be required for both assessment and evaluation. As a result, the availability of a computerized system with data access terminals at locations of both assessment and evaluation becomes a necessity. A computer system should also be available to conduct the complex statistical analyses for validation. This need not be the same computer system that stores driver records. Systems with appropriate software to conduct the analysis could be sought at universities, private firms, etc. Additionally, while the quality of driver records in all states is commonly low, the records available and the sites selected should at a minimum be free of inordinate delays, such as delay between time of conviction and time of entry into a licensing central file.

ADMINISTRATIVE STAFF AND RESEARCH PERSONNEL

The device does not require administration by professional staff. Thus clerical personnel may be utilized for administration and scoring. Time required will be approximately 7-16 minutes per subject, depending upon volume and scheduling. Professional staff will be required to monitor the administration, scoring, and data storage, as well as to plan and conduct the final evaluation. This could be expected to require a minimum of one full-time professional research person and an assistant.

ADEQUATE FLOW OF SUBJECTS

Since a large number of subjects will be required for adequate evaluation, assessment should be conducted in a centralized location where large numbers of drivers are available. Decentralization would pose numerous problems, including coordination of efforts, increased costs, and integration of data.

Although specific sample size requirements will be discussed with the evaluation plans in Chapter 6, a minimum of 10,000 subjects would be required in a one-year period to properly evaluate the assessment system.

COORDINATION OF PARTICIPATING AGENCIES

Activities of licensing agency and courts should be coordinated. A clear delineation of responsibility for offenders must be established. If the licensing agency takes mandatory action and suspends or revokes a driver's license, this action may be counter-productive to assessment and treatment in the courts, or vise versa.

RECEIPT OF ACCURATE AND TIMELY DRIVER RECORDS

This appears to be a major obstacle in current systems. Often accurate information is not reflected in driver record data, due to plea bargaining or data system failures. Accuracy often varies by the type of driver error. DWI citations are more often reduced to a lesser charge, such as reckless driving or speeding, than other types of violations. Mandatory actions also influence accuracy of data. Severe mandatory action policies under administration of the licensing agencies can influence the courts and enforcement personnel alike to avoid issuing appropriate citations for observed driving errors, and to reduce charges, or even dismiss cases on technicalities. In some cases, violations are dismissed as a condition of the defendent attending a court-sponsored traffic school. There have been instances cited where "wholesale" dismissals have taken place in the court. Obviously, any of the above conditions severely limit the usefulness of driving records as an assessment tool, since they do not reflect accurate information.

There are several time lag problems in receiving information which also limit its usefulness for diagnosis. The significance of accidents or convictions for diagnostic assessment may be lost after long delays. For example, Finkelstein and McGuire (1971) found that in California time lags occurring during some 20 different motor vehicle actions ranged from 11 to 213 days. The delays were primarily due to reporting and scheduling problems.

The courts are often dependent on timely information from the licensing agency to perform assessment prior to sentencing. The unavailability of records is often due to the remoteness of courts from the central record system, or poor recordkeeping procedures. Most time lags can be easily rectified, once the source of delay is identified and priority given to transmitting information.

RECEPTIVITY OF POTENTIAL ASSESSMENT INNOVATIVE PROGRAMS

Innovative programs often meet with resistence from personnel who have been employing more traditional means (e.g., hearings, licensing, mandatory policies, etc.). New programs seem to pose an initial threat, whether they simply represent a transfer of manual files to computer-operated files or represent a complete restructuring of current licensing procedure. The phenomenon is certainly not unique to the traffic enforcement/control system, but it is a real world problem which can reduce the utility of any diagnostic assessment approach at the outset. Retraining of personnel, and experience with the program, can often alleviate these problems.

SUMMARY

A driver assessment program in one system cannot have an impact on the total problem if its effects are eroded by other systems. The chain of events leading to diagnosis of problems and countermeasures must be consistent, and lead to common objectives and goals among different agencies. Driver problem diagnosis can only be improved through coordinated efforts by enforcement, courts, and the licensing agency to improve information systems (accuracy and timeliness) and to adopt common objectives for diagnosis and treatment.

System changes to improve information flow are essential to driver problem diagnosis. The records necessary to evaluate and predict efforts must be uniformally processed and retrievable.

In summary, the minimum state requirements to conduct an effective evaluation of a diagnostic assessment system include:

- Adequate Data Information Systems
- Adequate Administration and Research Personnel

- Adequate Flow of Subjects.
- Reduced time lags from conviction and accident reports to central agency file.
- Accurate reporting of conviction and accidents.
- Coordination of cooperating agencies.
- Receptivity of agencies
- Legislative support for evaluation, e.g., control groups.
- Public informed of diagnostic procedure.

A separate contract is currently in Progress which should allow comparison of state capability to meet many of the above criteria (DOT-HS-4-00967, State Driver Improvement Analysis, Public Systems, Inc.).

Chapter 6

EVALUATION PLAN FOR VALIDATION OF THE DIAGNOSTIC ASSESSMENT MODEL

A prototype assessment model was developed in response to the question, "What can operational assessors do now to identify driver problems?" The model includes those diagnostic variables which presently appear most promising within all levels of observation and conceptual areas.

Evaluation of the model diagnostic system will require the application of assessment approaches in an operational setting. Both reliability and validity (concurrent and predictive) evaluations of the assessment technique will be required. These will necessitate the collection of detailed follow-up information on driver errors (not only on total accidents); as well as accurate severity and cost data, to help identify cost-effective applications. Because of the requirement for detailed follow-up data, very large samples and lengthy follow-up periods will be required to obtain stable criterion estimates. This chapter presents a plan for the conduct of these evaluations.

The objectives of this evaluation plan are to provide answers to the following key questions:

(1) Can driver problems be assessed with a relatively high degree of reliability?

(2) To what extent do driver problems relate to future accident liability and driver errors?

(3) Is diagnostic assessment cost-effective?

(4) Is diagnostic assessment more cost-effective for only certain sub-populations?

To answer these questions, an evaluation should include (1) a pilot study, and (2) a major study with both concurrent and predictive phases.

CONDUCTING A PILOT STUDY

A pilot study is almost essential to provide information necessary to plan an efficient large scale evaluation study, as well as to increase the potential for a quality evaluation. While the sample size of the pilot study will not meet all statistical power requirements

for reliable accident prediction (since accidents are very rare events), the sample will be adequate to refine preliminary research plans, obtain accurate estimates of sample size requirements, and develop reliable test instruments and procedures for implementation in the larger-scale study. These objectives can be accomplished by following the basic steps outlined below.

SELECT THE SAMPLE

A sample of approximately 500 subjects should be randomly selected. By general research standards this would be considered an inordinately large sample for a pilot study, but it is necessary to select at least this many subjects to conduct preliminary evaluations using driving record criteria (e.g., accidents). It will be necessary to sample over an extended time frame, since 500 subjects would usually not be available at one time. While selecting the sample, it is important to record the number of subjects generated each day (or week) so that sample expectations for the larger study can be projected. Any other problems associated with sample selection should be noted for future planning purposes. Data recorded during the pilot study should answer these questions: What are the personnel and time requirements to process subjects? When are the peak periods (certain times of the day, week, or year)? Should selection criteria be modified to handle current case volume?

COLLECT AND PROCESS DATA

Subjects selected for the pilot study will be administered the Driver Profile. Completion time, reaction of subjects, and other pertinent information should be recorded during administration of the Driver Profile. This information will be useful for planning the larger study and for modifying the test instruments, if necessary. (It is recommended that optional items be added to the Driver Profile to increase reliability of the instrument. Optional items and references to complete test batteries are provided in Appendix A. The selection of additional items or test instruments is predicated on the amount of funds and resources available.)

Once the data have been collected, responses to the Driver Profile questionnaire can be entered into a computer storage system for later analyses (e.g., keypunch, optical scan procedures, etc.). Driver record information will be obtained from the central licensing agency file for all subjects tested. License number and other identifying information should be collected so that records can be matched. All data should be edited to insure accuracy of coding and keypunching (e.g., verification, range checks, logical checks).

