FILE

IDENTIFICATION OF SPECIFIC PROBLEMS AND COUNTERMEASURES TARGETS FOR REDUCING ALCOHOL RELATED CASUALTIES

Kenneth Perchonok

DECEMBER 1975

FINAL REPORT

Document is available through
the National Technical Information Service,
Springfield, Virginia 22151

Prepared for:

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

Prepared for the Department of Transportation, National Highway Traffic Safety Administration under Contract No. DOT-HS-4-00945. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.

2. Government Accession No.

3. Recipient's Catalog No.

4. Title and Subtitle

Identification of Specific Problems and Countermeasures Targets for Reducing Alcohol Related Casualties

5. Report Date

December 1975

6. Performing Organization Code

7. Author(s)

Kenneth Perchonok

8. Performing Organization Report No.

ZS-5547-V-1

9. Performing Organization Name and Address

Calspan Corporation
4455 Genesee Street
Buffalo, New York 14221

10. Work Unit No.

11. Contract or Grant No.

DOT-HS-4-00945

13. Type of Report and Period Covered

Final Report

12. Sponsoring Agency Name and Address

U.S. Department of Transportation
National Highway Traffic Safety Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

Police reports of accidents were analyzed in terms of accident characteristics and driver behaviors to determine the problems of drinking drivers. Analyses were conducted to profile the culpable drinkers and to compare them to culpable non-drinkers in terms of the nature of the accident generation, accident situations, and driver characteristics. In addition, driver drinking status and culpability were studied in conjunction with driver accident and conviction records.

Major findings included extremely high culpability rates for drinkers, a propensity for drinkers to have accidents in low demand situations, an over-representation of the young among the drinkers (but no more so than among the non-drinkers), and a higher proportion of drinkers in accidents among drivers with previous drinking convictions.

Some initial suggestions for countermeasures ideas responsive to the accident types of drinkers were made.

17. Key Words

Alcohol Accidents; Accident Causes; Drinking Drivers, Driver Records, Countermeasure Targets

18. Distribution Statement

Document is available through the
National Technical Information Service
Springfield, Virginia 22151

19. Security Classif. (of this report)

None

20. Security Classif. (of this page)

None

21. No. of Pages

162

22. Price

Form DOT F 1700.7 (8-69)

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF TABLES (continued)

INTRODUCTION

The problem of the drinking driver has been recognized for over half a decade. During that time, the effects of alcohol on driving and accidents have been extensively studied. However, most of the studies of effects upon performance have been performed in the laboratory, and thus had questionable application in the real world. On the other hand, most accident studies have been limited to statistical measures of accident and injury frequencies and rates.

As a result, the generally held view is that drinking and driving is hazardous, and the major remedial effort has been to reduce the frequency of such occurrences. Much of this effort has been directed through the ASAP endeavors which have focused upon enforcement, rehabilitation, and public education.

In contrast, the goal of this study was to examine accident data in order to provide a more detailed description of the drinking driver problem and to delineate the needs for countermeasures. Specifically, this involved the investigation of (1) how the accidents occurred, (2) the driving situations in which they occurred, and (3) the characteristics of the drivers involved. Using these data, drinking accident drivers were profiled and compared to nondrinking accident drivers. In this way, determinations were made of the problems of drinking drivers, their special problems in comparison to normal drivers, and those conditions in which drinking drivers were a problem.

This report has been reviewed and is approved by:

Edwin A. Kidd

Edwin A. Kidd, Head
Transportation Safety Department

SUMMARY OF FINDINGS

Almost all findings were based on the study of culpable driver/vehicle units in accidents. The culpable unit is the one that initiated, or was responsible for, the accident sequence. By studying these drivers, the analyses focused on the driver who "caused" the accident.

Driver and Vehicle Characteristics

Driver Sex

90%

The vast majority of culpable drinking drivers were males; only ten percent were females. For culpable nondrinking drivers, only 73 percent were males; thus, there was an overrepresentation of males among the culpable drinkers.

male

Driver Age

Driver age effects were more complicated. Among the culpable drinking drivers, the 19 and 20 year old drivers were most highly represented. On the other hand, for normal culpable drivers, the most highly represented group was the 17 and 18 year olds. In fact, while the 19 and 20 year old drinkers had more accident generation problems than drinkers in other age groups, the young were a greater problem among the nondrinkers than among the drinkers. The age group which had the most drinkers extended from 21 to 55. As such, this broad age group contained, in absolute terms, far more drinkers in accidents than did the combined younger and older groups. They also had more DWI's* relative to HBD's** than did other age groups. For these reasons, drivers were divided into two age groups in other analyses: young - up to and including 20; old - 21 and older.