DATA ANALYSIS

Analysis of the pilot test data should address three basic questions: (1) What is a driver problem (preliminary estimate)? (2) What is the reliability of test instruments? Is there a need for refinement? (3) What are the sample size requirements for implementation of the major study?

Driver problems can be defined as high-risk driving behaviors and their determinants. Driving behaviors can be measured through past accident involvement and through other detected errors (e.g., citations, convictions). Determinants are included as part of the driver problem definition since they further describe the problem, as well as frequently suggest treatment approaches. The predicted outcome of a driver problem, once identified, is future involvement in accidents and associated societal costs.

Data analysis should follow the three steps outlined below.

Step 1. Analyze prior record data to identify driver behaviors.

- Factor analyze all driver behavior data to determine if errors form a taxonomy. That is, can the available descriptors of drivers (e.g., conviction types, accident descriptions) be regrouped into dimensions described by factor analyses (e.g., recognition, risk-taking, or alcohol).

Step 2. Analyze Driver Profile to identify determinants of high-risk behaviors.

- Conduct reliability analyses of assessment techniques (items) including internal consistency measures of conceptual domains (complete tests, scales, or groups of similar items).

- Determine test-retest reliability. It is recommended that a small sample be selected for retesting (N = 100) to measure temporal consistency (optional).

- In conjuction with item analysis, submit data to factor analysis to clarify dimensions and structure of assessment domains.

- Interview subjects (small sample) to gain insight into clarity of items, test procedures, and subjects' reactions to Driver Profile.

- Discard poor items and/or improve unreliable items. Add items to increase reliability as necessary (some additional items are provided in Appendix A).

Step 3. Identify driver problem dimensions.

- Merge data file for driver behavior (Step 1) with data file for determinants (Step 2).[1]

- Factor analyze integrated file to identify driver problem dimensions (ignoring factors that do not contain driver behavior elements).

The completion of these three steps should result in a correlation (factor loading) between driver determinants (e.g., evidence of a drinking problem) and driver behavior (e.g., DWI conviction) to complete the definition of a driver problem.

A driver problem dimension should contain three classess of variables: (a) driver behaviors (prior convictions and accident-related errors); (b) diagnostic assessment dimensions or determinants (e.g., alcohol problem, emotional instability, vision problem); and (c) biographical characteristics of the driver (e.g., age, sex) Classess (a) and (b) are sufficient to identify a driver problem (e.g., emotional driving, extroversion, speeding errors might be a label applied to one problem). Biographical data might also lead directly to a description of a driver problem. However, the primary distinction is that biographical variables can be considered non-modifiable, and thus are of no utility in a driver problem description, since they do not clarify treatment alternatives. For example, a driver problem defined as "emotional-speeding" may suggest treatments such as psychological counseling or restricted drivers license. Defining the problem as "male--or female--emotional-speeding" adds little to the diagnosis.

These biographical variables are useful for determining interactions that may occur in the data, as well as clarifying the structure of driver problem domains. Age, sex, and marital status of the driver have been found to be the most useful biographical variables for this purpose. The research plan should provide for the inclusion of these variables, to examine the interactions of Driver Profile items among various sub-groups. This will allow verification or modification of the seven liability classes provided as a part of the model assessment system.

Factor analysis is useful for determining how certain variables group together (e.g., determinants and driver behavior). Cluster analysis will be useful for determining the number and types of people

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[1] Driver record and driver profile data could be submitted to factor analysis at the outset without resorting to separate analyses. However, separate analyses and refined scaling procedures before submittal would be expected to result in more reliable and "cleaner" dimensions.

with different driver problems because homogeneous grouping will result. The information thus gained will be used for planning the larger study --magnitude of the problem typologies, utility of assessment dimensions, and reliability of dimensions--and finally, will eventually be useful for countermeasure development.

In summary, the results of these analyses will provide the following:

- Reliability estimates for the instruments;
- Relationship of instruments to driving record (driver problem dimensions); and
- A profile of driver problems (cluster analysis).

CONCURRENT AND PREDICTIVE EVALUATION

The major evaluation of diagnostic assessment techniques will have two distinct phases. The first phase, essentially a repetition of the analyses presented in the pilot study, will be referred to as the "Concurrent Phase." The second phase will be concerned with the collection and analysis of follow-up data, and will be referred to as the "Predictive Phase."

CONCURRENT PHASE

Select the Sample

Characteristics of the pilot sample will be useful for determining sample size requirements for the major study. However, the pilot sample need not be used for estimating accident frequencies for different time periods. This information may already be available in statistical reports, and often is already broken down by biographical variables. If these data are not available, either an accident distribution should be obtained from the pilot study sample, or similar accident distributions can be generated randomly from the license file. Once sample parameters (means, variances) have been obtained, the sample size requirement of the larger study can be computed.

The information gained above can be used not only for sample size estimation, but also for planning potential problem driver groups (magnitude of the problem), potential countermeasure requirements and costs, operational systems planning, logistics, and budgeting.

There are several practical and technical issues to be considered in sample size selection. Practical issues relate to the potential for obtaining an adequate number of subjects within a specified time frame. The cost of data collection imposes another practical constraint. The technical issues relate to the sensitivity of measures employed, distributions of data, scales of measurement, and the determination of appropriate statistical techniques.

Sample size estimates proposed in this section are based upon the primary criterion of concern--traffic accidents. This criterion was selected for determining sample size because it is of critical importance in driver problem assessment. In addition, since accidents are very unreliable events, any sample that is adequate to measure accidents reliably is generally adequate to obtain reliable estimates on other variables.

Because accident criteria are extremely unreliable, large samples are required to obtain reliable estimates for the diagnostic assessment phases. The estimates are based on statistical parameters obtained from other research studies (means, variances, correlations). The population estimates for accidents are slightly above those for the average driving population, since potential candidates for assessment might be expected to have higher accident rates than the general driving population. Larger samples than those indicated in this section would be required if estimates were based on the average driving population.

The sample size will be based on some administrative decisions. Recommended confidence levels and expectations of difference are listed below:

	Suggested Levels
1. Type I error	$P < .05$
2. Type II error	$P < .20$
3. Differences in accident criteria which can reasonably be expected	10 - 5%
4. Magnitude of relationship which may be useful	$r = .10$

The evaluator will then refer to tabled values in most statistics texts, (e.g., Jacob Cohen, 1969) to determine samples required. Various general statistical formuli could also be used to compute sample sizes.

Sample size estimates as outlined in Table 6-1 serve as a guide for approximating the magnitude of the study. In addition to the application of a statistical formula for estimating sample sizes, empirical results from previous studies were useful in developing these sample estimates. Factors taken into account in past empirical studies included expectation of change of relationships (difference which can reasonably be expected), and shrinkage of multi-variate coefficients when submitted to cross-validation (attenuation).

Data Collection

Data collection and analysis procedures are the same as those discussed for the pilot study. The selection procedures and logistics should already have been established. In fact, in the event that major changes in instruments and procedures did not occur, pilot subjects could be used as part of the larger scale study.

TABLE 6-1. SAMPLE SIZE ESTIMATES AND PLAN

Study Phase	Sample Function and Criteria	Sample Size
A. PILOT STUDY Sample size refinement analysis for specific test site (optional)	• Sample driver records from central file • Sample population similar to projected study population • Generate population distributions • Reliability analysis • Administrative procedures and logistics • Test construction/ improvement • Select final test battery	• Sample size = 500
B. LARGE-SCALE STUDY • Concurrent Validation • Diagnostic Assessment Evaluation (driver problem analysis)	• Administer tests • Conduct reliability analysis • Develop driver problem factors • Develop scoring keys • Cross-validate	• Sample size = 10,000 [a)b)] • Split sample for cross-validation 5,000/5,000 [c)]
• Predictive Validation (one year follow-up)	• Construct and predictive validity of driver problems • Reliability analysis • Prediction of outcomes (accidents, injuries, dollar damage)	• Sample size = initial sample; 10,000 retested (attrition approximately 20%

a) Sample estimates based on power analysis using accident criteria (Cohen, 1969).

b) Need for increased samples beyond tabled values (formula) based on shrinkage found in empirical studies (e.g., Marsh and Hubert, 1974; Harano, 1974)

c) Estimates doubled to meet cross-validation requirements and to improve power for accident types as criteria, e.g., alcohol-related accidents. The utilization of low frequency accident types as criteria will increase power requirements.

Analysis of Data

The concurrent analysis of the major study will be the same as those conducted in the pilot study. The steps are summarized below:

1. Correlate driver records and test instruments to define a driver problem (factor analysis).

2. Conduct reliability analyses.

3. Submit factors to cluster analysis to identify homogeneous sub-populations of drivers.

Additional analyses might include the development of a refined scoring system (e.g., regression weights) for items included in the Driver Profile. A cut-off point (problem level score) on dimensions resulting from the driver problem analysis could also be established, replacing the subjective estimates posed in the diagnostic assessment model.

Summary

The results of the concurrent phase will provide reliable estimates of the magnitude of driver problems as defined by assessment techniques and driver behaviors, and on the degree of relationship between assessment techniques and driver behavior. The reliability analysis will provide further insight into the usefulness of assessment techniques. Finally, subjective item weights and cut-off criteria posed in the model can be replaced by empirical estimates derived from this phase. Of course, both the driver problem dimension (e.g., risk-taking, alcohol, or recognition) may be modified, as well as can the items in the Driver Profile.

PREDICTIVE PHASE

The predictive phase will determine the ultimate utility of the diagnostic assessment approaches. The objectives of this research step are (1) to verify accuracy of predictive assessment with follow-up accident data; (2) to determine the societal costs of driver problems in terms of future accidents, costs, injuries, and fatalities; and (3) to obtain follow-up data to verify the initial problem diagnoses. The first two of these objectives can be accomplished simply by examining follow-up accident records of all drivers assessed.

The third objective could be considered optional, since the accuracy of the assessment system for predicting accidents has already been determined. Verification of initial problem diagnosis would

only be essential in the context of specific countermeasure programs. This phase is accomplished by repeating the sequence of steps posed initially for the identification of driver problems, to independently verify the structure of driver problems. Initial dimensions and scoring procedures can also be validated on follow-up criteria.

Data Collection

Obtain follow-up accident records for each driver assessed. These records should contain descriptive information on types of driving errors that have occured, and on severity of accidents (i.e., extent of property damage, injuries, fatalities).

To verify initial problem diagnosis, request drivers initially diagnosed to return for re-testing. At a minimum, a one year lapse from original diagnosis would be required. It will be necessary to contact subjects and request that they participate in follow-up testing. Participation can be expected to be somewhat low (60 - 70%, at best) if participation is voluntary. (Participation might improve if a requirement for re-testing became one condition of sentencing.) The mechanism for enlisting participation will depend on several factors, including resources, reaction of the public, and legal constraints within a particular jurisdiction.

Information might also be obtained from secondary sources (e.g., mental health agencies, alcohol treatment agencies, etc.). However, the collection of this information is subject to several constraints. (See Chapter 2 of Volume I of this report.) The ease of collection will depend on resources, cooperation among social agencies, and other legal and administrative considerations.

Data Analysis

Conduct correlational analysis to determine the extent to which previous problems (diagnosis) can predict future problems. Specific statistical techniques might include factor analysis, multiple regression and multiple discriminant function analysis (see Appendix D). Further refinement could be achieved by recording any intervening events that modify a problem (e.g., corrective lenses, alcohol treatment). Such analyses taking these factors into account would be conducted.

The specific statistical technique to be used in these analyses will depend on the results of the concurrent analysis, and also the preference of the data analyst. Therefore, general operations, rather than specific techniques will be described below.

1. Correlate driver problem dimensions from concurrent phase with driver problem dimensions obtained in the predictive phase.[2]

2. The driver problem dimensions from the predictive phase should contain similar assessment techniques, or, at a minimum, similar constructs. New dimensions may emerge from separate analyses of follow-up data. However, the focus of this research step is to answer the question of the accuracy of initial diagnosis in predicting future driver problems.

3. Determine cut-off scores which optimize classification of drivers into driver problem categories (false positives/ false negatives).

4. Determine quantitative weights (e.g., regression) to be assigned for assessment techniques (items); both differential weights for driver problem classes and assessment technique items.

The ultimate criteria for validating the utility of diagnostic assessment are costs to society and the individual. Several suggested measures include total accidents, cost of accidents, and severity of accidents. Such detailed information must be collected in the intervening one-year period for all applicable study subjects. Ideally the information collected should be more detailed than current reporting standards so that refined analyses can be accomplished. It should include:

- Detailed description of driver errors.
- Dollar damage to subject's vehicle, other vehicle(s) and property.
- Severity of accident-injury.
- Cost of diagnostic assessment (personnel, other resources).

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[2] The approach discussed here at first glance appears to represent traditional test-retest reliability. However, the assumption of "constancy" over time (upon which the concept of reliability is based) cannot be totally supported. The authors prefer to view the problem as a validity (content) issue.

The validated problem categories (individual scores on a dimension) can then be used to predict the above criteria. An index combining costs and severity could also be used as a criterion. Multivariate correlational analysis (e.g., canonical, regression and discriminant function analysis) would be used to determine the extent to which problem driver groups incur differential societal costs. The results of the analysis will prove useful for determining the way in which future diagnostic efforts will be most cost-effective. The basic elements for determining cost effectiveness include: (1) degree to which driver problems are related to future accident involvement; (2) the relative societal costs of specific driver problems; and (3) magnitude of the population exhibiting a particular problem.

A LONG-TERM PLAN FOR INTEGRATION OF DIAGNOSTIC APPROACHES AND COUNTERMEASURES

An objective of driver problem diagnosis is the implementation of effective treatments to modify driver problems.[3] These "treatments" also eventually require evaluation. Since the evaluation plan in this chapter proposes a very large effort, it may be useful to examine the overlap between evaluations of diagnosis and evaluations of treatments. This section will therefore briefly discuss the possibilities for combining these evaluations.

As an extension of analyses posed for diagnostic assessment evaluation, controlled experimentation (combining the efforts of diagnosis and treatment of problems to form "tailored treatment" approaches) is an extremely powerful approach to answering several questions simultaneously:

1. To what extent can certain driver problems be modified?

2. What types of problems are modifiable (e.g., behavior modification) and what types are not? Those problems which are not amenable to modification may require system changes (e.g., provisions for transportation, sanctions to reduce driving exposure).

3. What diagnostic and countermeasure methods are most cost-effective?

Figure 6-1 presented in a literature review of driver improvement programs by Public Systems inc. (1975), outlines the evaluation steps for tailored-treatment approaches. The plan for accomplishing steps (a), (b), and (c) has already been discussed in this chapter. The remaining items in the Figure (d - h) will be briefly discussed below.

(d) Evaluate Typology for Treatment Implications; and

(e) Develop Tailored Treatments.