---

* DWI's: Drivers cited by the police for drinking/driving violations.

** HBD's: Drivers reported by the police to have been drinking, but no citation was issued.

Vehicle Type

Cars were compared to light trucks and heavy trucks in terms of culpable accident involvements. The most notable finding here was that drivers of heavy trucks represented only one-half of one percent of the drinkers as compared to five percent of the nondrinkers. In other terms, while 17 percent of the car drivers were drinkers, and 20 percent of the light truck drivers were drinkers, only two percent of the heavy truck drivers were drinkers.

Driver History

It was found that the proportion of drinkers in accidents increased with the number of previous accidents, the number of previous non-alcohol driving convictions, and the existence of at least one previous alcohol driving conviction. While eight percent of the accident drivers without previous convictions were reported as drinking in their accidents, for those with at least one previous alcohol driving conviction, fully 36 percent were drinking in their accidents.

It was also found that these previously convicted drivers were more often culpable in their accidents (38 percent for no convictions versus 56 percent for those with at least one alcohol driving conviction). Essentially all of this difference was accounted for by the fact that those with previous convictions were more likely to be drinking, and drinkers were more likely to be culpable. The culpability rate was uniformly low for nondrinkers irrespective of previous convictions, and uniformly high for drinkers irrespective of their previous convictions.

Accident Situations

Situational analyses showed drinkers, in comparison to nondrinkers, had a higher proportion of their accidents at night, on unlighted roads, in rural areas, on two-lane roads, on curves, on dry roads, and not at intersections. These results, then, showed the drinker to have had relatively more accidents than nondrinkers in situations characteristic of low traffic conflict, rural roads.

Culpability Analyses

The likelihood of being culpable, or initiating the accident sequence, was determined for drinkers and nondrinkers as a function of the situation in which the accidents occurred. For technical reasons, single and multivehicle accidents were analyzed separately. In all instances, the drinking drivers were more often culpable than the nondrinkers; this, by a wide margin. In fact, the culpability rate of the drinkers was so high that it overwhelmed all situational effects except one. (Drinkers were more often culpable on curves than on straight roads.) However, in comparing drinkers to nondrinkers in single vehicle accidents, a number of differences were found. The increase in culpability for drinkers was greater (1) on dry roads compared to wet, and wet roads compared to ice or snow covered roads; (2) on multilane versus two-lane roads; (3) on straight versus curved roads; and (4) in clear versus rainy weather. The basis for these effects was that some situations were less conducive than others to culpability among nondrinking drivers; but the drinking drivers received little or no benefit in them. That is, although for normal drivers, nonslippery road surfaces, multilane roads, straight roads, and clear weather were less conducive to culpable behaviors leading to accidents, the propensity toward culpable accident involvements by drinkers effectively wiped out these benefits.

Accident Characteristics

Class R Accidents

For drinking drivers, 42 percent of their accidents involved striking a stationary target (usually the road edge or a parked vehicle) located to the front but to the side of the vehicle's path. The subject vehicle left its path due to a lateral move as distinguished from an intended turn. Because most of these accidents were a ran-off-road type, they were referred to as class R accidents. The 42 percent for the drinking drivers can be contrasted to 18 percent for nondrinking drivers.

ran off road

These class R accidents accounted for the largest proportion of accidents for drinking drivers under 21 years old in rural areas (66 percent). Under similar circumstances, but considering only nighttime accidents, they accounted for 68 percent of the accidents. They were least frequent for drinkers among daytime urban accidents (18 percent), and accounted for only 25 percent of all urban drinking accidents.

More generally, the class R accidents accounted for a larger proportion of accidents for the young, for nighttime accidents, for rural versus suburban, and for suburban versus urban. Overall, there was little distinction between males and females in this regard.

While the young drivers in rural areas had the highest frequency of class R accidents relative to all drinking accidents, they did not have the largest absolute frequency of class R accidents. This is simply because most drivers were older than 20. Only 26 percent of the class R drinking accidents involved young drivers, the remainder involved drivers over 20. For them, 37 percent of the accidents were class R.