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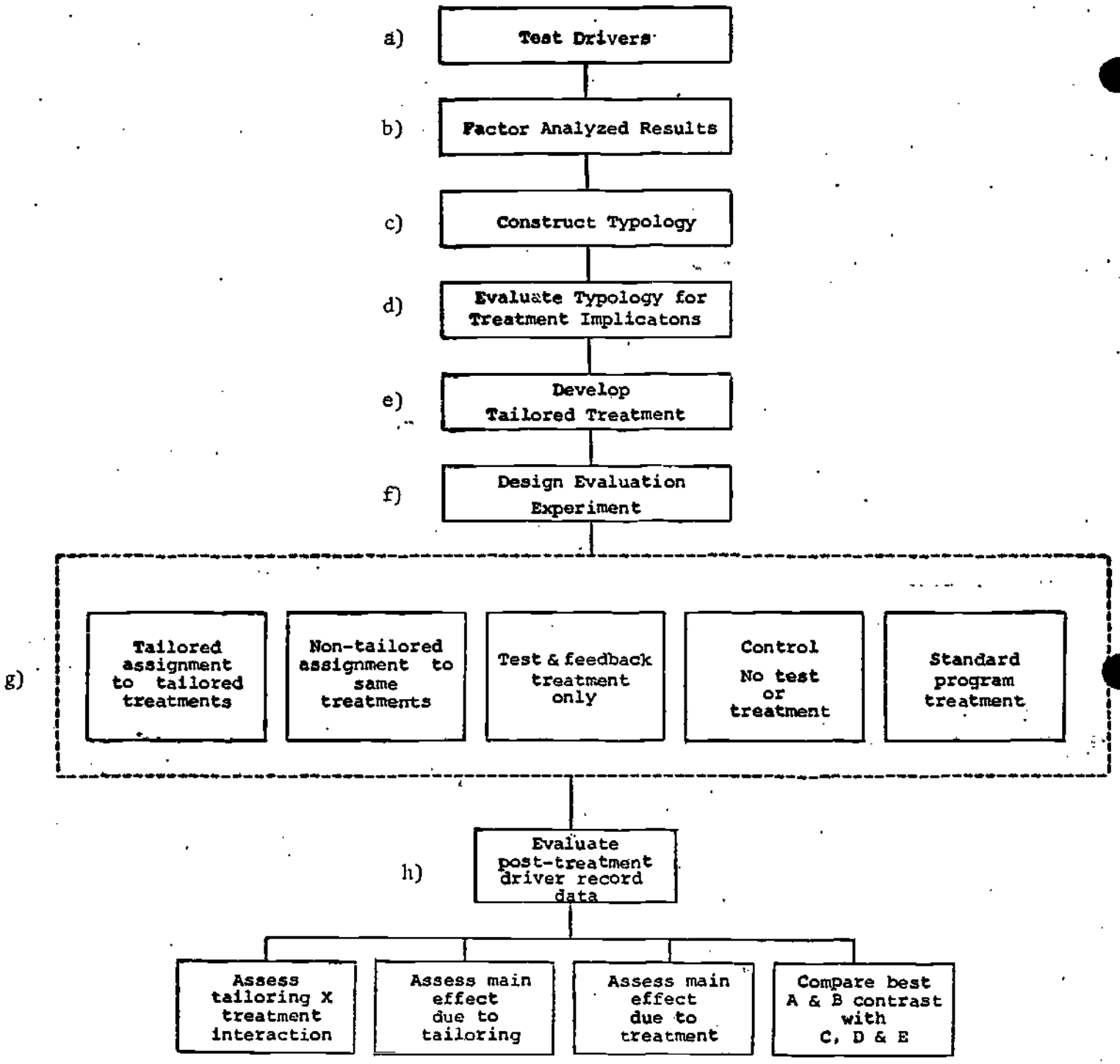
[3] "Treatments" are frequently countermeasure programs. Other administrative actions (e.g., sanctions) may also be imposed. For our purposes, both administrative actions and countermeasure programs will be referred to as treatments.



Source: State Driver Improvement Analysis Report on Driver Improvement Literature Review (Public Systems, inc., 1975)

FIGURE 6-1. DEVELOPMENT AND EVALUATION OF A TAILORED TREATMENT PROGRAM

To accomplish these tasks, the driver problem types should be examined to determine appropriate treatments. The treatments may include behavior modification approaches, sanctions to reduce high-risk exposure (e.g., occupational license), restricted licenses, or driver training for inexperienced drivers.

(f) Design Evaluation Experiment; and

(g) Assign Drivers to Study Groups

Item (g) describes possible experimental and control options for assignment of drivers. To the extent of resources available, the design should include the following groups for comparison purposes.

- Pure Control. Drivers do not receive diagnostic assessment or treatment.
- Limited Controls. Drivers diagnosed but not treated, to examine the effects of diagnosis.
- General Driver Improvement. All drivers with problems identified are referred to general "standard" safety program.
- Assignment to Tailored Treatments. Treatments are tailored to specific driver problems.
- Random Assignment to Tailored Treatments.

Each of these groups is necessary to examine all effects of diagnoses, all treatment program effects, and the effects of all combinations of diagnosis and treatment. The final selection of study groups must be based on the number of driver problem groups and treatment options, sample size requirements, and operational constraints which may limit the complexity of the research design.

(h) Evaluate Post-Treatment Driver Record Data.

Evaluation of the design entails the random assignment and comparison of various treatment groups with appropriate control groups using follow-up driving criteria. "Controls" would be used to evaluate the diagnostic assessment design discussed earlier, since the effects of treatment would not influence the validity estimates (other uncontrolled factors would, of course). "Controls" would also be used to measure the cost-effectiveness of the diagnostic -treatment process.

In summary, the evaluation posed in Figure 6-1, Item (h) will answer the following questions:

- Is a tailored treatment approach (diagnosis and treatment) more effective than providing a "general countermeasure" to all drivers regardless of the specific problem?
- Is treatment (tailored or general) more effective than no countermeasure at all?
- Which driver problems are more amenable to treatment? Which are not?
- Does diagnosis (testing) have any impact on subsequent driving behavior?

Additionally, the cost vs. benefits of the assessment-treatment process should also be examined. The combined costs of assessment and treatment can be easily computed. The societal costs of accidents avoided can then be examined by comparisons of "treated" vs. control groups to determine net benefit to society.

SUMMARY

The plan described above for the evaluation of diagnostic assessment techniques contains several essential elements. These include testing a large number of drivers using a Driver Profile, correlation of the Driver Profile responses and prior driving record to identify driver problem dimensions (multivariate analysis), collection of follow-up driver record information and driver problem data for the predictive phase of the evaluation, and validation of the driver problem dimensions by correlation of the initial diagnosis with future behaviors. The magnitude (impact) of a driver problem would be measured by follow-up information on accident costs and severity information.

The additional steps needed to incorporate countermeasures into the evaluation plan were also discussed. The utility of diagnostic assessment and countermeasures could be evaluated by this design, to determine societal gain or loss.

DEFINITION OF MODEL ASSESSMENT VARIABLES AND OPTIONS FOR ADDITIONAL ASSESSMENT

The Driver Profile contains 24 items, five of which can be obtained directly from a Driver Record (Form A). The remaining 19 items (Form B) contain representative items from conceptual areas found in the course of the state-of-the-art review to have some potential for diagnostic assessment of a driver problem. The objective of this section is to describe each assessment variable, identify sources of information, and finally offer additional items and/or standardized test instruments which could be used to increase the reliability of the Driver Profile. (Expansion of the Driver profile beyond the current 24 items is primarily recommended for research efforts, as discussed in Chapter 6.

PART A. DRIVER RECORD

1. Total Violations. Convictions for violations, excluding non-moving, parking or technical violations. A three-year prior record (including current conviction, if applicable) will define the performance period.

   Primary Source: Driver Record
   Secondary Source: Ask Subject

2. Type of Violations (Convictions). Due to the large number of vehicle code violations, general definitions of violation type will be given. A detailed coding scheme used in California for organizing violations is provided in Peck et al., 1971.

   a. Speed Violations. Citations include all speeding-related violations, such as exceeding speed limits, unsafe speed for conditions, speed contest and below minimum speed, impeding normal traffic flow.

   b. Right-of-Way Violations. Citations include all failures to yield to vehicles or pedestrians both at uncontrolled intersections or crosswalks.

   c. Signs, Signals and Marking Violations. Citations include failure to stop at signs, railroad crossings, flashing red lights, crossing double solid lines, passing school bus when red lights are flashing.

   d. Major Violations. Citations include hit and run, reckless driving, driving under the influence of alcohol, dangerous drugs, manslaughter.

e. All Others (excluding equipment or technical).

i. Turning, stopping and signalling. Improper position of left or right turns, U-turn violations, parking/stopping in unlawful locations, failure to heed required turn, turning without signalling; and

ii. Driving, Overtaking and Passing. Overtaking vehicle and passing without sufficient clearance, passing on wrong side, failure to obey directions of a traffic device on divided highway, passing too slowly.

3. Probation, Suspension or Revocation within Last Three Years. Includes any mandatory or discriminatory action(s) taken by the Department of Motor Vehicles (regulatory agency) for negligent driving: too many "points," implied consent (alcohol) or conviction for drinking when intoxicated. If action was taken for medical conditions, indicate source of problem on item 18 of the profile.

Primary Source: Driver Record

Secondary Source: Ask Subject

4. Conviction for Driving While Intoxicated (DWI). Any conviction related to alcohol use while driving.

Primary Source: Driver Record

Secondary Source: Ask Subject

More accurate information may be available by reference to citations. Convictions for reckless driving and in some cases "speeding" may originate from DWI citations.

Optional Items. If available, BAC level may improve assessment of drinking problem. This item could be added to assessment model with BAC levels indicating increasing problems. For example:

BAC .10 - .15 = slight problem

BAC .15 - .25 = problem indicated

BAC .25+ = major problem

Source: Police citation and/or lab report on BAC level

5. Total Number of Accidents During Last Three Years. Record all reportable accidents (property damage and injury/fatal accidents). If information obtained from the driver ask for reportable accidents only (specific dollar damage e.g., above $200).

Primary Source: Driver Record

Secondary Source: Ask Subject

PART B. PERSONAL INFORMATION

6. Marital Status. Record current marital status. Combine divorced, separated. If the event occurred more than a year ago, check (c). If recent change (negative event) within last 6 months--divorced/ separated, check (b).

Primary Source: Ask Subject

Secondary Source: Driver Record, Local divorce court--file for divorce, legal separation

7. Completion of High School. Useful as socio-economic indicator.

Primary Source: Ask subject

Item can be expanded to include all levels of education:

_____ Less than 8 years
_____ Less than 12 years
_____ Completed high school
_____ Some college
_____ College graduate
_____ Post graduate

8. Occupation. Categories in model represent rather broad groupings of occupational categories. Representative occupation for categories are provided below.

a. Unemployed--current status

b. Skilled laborer--mechanic, carpenter, plumber, welder, electrician

c. Unskilled laborer/service workers--service station attendant, general construction laborer, farm worker

d. Professional/technical/manager--physician, lawyer, computer programmer, sales manager

e. Professional driver. A major aspect of the job required driving (truck, cab, delivery)

f. Student. Although driver may have part-time jobs classify as student if attending school half to full time.

Primary Source: Ask Driver

9. Number of Job Changes in Last Three Years. Regardless of positive or negative change, code number of job changes in past three years. Change from student, unemployed status to job considered change.

Primary Source: Ask Driver

10. Smoking Cigarettes. Item has shown to be a predictor of accident liability. Explanations range from psychological concepts such as overdependency, a measure of individual stress to simple distraction while driving an automobile.

Primary Source: Ask Driver

11. Type of Vehicle Driven Most Often. Type of vehicle driver suggests exposure (e.g., commercial/truck drivers), possibly attitudes (e.g., racy sportscars) and risk-taking (motorcycle). Categories appear to be sufficient and research does not strongly support finer breakdowns.

Primary Source: Ask Driver

Secondary Source: Registration and/or license file, but may be more difficult to obtain than simply asking the driver.

12. Vehicle Ownership. Research has shown that vehicle ownership is a predictor of accident liability for young drivers. Owners have higher accident liability (increased exposure).

Optional Items. In addition to vehicle type, vehicle accessories and attitudes toward car are useful predictors, especially for younger drivers:

- Would you like to drive a rebuilt car in a race?
- Do you spend a lot of time working on your car?

- What kind of accessories do you have on your car?

Several additional items can be found in more complete test instruments:

- Driver Attitude Survey (DAS) Schuster and Guilford (1962)
- California Inventory of Driver Attitudes (CIDAO), Harano et al (1973)
- High-Risk Driver Questionnaire, Selzer et al (1974)
- Safe Driver Inventory, McGuire (1956)

13. Seatbelt Usage. Usage of seatbelts is a measure of "safety-consciousness." Usage may result in both better control of vehicle and lower severity of accidents.

- Do you use seat belts all the time?
- Do you use seat belts just on long trips?
- Do you think you are a safer driver if you use seat belts?

Optional Instruments.

Driver Attitude Survey (DAS) Schuster and Guilford (1962)

California Inventory of Driver Attitudes (CIDAO), Harano et al (1973)

Safe Driver Inventory, McGuire (1956)

Primary Source: Ask Driver

14. Do You Like to Drive for Fun? Research has shown that drivers who use the vehicle or driving to express emotions and feeling have higher accident involvement.

Optional Items.

- Do you drive to think about a problem?
- Do you get a feeling of freedom when you drive?
- I get a feeling of power when I drive.
- I get more fun out of driving a car than any other activity.

- I like to put extras on my car to attract attention.

Optional Test Instruments.

- Driver Attitude Survey (DAS) Schuster and Guilford (1962)
- California Inventory of Driver Attitudes (CIDAO), Harano et al (1973)
- Safe Driver Inventory (1956)

Source: Ask Driver or administer test instrument

15. Do You Feel That Enforcement Officers Are Too Strict? Hostility toward authority in general and specifically toward enforcement officers are indicators of high accident risk and traffic violations.

Optional Items.

- Society should not have the right to question the way I drive.
- Police officers are rougher on teenagers than adults.
- Young people are much better drivers than older people (authority).
- Police officers are unfair.
- I didn't deserve the traffic ticket.
- I have always hated regulations.

Optional Test Instruments.

- Driver Attitude Survey (DAS) Schuster and Guilford (1962)
- California Inventory of Driver Attitudes (CIDAO), Harano et al
- Safe Driver Inventory (McGuire, 1956)
- High-Risk Driver Questionnaire, Selzer et al (1974) - Total questionnaire 204 items

Source: Ask Driver or Administer test instrument

16. When You Are Upset or Angry, Do You Like to Get in the Car and Take a Ride to Cool Down?

Optional Items.

- Do you drive to blow off steam after an argument?
- Do you often sound your horn when another driver is going too slow?
- Does driving help you calm down when you are tense?

Optional Instruments.

- Driver Attitude Survey (DAS) Schuster and Guilford (1962)
- Safe Driver Inventory. McGuire (1956)
- California Inventory of Driver Attitudes (CIDAO), Harano et al (1973)

17. General Problems. Situational stress in a variety of areas tend to increase accident liabilities. Also, items are related to problem drinking and drinking and driving. "General Problems" includes such categories as financial problems, marital and family problems, problems on the job or at school, problems with health and problems with friends or neighbors. Several inventories add more comprehensive coverage of life stresses and provde greater detail. Below are sample items from the more complete inventories.

Optional Items:

- How often are you worried that you will never be able to catch up financially? (MAST; Selzer, 1971)
- How often are you concerned about not making as much money as you need or want to? (MAST)
- How many times have you and your wife seriously considered divorce in the last two years? (M-F; Mortimer et al., 1971)
- How often do you have problems with your children that make you seriously angry? (MAST)
- How is your general health? (M-F)
- How good do you think your work is at your present job?
- Have you had occasional trouble with work? (M-F)

- How many large debts do you have? (M-F)
- Do you feel that your life is difficult to manage and you are not sure how to straighten it out? (M-F)
- As compared to two years ago, are you experiencing much more tension and stress?

Optional Instruments. General stress items can be found in the following test instruments:

- Mortimer-Filkins (HSRI Test). Court Procedures for Identifying Problem Drinkers (Mortimer et al, 1971)
- Michigan Alcohol Screening Test (MAST). Selzer (1971)
- High-Risk Driver Questionnaire. Selzer et al (1974)
- Life Activities Inventory. Human Factors Laboratory, 1974. Contract No. DOT-HS-350-3-707
- Information and Attitude Survey (Drinking Problem). Didenko et al., 1972.

Primary Source: Ask Driver

Secondary Source: Other Social Agencies

19. How Often Do You Drink in the morning? Drinking in the morning may be symptomatic of a drinking problem. Frequency of drinking, preference for certain types of alcoholic beverages and frequency of drinking/binge drinking, etc. Optional test instruments are identified after Item 21.

Optional Items.

- How often do you usually drink beer (or liquor or wine)? (Perrine, 1974)
- How much beer do you usually drink at one time? (Perrine, 1974)
- Drinking seems to ease personal problems (M-F)
- A drink or two gives me energy to get started (M-F)

20. Has Your Spouse or a Close Friend Ever Said Anything About Your Drinking or Been Worried or Upset about Your Health or Money Because of Drinking?