Thus, while the above discussion pertains to the problems of drinking drivers within specified conditions of age, sex, etc., they should also be viewed in absolute terms. In the analysis of 1,025 class R accidents for drinkers, 922 (90 percent) of the drivers were males, 884 (86 percent) occurred at night, 759 (74 percent) involved the older drivers, and 498 (49 percent) occurred on rural roads. Over half of them (56 percent) involved males over 20 at night. On the other hand, of these older male drinkers at night, only 39 percent of their accidents were class R types.

Rear End Accidents

The second most frequently occurring accident type for the drinkers was the rear end accident, in which the drinking driver continued a collision course into a slower or, more frequently, stopped car ahead. Fourteen percent of the culpable drinking drivers were involved in such accidents. For non-drinking culpable drivers, rear end accidents accounted for 18 percent of the total. This does not necessarily imply drinkers had a reduced propensity for rear end accidents, but to some extent reflects the dominance of class R accidents for the drinkers.

Among the culpable drinking drivers, the rear end accidents occurred more frequently for drivers over 20, during the day, and in urban and suburban areas. Males and females showed little difference in this regard. There were 259 daytime accidents for the older drinking drivers in urban and suburban areas. Of these, 61, or 24 percent, were rear end accidents. Although the proportion of rear end accidents was highest in these conditions, the preponderance of nighttime drinking was such that most rear end accidents involving drinking occurred at night. There were 81 daytime rear end accidents and 256 at night. Thus, while drinkers had a greater propensity for these accidents during the day, the greater problem in absolute terms existed at night.

Striking a Parked Vehicle in One's Path

Eight percent of the culpable drivers' accidents involved the vehicle continuing along its path and striking a parked vehicle. This accident type differs from those class R accidents which involved parked vehicles since the latter involved a lateral move to precipitate the accident. It differs from the rear end accidents in that they included collisions with stopped vehicles, but not parked ones. Thus, in the rear end accidents the subject vehicle and the vehicle struck were in a traffic lane; in the accidents discussed here, the subject vehicle was, at least in part, in a parking lane. The nondrinking drivers had only four percent of their accidents in this way.

For drinkers, these accidents constituted 14 percent of all their urban accidents. They were also somewhat more frequent for accidents involving older drivers, male drivers, and accidents occurring at night. When all four of these factors were present, there were 403 accidents; of them 73, or 18 percent, involved striking a parked car in the subject's path.

Moving Laterally to Strike an Oncoming Vehicle

The last accident type to account for more than five percent of the drinkers' accidents involved moving, as opposed to turning, into an adjacent lane and striking an oncoming vehicle; seven percent of the culpable drinkers were involved in this way. This accident type accounted for five percent of the culpable nondrinkers' accidents.

Relative to all accident types for drinking drivers, this type occurred most frequently for females, during the day, in suburban areas. However, only 14 accidents occurred when all three conditions were met; of these three involved this class of lane departure accident.

The Active-Passive Dimension

The analysis of nine types of accidents for culpable drinkers and nondrinkers showed that the two groups of drivers tended to have accidents which differed in a fundamental way. The drinkers had fewer of their accidents in situations where their attention was likely to have been drawn to the task at hand. More specifically, they tended to initiate relatively fewer accidents when a maneuver was planned (e.g., turning), there was prior activity (e.g., stopping), the situation inherently required increased caution (e.g. intersections), or some effort would have been required to avoid the accident. Briefly, the drinkers less often initiated accidents in conditions requiring their attention, and more often initiated accidents in nondemanding situations.

Drinkers & non-demanding situations

Considering these findings and those implying characteristically rural accidents for drinkers, the question was raised as to whether one of these two factors accounted for the other. An analysis of the proportion of drinking drivers in the various types of accidents in urban, suburban, and rural areas showed a greater representation of drinkers in suburban and rural areas for most accident types. On the other hand, accident type accounted for a much greater part of the variation in the proportion of drinkers than did location. Perhaps most importantly, the tendency for drinkers to be overrepresented in passive, low demand accidents was observed in all three types of locations, including urban areas.

Critical Reasons

The reasons for culpable drivers' activities leading to the accident can be difficult to assess with police reports. Thus, there were few findings which could be accepted with confidence; they are noted here. Culpable drinking primary causal factor

drivers were involved due to the failure to make necessary observations in 42 to 61 percent of their accidents. Primary control failures (failure to guide the vehicle where the driver wanted it to go) occurred in 15 to 21 percent of the drinkers' accidents. Induced control failures (those at least partly induced by slippery road surfaces) occurred in five to seven percent of the drinkers' accidents.

Primary control failures constituted approximately twice the proportion of critical reasons for drinkers versus nondrinkers. On the other hand, drinkers had approximately one-half the proportion of induced control failures in comparison to the nondrinkers. Considering both types of control failures together, they were a particular problem for the HBD's (27 to 37 percent of their accidents).

The HBD's also appeared to have more driver breakdowns (inability to provide control inputs) (4.5 percent) than DWI's (1.5 percent) or nondrinkers (0.4 percent).

Police Citations

Analyses of police citations, excluding drinking citations, showed that 23 percent of the drinkers were cited for rules of the road violations; the figure for nondrinkers was seven percent. This difference was largely accounted for by the greater frequency for the drinkers of high speed or reckless driving citations, and citations for lane departures. It was also shown that the greatest increment in speeding violations for drinkers versus normals occurred for the younger drivers.

In looking at citations involving driving the wrong way on one-way roads, almost all such violations were associated with drinking drivers. However, there was only a total of eleven one-way citations among 6,780 accident drivers.

Interviews

Telephone interviews were conducted with a sample of culpable drivers. There was no significant difference when comparing the driver status distribution in this sample to the sample from which they were drawn. The major finding here was technical in nature. Of the interviewees who admitted to drinking before their accidents, only approximately 15 percent were not reported as drinking by the police. This implies the potential under-reporting of drinking by the police was quite limited, and was not likely to be a major source of bias in the analyses in this report.

Other interview findings showed HBD's were more often involved in accidents 11 to 50 miles from their homes than were cited drivers and non-drinking drivers. This seemed to agree with other findings showing the HBD's to have more rural accidents. There was, however, no important difference in familiarity with the accident road across driver status groups. This suggested the HBD's also had more exposure in this distance range. It was also shown that lack of familiarity with the road could not have been a major contributor in many accidents since approximately 85 percent of the drivers in each of the driver status groups had driven the accident road at least a few times per month.

Finally, among the interviewed drivers, the incidence of drinking in their accidents decreased from 67 percent for those who had not completed high school to approximately 45 percent for those who had completed high school and had additional vocational or college training.

DWI's Versus HBD's

Since a blood alcohol level of 0.10 percent or higher is the policeman's most objective basis for justifying a citation, one might well expect the DWI's to have suffered greater impairment than the HBD's. In turn, one

DWI's - more similar to normals than HBD's *1

could expect the proportions in the analyses to have aligned themselves in a DWI-HBD-normal ordering. This was often not the case. In almost all analyses of accident characteristics and driver behaviors, police citations, and accident situations, approximately half or more of the comparisons showed DWI's were more similar to the normals than were the HBD's.

Some of the more notable departures from the expected ordering are: (The percent of involvements is given in order of DWI-HBD-normal.)

Class R Accidents:	36-48-18
Rear End Accidents:	15-12-18
Primary Control Failures:	(12 to 18) - (20 to 26) - (7 to 8)
High Speed and Reckless Driving Citations:	6-10-3
Two Lane Roads:	65-80-60

*

Such departures may suggest that the DWI is more concerned about his condition (he probably has greater fear of the police), and therefore makes greater attempts to be cautious thereby emulating, to some extent, the nondrinking driver. The HBD's, unconcerned about a few drinks, seem more carefree. This is suggested by their higher incidence of class R accidents, control failures, and high speed or reckless driving citations.

Drinker-Nondrinker Similarities

While the major focus of this study was the problems of drinkers and their differences from nondrinkers, in many instances there were similarities between the two groups. In both groups, the most frequent thing struck was another motor vehicle. Among the accident types, the class R followed by rear end accidents was most frequent. Both had more speeding violations for the young. Both had an overrepresentation of the young in accidents. Both groups had many more male than female drivers.

Other similarities were highest accident frequencies on two lane roads, on straight roads, in clear weather, and on dry roads. For both groups, approximately half of the accidents were within three miles from home and approximately 85 percent of the drivers had driven the accident roads at least a few times per month.

CONCLUSIONS

In this study, the serious nature of the drinking-driving problem was best measured by culpability rates. Ninety to 95 percent of the drinkers were responsible for the initiation of the accidents in which they were involved. Furthermore, in considering situations where nondrinkers had low culpability rates, the propensity of the drinkers for culpable involvement almost completely dominated those situational benefits.