- Have you ever lost your job because of drinking?
- Do you feel that drinking is causing any problems in your life?
- Has anyone ever mentioned that you will ruin your health because of drinking?

21. How Often Do You Usually Drive after Drinking a Couple of Drinks of Liquor or Three or More Beers?

Optional Items.

- In the past year, how many times have you drunk more than you could handle, but still been a good driver when you got behind the wheel? (M-F)
- During the past year, how often (three point scale) have you driven after having had something to drink? (Perrine, 1974)

Optional Test Instruments for Items 18, 19, 20, and 21.

- Mortimer-Filkins (HSRI Test). Court Procedures for Identifying Problem Drinkers (Mortimer et al., 1971).
- Michigan Alcohol Screening Test (MAST). Selzer (1971)
- High-Risk Driver Questionnaire. Selzer et al (1974).
- Life Activities Inventory. Human Factors Laboratory, 1974. Contract No. DOT-HS-350-3-707
- Information and Attitude Survey (Drinking Problem). Didenko et al, 1972.

Primary Source: Ask Driver

Secondary Source: Other social agencies

22. About How Many Miles Do You Drive Every Day on the Average? There are several different units for measuring both quantitative and qualitative exposure. All estimates are subject to a high degree of error.

- How many miles do you drive per year?
- How many miles do you drive per week?
- How many miles do you drive per month?

- How many miles do you drive per weekend?
- How many hours do you drive per day?
- What per cent of time do you drive after dusk?, midnight?

Optional Instruments. Most driver inventories contain some exposure variables. They are usually not included in the test instrument itself, but are presented in a separate questionnaire.

- See study listing Exposure Variables (Harano et al, 1973).
- See study on measures of exposure (House and Waller, 1971; Burg, 1973)
- Information and Attitude Survey (Drinking Problem). Didenko et al, 1972.

Primary Source: Ask Driver

23. Driver Self Analysis. Contains assorted items dealing with self perception of driving problems. Items lead directly to a self-analysis of problems. No additional items recommended since several have already been addressed in other items.

Optional Test Instruments.

- Driver Attitude Survey (DAS), Schuster and Guilford (1962).
- California Inventory of Driver Attitudes (CIDAO). Harano et al (1973).
- Information and Attitude Survey (Drinking Problem). Didenko et al., 1972.
- Safe Driver Inventory (McGuire, 1956).

24. Treatment or Services from Other Agencies. Affirmative responses may indicate a problem area, especially items (c) alcohol, and (e) medical problem. The source of a problem(s) may emerge from initial diagnosis. The operational assessor may be able to obtain additional information from other agencies and/or refer the individual to such an agency for further diagnosis and/or treatment. The following list, adapted from Filkins et al (1973), describes treatment needs. The operational assessor should identify specific agencies (in his community) which may relate to a specific problem.

TREATMENT NEEDS (Check one or more as needed)	TREATMENT AGENCIES
____Further Diagnosis	_____
____Alcoholism Treatment	_____
____Alcohol Education	_____
____Mental Health Care	_____
____Family Counseling	_____
____Marriage Counseling	_____
____Financial Guidance	_____
____Job Training	_____
____Employment	_____
____Living Arrangements	_____
____Legal Aid	_____
____Driver Re-Training	_____
____Doctor Care	_____
____Physical Therapy	_____
____Other	_____

Primary Source: Ask Driver

Secondary Source: Other Agency

USEFUL MEASURES/TECHNIQUES FOR DRIVER ASSESSMENT BY LEVEL OF OBSERVATION*

I

** Total Convictions
** Moving Convictions
** Equipment Convictions
** Sign, Signals and Marking Convictions
** Right-of-way Convictions
** Reckless Driving Convictions
** Driving While Intoxicated Convictions
** Speeding Convictions
** Prior Accidents (Injury, Property Damage)
Turning and Stopping Convictions
** Prior Driver Improvement Actions-- (Warning Letter, Suspensions, Revocations)

Area of Residence
Failure to Appear
License Restriction
Number of Attempts to Pass Driving Test
License Class
** Age
** Marital Status
** Sex
Years Driving
Make and Year of Car
Vision Testing
** Motor Vehicle Ownership
** Medical Conditions

II

BAC Level at Arrest
Court Abstracts (Amount of Fine, Deviation from Speed Limit)
Socio-Economic Status
** Occupation
** Education
Criminal Convictions
Unemployment

Divorce Court Abstracts
Prior Alcoholism Treatment
Prior Drug Treatment
Medical Information--Physician/Agency
School Grades
** Contact with other Agencies (e.g., Mental Health, Public Health, Alcoholism Treatment)

III

Performance

Perceptual style (Imbedded Figures Test)
Complex Reaction Time

Biographical

** Job Changes
Social Activities (involving automobiles)

General Social Activities
** Amount of Cigarette Smoking
** Financial Problems
** Marital Problems (divorce, separation, arguments)
Family Stress
Occupational Stress
** Problems with Friends
** Problems at School
Grades in School
Activities at School

* The list contains items and techniques which demonstrate some utility for accident liability prediction. They are presented here for consideration in future research. Items with (**) were selected for the diagnostic assessment model.

Biographical (Continued)

Outdoor Activities
Socio-Economic Status (income prestige)
** School Drop-Out
Unemployment

Psychological Factors

** Attitudes Toward Authority
Non-Conformity
Emotional Stability Measures
Self-rating on Assertiveness/aggressiveness
Over-Confidence
Intolerance and Impatience
Hostility Measures
Self-report "Older drivers drive too slowly"
** Drive to "think about a problem"
** Drive to "blow off steam"
** Drive "for fun"
Drive to "get away from people"
Drives recklessly too often
Car races frequently
Seat Belt Usage
** Preference for High Performance Cars
Accessories on Car

Instruments:

General

Minnesota Counseling Inventory (MCI)
Sixteen Factors Personality Inventory (16F)
Minnesota Multiphasic Personality Inventory (MMPI)
Gordon Personal Profile (GPP)
Extroversion/Introversion--Eysenck/Maudsley

Driver Specific Inventories

** Driver Attitude Survey (DAS)
** Mann Inventory
** California Inventory of Driver Attitudes and Opinions (CIDAO)
** Safe Driver Inventory

Alcohol Factors

Number of Drinks Consumed per Sitting
** Prequency of Beer/Liquor Consumption
Problem with Parents/In-Laws
Physical Stresses
Poor Physical Health
Disability
Previous Arrests
Poor Drinking Controls
Physical and Psychological Dependence on Liquor
Marital Problems
** Family Problems
Poor Work History
** Amount of Drinking and Driving
Problems at School
Binge Drinking
Belligerence Associated with Drinking

Instruments (Alcohol Factors):

Michigan Alcohol Screening Test (MAST)
Mortimer-Filkins (M-F)
Driver Attitudes Survey (DAS) - alcohol scale
Vermont Driver Profile
Life Activities Inventory

Exposure Factors

** Mileage (annual, monthly, weekly, daily)
Number of long trips
Number of short trips
Hours Driven (Job, Pleasure)
Nighttime Driving (%, hours)
Rush-Hour Driving (%, hours)
Combined Indices of Exposure