It should be noted that the experience of Calspan accident investigators suggests some police reporting bias exists against drinking accident drivers. However, the primary nature of this bias is not so much to "nail" the drinker, but to emphasize his responsibility if, indeed, he was at fault. This could have had some influence in determining culpability in the accident analysis process, but the effects would not be large. Such biases would certainly be an order of magnitude smaller than the effects noted above. In an earlier study (Perchonok, 1972), where 80 percent of the accidents were investigated in-depth, the culpability rate for drinkers was also over 90 percent.

cm. [illegible] at

The most frequent problems for culpable drinkers, and therefore, the greatest needs for countermeasures, were (1) class R accidents, (2) rear end accidents, (3) accidents where an in-path parked vehicle was struck, and (4) accidents involving a move to the left thereby striking an oncoming vehicle. The class R accidents were, by far, the most frequent accident type for drinkers.

The subgroups of drinking drivers having the most difficulty with these four types of accidents were:

Class R - Young drivers, rural areas.

Rear end - Older drivers, daytime, urban and
suburban areas.

In path parked vehicle - Urban areas.

Move toward oncoming vehicle - Female drivers.

However, it would be misleading to recommend these specific combinations as targets for countermeasures without qualification. First, class R accidents, followed by rear end accidents, were the two most frequently occurring accident types irrespective of driver age, sex, accident location, or day versus night. Thus, for example, while female drinkers had the highest proportion of moves toward an oncoming vehicle, the biggest problem of drinking females was class R and rear end accidents.

Secondly, when considering targets for countermeasures, the most beneficial remedial measures would be those affecting the largest number of potential accidents. In this regard, no matter which drinking accident type is under consideration, it more often involved males than females, drivers older than 20, and nighttime rather than daytime driving.

From this point of view, the greatest needs for countermeasures reside with older males at night, for class R and rear end accidents. It can be added that class R accidents typically occurred in suburban and rural areas, while rear end accidents typically occurred in urban and suburban areas. It is these accidents which are in greatest need of prevention.

It would be inappropriate to specify which drivers, accidents, and situations *should be* targets for countermeasures without a study of the possible countermeasures themselves. First, information is needed on expected effectiveness, without which benefits cannot be estimated. Second, of course cost/benefit relationships can be determined only if the cost can be estimated. Third, there is a question as to whether maximal benefits per unit cost should be the sole criterion. For example, if one knew how to reduce class R accidents, he might achieve a lower cost/benefit ratio by treating young drinking drivers in rural areas at night; however, the greatest benefit would be obtained by treating all drinking drivers even if the cost/benefit ratio were somewhat higher.

Thus, a less rigorous approach is taken here. Simply, do the findings suggest any potentially useful countermeasures for further consideration? Even from this viewpoint, the problem is made difficult by the nature of drinkers' problems: specifically, the propensity of drinkers to have accidents in low demand situations. If drinkers frequently suffered from overload problems, then the task would clearly be to simplify the driving situation. But this is not the problem, and it appears that simplification of the stimulus universe might, in fact, be counterproductive. Indeed, the very problem is that drinkers had most of their accidents in simple situations. The only recommendation here is based on the fact that drinkers were underrepresented in those situations where their attention was brought to focus upon the driving task. In this regard, a large portion of their accidents, including class R and left-hand moves toward oncoming vehicles, reflected failures in simple lane maintenance activities. This brings to mind improved lane delineation. Possibly active delineation techniques, in which drivers would be warned of impending out-of-lane moves, could be cost effective. Possibilities range from improved visual detection properties of delineators, to delineators generating tire noise, to slightly raised delineators providing mechanical feedback to the driver, to electronic detection of lane edges. Note that such techniques would be effective primarily with shallow angle lane departures where time for corrective maneuvers could be available. The frequency of shallow angle departures as well as specific delineation approaches could be studied in more detail using in-depth accident data.

CM line main.
① lane delineation

Regarding rear end accidents, most occur at intersections. Perhaps early warning to drivers approaching intersections would be fruitful. For example, those signalized intersections which are controlled by induction loops, or the like, could also provide active upstream warning to approaching drivers. Storage lanes for left turning vehicles would also be effective.

Int
Sign

That there were many more rear end accidents than accidents involving citations for passing through traffic control signs and signals, suggests drivers do a better job of recognizing signs and intersections than stopped vehicles. This may reinforce the concept of active signals upstream, or it may suggest the need for improved rear lighting for stopped vehicles. Note, in this latter instance, the countermeasure resides with the "other vehicles", not the culpable one.

Third, it is possible that if drivers understood the nature of this problem, their responsiveness to traffic controls or intersections could be extended to vehicles stopped at intersections.

One more point regarding these approaches: the examples of potential countermeasures were in no way specific to drinkers; they could be applicable to all drivers. Indeed, the concept of finding problems more or less unique to drinkers may, in many instances, be unduly restrictive.

There are, however, a family of countermeasures which are specific to drivers who are drinking. They are the various ignition interlock systems involving breath testers, short term memory testers, and tracking testers. The basic problem with these devices is that they produce false positives and raise legal issues regarding the right to drive. One way to resolve these difficulties is to reduce the effect of a failed test. For example, a test failure could activate a warning light observable to other drivers and to the police. It could preclude ignition only if the system were tampered with. In this way, the risk to the drinking driver of being stopped by the police would be considerably increased. If the trip were an absolute necessity (an emergency, for example), and the vehicle were stopped by the police, the police could then assist the driver. In the case of a false positive, only inconvenience would be involved.

AS+S
Mod file

It would be reasonable to have such systems installed only on vehicles owned by convicted drinking drivers; as part of their punishment, they would bear the cost of equipment and installation.

There are a number of findings which show that there are certain factors which limit the alcohol problem. They may point the way for broader application of similar approaches. For example, that the DWI's often had patterns approaching those of nondrinkers implies that the more heavily drinking drivers do, to some extent, recognize the risks of the situation. Complementing this was the low incidence of induced control failures for DWI's and the generally low frequency of accidents on icy and snowy roads for both DWI's and HBD's. Finally, the very small number of drinking accidents for truck drivers supports the same view. Although it is not known whether these effects were due to limited exposure when drinking, limited drinking when driving, or special caution when drinking and driving, the point is that when perceived risk was high, there were those who took useful steps to limit it. Another finding which strongly supports this viewpoint was the relatively lower frequency of accidents for drinkers, in comparison to normals, in situations where the driver's attention was drawn to the driving task. Thus, there may be benefits, in terms of reduced alcohol accidents, if the perceived risk of drinking and driving were increased for all drivers. While the story is an old one, this means sincere efforts to improve educational efforts, punitive techniques, and perhaps driver licensing.

inc perc. risk
↓
· educ
· lic
· enforcement

Regarding education, perhaps improved knowledge of drinking effects will help drivers to help themselves. Regarding punitive efforts, it seems reasonable to impose more substantial economic penalties on drunk drivers. For repeaters, licensing techniques may be more appropriate. While some people will drive without a license, others will not. In extreme cases, it has been suggested that vehicle registration be suspended or, if necessary, the vehicle impounded. One target group here could be those drivers with previous drinking convictions who were drinking in later accidents. While the imposition of effective penalties has been limited in the courts, it should be recognized that a heavy truck driver working for a large firm risks his livelihood by drinking and driving; it seems, therefore, that increased punitive risks for other drivers should not be dismissed as untenable.

There are a number of lines of inquiry which are suggested as a result of this study. The results showed HBD's had greater relative frequencies of class R accidents, of control failures (both primary and induced), and speeding and reckless driving violations than DWI's. If, in fact, the DWI's had more to drink or greater BAL's than the HBD's, these results suggest the real problem may be more one of mood effects of alcohol rather than impairment, per se. Again, the relatively lower involvements for drivers in more demanding situations also support this view. That is, the drinker's impairment can, to some extent, be mitigated if the *driver attempts to be cautious. It appears* the DWI, on average, more often perceived the need for increased caution, whereas the HBD may have been less fearful of accidents or the police, and therefore, provided little compensation for his condition.

Mood?

If this hypothesis is correct, it suggests the need to incorporate it in our thinking about the drinking problem. If drivers with high BAL's can act cautiously and if those with low BAL's tend not to, then the relationship between BAL and mood needs to be better understood, as do means for altering moods. Most experimental work on drinking and driving has focused on impaired tracking, split task performance, etc. Yet the best known limitation of these efforts has been their questionable application to the real world. In particular, it is extremely difficult to elicit real world mood effects in experimental subjects. Yet it seems clear that such studies, probably performed outside the laboratory, are needed.

Another area of inquiry is based on the results showing that drivers need not have a severe alcohol-accident problem. What are the motives here? Is it fear of accident involvement? Is it fear of the police and ensuing penalty? Is it some sort of generalized concern for doing what is right? Indeed, how many drivers are concerned about drinking and driving at all? It would seem one of the most constructive approaches to the drinking driving problem is to determine the motives that can reduce it.