Form A

← Align with arrow on Driver Profile

SCORING KEY--DRIVER PROFILE
Females less than 20

DATE __ __/__ __/__ __

NAME _____

DRIVER LICENSE NUMBER _____

[X] Driver less than 20
[ ] Driver 20-29
[ ] Driver 30-59
[ ] Driver over 60

[ ] Male
[X] Female

	RISK-TAKING	RECOGNITION	ALCOHOL
1.	1	1	1
2.			
a.	3	-	2
	4	-	3
b.	-	3	-
	-	4	-
c.	-	3	-
	-	4	-
d.	2	-	2
	3	-	3

← Align with arrow on Driver Profile

	RISK-TAKING	RECOGNITION	ALCOHOL
e.	1/2	1/2	1/2
3.	2	1	1
4.	-	-	4
5.	1/2	1/2	1/2

Form B

DATE __/__/__

NAME _____

	RISK-TAKING	RECOGNITION	ALCOHOL
6.			
a.	-	-	-
b.	1	1	2
c.	1	1	1
d.	-	1	1
7.			
	-	-	-
	1	-	1
8.			
a.	-	1	-
b.	-	1	-
c.	-	1	-
d.	-	-	-
e.	1	1	-
f.	-	1	-
9.	-	-	-
10.			
a.	1	1	1
b.	2	2	2
11.			
a.	-	-	-
b.	2	-	-
c.	2	1	-
d.	1	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
12.	1	-	-
	-	1	-
13.	-	-	-
	1	1	-
14.	1	2	-
	-	-	-
15.	2	-	-
	-	-	-
16.	2	2	-
	-	-	-
17.			
a.	1	1	-
b.	1	1	-
c.	1	1	-
d.	1	1	-
e.	1	1	-
18.			
a.	-	1	-
b.	-	-	-
c.	-	-	3
d.	-	2	-
e.	-	-	-
f.	-	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
19.			
a.	-	-	3
b.	-	-	2
c.	-	-	1
d.	-	-	-
20.			
a.	-	-	3
b.	-	-	2
c.	-	-	1
d.	-	-	-
21.			
a.	-	-	5
b.	-	-	4
c.	-	-	3
d.	-	-	2
e.	-	-	1
f.	-	-	-
22.			
a.	4	4	4
b.	3	3	3
c.	2	2	2
d.	1	1	1
e.	-	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
23.			
a.	1	1	-
b.	1	1	-
c.	1	1	-
d.	-	-	1
e.	1	1	-
f.	-	1	-
g.	-	1	-
h.	-	1	-
i.	-	1	-
TOTAL	Sum of Points: _____	Sum of Points: _____	Sum of Points: _____

← Align with arrow on Driver Profile

SCORING KEY--DRIVER PROFILE
Females 20-29, 30-59

DATE __ __/__ __/__ __

NAME _____

DRIVER LICENSE NUMBER _____

[ ] Driver less than 20
[x] Driver 20-29
[x] Driver 30-59
[ ] Driver over 60

[ ] Male
[x] Female

	RISK-TAKING	RECOGNITION	ALCOHOL
1.	1	1	1
2.			
a.	2	-	2
	3	-	3
b.	-	3	-
	-	4	-
c.	-	3	-
	-	4	-
d.	2	-	2
	3	-	3

← Align with arrow on Driver Profile

	RISK-TAKING	RECOGNITION	ALCOHOL
e.	1/2	1/2	1/2
3.	3	1	4
4.	-	-	-
5.	1	1	1
	2	2	2

Form B

DATE __ __/__ __/__ __

NAME _____

	RISK-TAKING	RECOGNITION	ALCOHOL
6.			
a.	-	-	-
b.	1	1	3
c.	1	1	2
d.	1	1	1
7.	-	-	-
	1	-	1
8.			
a.	-	2	1
b.	-	1	1
c.	-	2	1
d.	-	-	-
e.	1	1	-
f.	-	1	-
9.	-	1	1
10.			
a.	1	1	1
b.	2	2	2
11.			
a.	-	-	-
b.	1	-	-
c.	1	1	-
d.	1	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
12.	-	-	-
	1	1	-
13.	-	-	-
	-	1	-
14.	1	1	-
	-	-	-
15.	1	-	-
	-	-	-
16.	1	2	-
	-	-	-
17.			
a.	-	1	-
b.	-	1	-
c.	-	1	-
d.	-	1	-
e.	-	-	-
18.			
a.	-	1	-
b.	-	-	-
c.	-	-	3
d.	-	2	-
e.	-	-	-
f.	-	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
19.			
a.	-	-	3
b.	-	-	2
c.	-	-	1
d.	-	-	-
20.			
a.	-	-	3
b.	-	-	2
c.	-	-	1
d.	-	-	-
21.			
a.	-	-	5
b.	-	-	4
c.	-	-	3
d.	-	-	2
e.	-	-	1
f.			
22.			
a.	4	4	4
b.	3	3	3
c.	2	2	2
d.	1	1	1
e.	-	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
23.			
a.	1	1	-
b.	1	1	-
c.	1	1	-
d.	-	-	1
e.	1	1	-
f.	-	1	-
g.	-	1	-
h.	-	2	-
i.	-	1	-
TOTAL	Sum of Points: ____	Sum of Points: ____	Sum of Points: ____

← Align with arrow on Driver Profile

SCORING KEY--DRIVER PROFILE
Males 20-29

DATE __ __/__ __/__ __

NAME _____

DRIVER LICENSE NUMBER _____

[ ] Driver less than 20
[x] Driver 20-29
[ ] Driver 30-59
[ ] Driver over 60

[x] Male
[ ] Female

	RISK-TAKING	RECOGNITION	ALCOHOL
1.	1	1	1
2.			
a.	3	-	1
	4	-	2
b.	3	-	-
	4	-	-
c.	3	-	-
	4	-	-
d.	2	-	2
	3	-	3

← Align with arrow on Driver Profile

←

	RISK-TAKING	RECOGNITION	ALCOHOL
e.	1 / 2	1 / 2	1 / 2
3.	2	1	1
4.	-	-	4
5.	1 / 2	1 / 2	1 / 2

Form B

DATE __ __/__ __/__ __

NAME _____

	RISK-TAKING	RECOGNITION	ALCOHOL
6.			
a.	-	-	-
b.	2	-	3
c.	2	-	2
d.	2	-	2
7.	-	-	-
	1	-	1
8.			
a.	2	-	2
b.	1	-	1
c.	2	-	3
d.	-	-	-
e.	1	1	-
f.	1	-	-
9.	1	-	1
10.			
a.	1	-	1
b.	2	-	2
11.			
a.	-	-	-
b.	1	-	-
c.	1	-	-
d.	1	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
12.	-	-	-
	-	-	-
13.	-	-	-
	1	1	-
14.	1	-	-
	-	-	-
15.	1	-	1
	-	-	-
16.	2	1	1
	-	-	-
17.			
a.	1	-	1
b.	1	-	1
c.	1	-	1
d.	1	-	1
e.	-	-	-
18.			
a.	-	1	-
b.	-	1	-
c.	-	-	3
d.	-	2	-
e.	-	-	-
f.	-	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
19.			
a.	-	-	3
b.	-	-	2
c.	-	-	1
d.	-	-	-
20.			
a.	-	-	3
b.	-	-	2
c.	-	-	1
d.	-	-	-
21.			
a.	-	-	5
b.	-	-	4
c.	-	-	3
d.	-	-	2
e.	-	-	1
f.			
22.			
a.	4	4	4
b.	3	3	3
c.	2	2	2
d.	1	1	1
e.	-	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
23.			
a.	1	-	-
b.	1	-	-
c.	1	-	-
d.	-	-	1
e.	1	-	1
f.	-	-	-
g.	-	1	-
h.	-	1	-
i.	1	-	-
TOTAL	Sum of Points: ____	Sum of Points: ____	Sum of Points: ____