The data indicated drinking drivers had serious lane maintenance problems as exemplified by class R accidents. Furthermore, results implied that the drinking driver can exert useful caution when he is aware of the need. It is therefore recommended that detailed accident reports be studied to determine whether conditions in general and departure angles in particular would allow sufficient time for drivers to correct their paths if methods alerting the driver to lane delineation encroachment were available. In this regard, it might be well to distinguish lane departures associated with lack of control versus loss of control.

Regarding accident research in general, many questions remain about the nature of alcohol accidents. There is a need for a more thorough understanding of the reasons for accident involvement by drinkers. A more detailed examination of the relationship between accident types and accident situations could be expected to shed more light on the problems of drinkers. In-depth driver interviews gathering information on accident driver moods seems indicated. In terms of the current data set, it is clear that the information therein exceeds that which has been utilized. Indeed, while this study focused upon the drinking driver, there is much information in the data set pertaining to normal drivers which does not exist in the current literature.

Finally, results suggested that the increase in perceived risk tends to limit the alcohol accident problem. This suggests greater penalties for convicted drinkers. On the other hand, the reticence of judges and juries to mandate large penalties is well known. Apparently, greater effort is needed in determining meaningful penalties which are also palatable to the courts.

METHODOLOGY

Data Collection

Data were collected in the eight contiguous counties comprising Western New York. The counties are: Allegany, Cattaraugus, Chautauqua, Erie, Genesee, Niagara, Orleans, and Wyoming. The major cities in this area are Buffalo and Niagara Falls. A map of the area appears in Appendix A.

The primary data source was police reports. They were sampled directly from police files and duplicated for use at Calspan. It was desirable to obtain a sample in which half the accidents involved drinking, and half not. From previous data, it was estimated that the police reported at least one driver had been drinking in approximately ten percent of the accidents. Thus, it was decided to include all accidents involving reported drinking and one out of every nine nondrinking accidents. The latter was accomplished by a systematic sampling of every ninth nondrinking accident report.

Case selection was performed by Calspan personnel. The sampling process required an examination of each of the approximately 40,000 reports to determine if the accident belonged to the drinking or nondrinking subsample. In some districts, where the reports were filed by location rather than year, the process was particularly tedious. Nonetheless, the process was maintained at all police departments so as to develop samples quite nearly representative of the Western New York area for one full calendar year (1973).

It cannot be said that every police agency was included. First, many agencies do no accident investigation work. Second, some agencies were so small that their inclusion would have been of little value. Of the 50 agencies requested to participate, 48 did so; one refused, and the files at the other were not sufficiently well organized so as to allow confident sampling. Comparison of the number of accident reports generated by the nonparticipating agencies with those represented by the data suggests less than five percent of all police reported accidents were excluded. As such it was deemed appropriate to treat the data as if all of Western New York were represented.

Other data sources included a BAL file, New York State driver history data, and telephone interviews. The BAL file is a central record containing blood alcohol levels for drivers charged with DWI by most police jurisdictions in Erie County. The BAL's were derived almost exclusively from breath tests, although in some instances blood was used.

Driver history data was based on Calspan's merged accident file obtained from the New York State Department of Motor Vehicles. The accidents in this file are derived from those police reports sent to Albany by the local agencies plus all driver reported accidents. (Most local police agencies forward only the reports of the more severe accidents.) DMV, when possible, matches drivers and vehicles in these accidents with the corresponding drivers in their driver license file and vehicles in the vehicle registration file. The resultant merged file was obtained by Calspan for its NHTSA Tri-Level Accident Study.

Police reported accidents in the DMV file were then matched with those sampled from the police records. This process utilized accident county, month and date, hour, and driver age and sex to produce reasonably stringent rules for matching accidents. When a good match occurred, driver history information was taken from the DMV file and added to the tape for this study.

The final data source was telephone interviews of drivers in the original accident sample. The drivers were randomly selected from all culpable* drivers in Erie County accidents in the original sample. Once selected, contact with a driver was repeatedly attempted; calls were made during the day and evenings, and when needed, appointments were made for return calls. Approximately three-eighths of those selected could not be contacted, and one-eighth refused to cooperate. The result was a sample of approximately 400 interviews. A copy of the interview format is in Appendix B.

---

* A culpable driver is one who initiated the accident sequence. It is discussed more fully in the next section.