← Align with arrow on Driver Profile

SCORING KEY--DRIVER PROFILE
Males 30-59

DATE __ __/__ __/__ __

NAME _____

DRIVER LICENSE NUMBER _____

[ ] Driver less than 20
[ ] Driver 20-29
[x] Driver 30-59
[ ] Driver over 60

[x] Male
[ ] Female

	RISK-TAKING	RECOGNITION	ALCOHOL
1.	1	1	1
2.			
a.	2	-	2
	3	-	3
b.	2	-	-
	3	-	-
c.	2	-	-
	3	-	-
d.	2	-	2
	3	-	3

← Align with arrow on Driver Profile

	RISK-TAKING	RECOGNITION	ALCOHOL
e.	1/2	1/2	1/2
3.	3	1	1
4.	-	-	4
5.	1	1	1
	2	2	2

Form B

DATE __/__/__

NAME _____

	RISK-TAKING	RECOGNITION	ALCOHOL
6.			
a.	-	-	-
b.	2	-	3
c.	2	-	2
d.	2	-	2
7.	-	-	-
	1	-	1
8.			
a.	2	-	3
b.	1	-	1
c.	3	-	3
d.	-	-	-
e.	1	1	-
f.	-	-	-
9.	2	-	2
10.			
a.	-	-	1
b.	-	-	2
11.			
a.	-	-	-
b.	1	-	-
c.	1	-	-
d.	1	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
12.	-	-	-
	-	-	1
13.	-	-	-
	1	1	-
14.	1	-	-
	-	-	-
15.	1	-	1
	-	-	-
16.	1	1	1
	-	-	-
17.			
a.	1	-	2
b.	1	-	2
c.	1	-	2
d.	1	-	2
e.	-	-	-
18.			
a.	-	1	-
b.	-	1	-
c.	-	-	3
d.	-	2	-
e.	-	-	1
f.	-	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
19.			
a.	-	-	3
b.	-	-	2
c.	-	-	1
d.	-	-	-
20.			
a.	-	-	3
b.	-	-	2
c.	-	-	1
d.	-	-	-
21.			
a.	-	-	5
b.	-	-	4
c.	-	-	3
d.	-	-	2
e.	-	-	1
f.			
22.			
a.	4	4	4
b.	3	3	3
c.	2	2	2
d.	1	1	1
e.	-	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
23.			
a.	1	-	-
b.	1	-	-
c.	1	-	-
d.	-	-	1
e.	1	-	-
f.	-	-	-
g.	-	1	-
h.	-	1	-
i.	1	-	-
TOTAL	Sum of Points: _____	Sum of Points: _____	Sum of Points: _____

← Align with arrow on Driver Profile

SCORING KEY--DRIVER PROFILE
Males & Females 60+

DATE __ __/__ __/__ __

NAME _____

DRIVER LICENSE NUMBER _____

[ ] Driver less than 20
[ ] Driver 20-29
[ ] Driver 30-59
[x] Driver over 60

[x] Male
[x] Female

	RISK-TAKING	RECOGNITION	ALCOHOL
1.	1	1	1
2.			
a.	-	1	1
	1	2	2
b.	-	3	-
	-	4	-
c.	-	3	-
	-	4	-
d.	2	-	2
	3	-	3

← Align with arrow on Driver Profile

←

	RISK-TAKING	RECOGNITION	ALCOHOL
e.	1/2	1/2	1/2
3.	3	1	1
4.	-	-	4
5.	1	1	1
	2	2	2

Form B

DATE __/__/__

NAME _____

	RISK-TAKING	RECOGNITION	ALCOHOL
6.			
a.	-	-	-
b.	-	-	2
c.	-	-	1
d.	-	-	1
7.	-	-	-
	-	-	-
8.			
a.	-	-	-
b.	-	-	-
c.	-	-	-
d.	-	-	-
e.	1	1	-
f.	-	-	-
9.	-	-	-
10.			
a.	-	1	-
b.	-	2	-
11.			
a.	-	-	-
b.	1	-	-
c.	1	1	-
d.	1	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
12.	-	-	-
	-	1	-
13.	-	-	-
	-	1	-
14.	-	-	-
	-	-	-
15.	-	-	-
	-	-	-
16.	-	3	-
	-	-	-
17.			
a.	-	1	-
b.	-	1	-
c.	-	1	-
d.	-	1	-
e.	-	-	-
18.			
a.	-	1	-
b.	-	1	-
c.	-	-	3
d.	-	2	-
e.	-	-	-
f.	-	1	-

	RISK-TAKING	RECOGNITION	ALCOHOL
19.	-	-	3
a.	-	-	2
b.	-	-	1
c.	-	-	-
d.			
20.			
a.	-	-	3
b.	-	-	2
c.	-	-	1
d.	-	-	-
21.			
a.	-	-	5
b.	-	-	4
c.	-	-	3
d.	-	-	2
e.	-	-	1
f.	-	-	-
22.			
a.	4	4	4
b.	3	3	3
c.	2	2	2
d.	1	1	1
e.	-	-	-

	RISK-TAKING	RECOGNITION	ALCOHOL
23.			
a.	1	1	-
b.	1	1	-
c.	1	1	-
d.	-	-	1
e.	1	1	-
f.	-	1	-
g.	-	1	-
h.	-	2	-
i.	-	2	-
TOTAL	Sum of Points: _____	Sum of Points: _____	Sum of Points: _____

DRIVER PROBLEM ASSESSMENT GUIDE

Females less than 20

	RISK-TAKING	RECOGNITION	ALCOHOL
AVERAGE	Score: less than 10 points	Score: less than 14 points	Score: less than 10 points
SLIGHT PROBLEM	Score: 10 to 20 points	Score: 14 to 22 points	Score: 10 to 20 points
MAJOR PROBLEM	Score: greater than 20 points	Score: greater than 22 points	Score: greater than 20 points

DRIVER PROBLEM ASSESSMENT GUIDE

Females 20-29, 30-59

	RISK-TAKING	RECOGNITION	ALCOHOL
AVERAGE	Score: less than 10 points	Score: less than 12 points	Score: less than 10 Points
SLIGHT PROBLEM	Score: 10 to 15 points	Score: 12 to 20 points	Score: 10 to 20 points
MAJOR PROBLEM	Score: greater than 15 points	Score: greater than 20 points	Score: greater than 20 points

DRIVER PROBLEM ASSESSMENT GUIDE

Males 20-29

	RISK-TAKING	RECOGNITION	ALCOHOL
AVERAGE	Score: less than 15 points	Score: less than 8 points	Score: less than 12 points
SLIGHT PROBLEM	Score: 15 to 25 points	Score: 8 to 14 points	Score: 12 to 20 points
MAJOR PROBLEM	Score: greater than 25 points	Score: greater than 14 points	Score: greater than 20 points

DRIVER PROBLEM ASSESSMENT GUIDE

Males 30-59

	RISK-TAKING	RECOGNITION	ALCOHOL
AVERAGE	Score: less than 15 points	Score: less than 6 points	Score: less than 15 points
SLIGHT PROBLEM	Score: 15 to 25 points	Score: 6 to 12 points	Score: 15 to 25 points
MAJOR PROBLEM	Score: greater than 25 points	Score: greater than 12 points	Score: greater than 25 points

DRIVER PROBLEM ASSESSMENT GUIDE

Males & Females Over 60

	RISK-TAKING	RECOGNITION	ALCOHOL
AVERAGE	Score: less than 8 points	Score: less than 15 points	Score: less than 10 points
SLIGHT PROBLEM	Score: 8 to 15 points	Score: 15 to 25 points	Score: 10 to 20 points
MAJOR PROBLEM	Score: greater than 15 points	Score: greater than 25 points	Score: greater than 20 points

GLOSSARY OF TECHNICAL TERMS

The specific multivariate statistical techniques to be used in analyzing the data will depend on availability of computer programs, assumptions underlying the distributions of data, and the preference of the analyst. For the non-technical reader a brief comment on techniques is provided.

FACTOR ANALYSIS. A mathematical procedure for objectively grouping entities (variables) on the basis of their similarities and differences. Similar variables are called factors or dimensions.

CLUSTER ANALYSIS. Factor analysis or factoring is only a subordinate part of cluster analysis. Cluster analysis is a procedure for grouping together objects (e.g., people) that have similar patterns of characteristics. These characterisitics may or may not result from factor scores.

MULTIPLE CLASSIFICATION ANALYSIS (MCA). A technique for examining the interrelationships between several predictor variables and a dependent variable within the context of an additive model (Andrews, F., Morgan, J., Sonquist, J. Survey Research Center, Institute for Social Research, The University of Michigan, Ann Arbor, Michigan, 1971).

DISCRIMINANT FUNCTION ANALYSIS. The results of the technique indicate the components (or variables) which best separate groups of people (e.g., accident vs. non-accident groups). Two or more criterion groups (e.g., different groups of driver problems) can be analyzed at the same time.

MULTIPLE REGRESSION. A method for examining the linear relationship of two or more predictor measures and a single criterion measure.

CANONICAL ANALYSIS. A method for examining the relationship or two or more predictor measures and two or more criterion measures.

CROSS VALIOATION. A method for verifying the reliability or validity of relationships. Although there are several statistical procedures, the primary method is to replicate results on an independent sample.

ATTENUATION. The reduction in a correlation between variables due to errors of measurement (low reliability).

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