Data Processing and Data Elements

Police reports were coded in a format allowing analysis with either the accident or the vehicle as the statistical unit. Each accident consisted of one record containing accident data (i.e., data describing the conditions in which the accident occurred) and one record for each motor vehicle involved. The coding was performed in two separate steps. The routine coding involved all those data items which appeared more or less explicitly on the police forms. The accident and vehicle forms for the routine coding appear in Appendix C.

The second coding step was performed during the same time period by a separate group of analysts. This effort involved the coding of the causal structure, a description in a structured format of the way each vehicle was involved in its accident. The coding form for the causal structure appears in Appendix D as does a description of the causal elements.

The causal structure allows for a very wide variety of combinations of its elements. In order to simplify the analysis of these data, related elements were studied empirically in terms of the frequencies of the various combinations in the current data. In this process new codes were computer generated which reflected the most frequent combinations of the individual elements. This resulted in five variables with highly concentrated information. The first was the accident configuration; it gives the path of the subject vehicle along with the location and relative path of the target. (The target signifies the thing "struck", be it another vehicle, a pedestrian or bike, train, animal, road departure, or rollover, whichever occurred first.) The second was the critical event specifying what the driver/vehicle unit did to create a condition such that, short of highly skilled maneuvers, an accident would occur. Examples are start, wide left turn, and continue. The third variable was the critical reason; it describes the condition allowing or eliciting the critical event. Examples are information failure, external influence, and control failure due to slippery roads. The fourth and fifth were the prior event and the prior reason; they were based on codes allowing the case analyst to describe behaviors preceding the critical event if it added to the accident description.

A final part of the causal structure which received frequent use is culpability. This concept is based on the premise that drivers rely heavily on their expectations. They expect vehicles to stay in their lanes, to stop at stop signs, etc. Without the validity of such expectations, safe traffic flow would not be possible. Thus, a situation is said to be abnormal if the expectations of a hypothetical, normal driver would be violated. The first driver/vehicle unit to create an abnormal situation is said to be culpable.

The coded data resulting from the routine coding and the causal structure were rigorously monitored using three computer edit programs. The first two checked for illegal codes and inconsistencies within the routine data and within the causal coding. Because of the logical relationships among the elements in the causal structure, the resultant data could be very effectively edited. The third program checked consistency between the routine codes and the causal codes. Because these two coding steps were performed independently, errors in coding which would not be detected in the first two edits were detected here.

One point of particular importance refers to the terms used to describe driver status with regard to drinking. Since driver status was used in almost all analyses, a clear definition of terms is necessary. The levels of driver status were determined on the basis of both drinking citations and driver condition. The first level was used whenever the driver was charged with operating a motor vehicle while his ability to do so was impaired, while his blood alcohol level was .10 percent or higher, or while he was intoxicated; impairment due to the use of drugs was not included. This level, for convenience, is referred to throughout this report as DWI, and drivers so charged are called DWI's. The second level was used whenever the driver was reported to have been drinking but did not receive any of the three alcohol related charges specified above;

this level is labeled HBD. Together the HBD's and the DWI's constitute the drinkers in the sample; throughout the text the term is used this way. The third level of driver status includes those drivers who were not, according to the report, drinking and for whom their was no other indication of impaired condition such as drug use, ill, asleep, etc. For lack of a better term, these drivers are referred to as normals or nondrinkers.

Thus, driver status has three levels: DWI, HBD, and normal. It can be expected that a large majority of the drivers in the first level had consumed enough alcohol to meet or exceed the .10 percent blood alcohol level. This follows from the fact that many alcohol charges are contested by the driver so that, in general, the officer will not cite the drinker unless he is quite certain of his grounds. To verify this, BAL's for DWI's in Erie County were tabulated. They are shown in Table 1.

TABLE 1

Blood Alcohol Level for DWI's

BAL (%)	Frequency	Cumulative Percent for Known BAL
0.0	5	0.6
0.01-0.03	11	1.8
0.04-0.06	15	3.6
0.07-0.09	48	9.1
0.10-0.14	171	28.8
0.15-0.19	291	62.3
0.20-0.24	208	86.3
0.25-0.29	84	96.0
0.30-0.34	28	99.2
0.35-0.39	6	99.9
0.40 and more	1	100.0
Drugs	3	
Refused Test	167	

These data show that of 868 DWI's where BAL was known, nine percent tested below the .10 level; conversely, 91 percent were .10 or higher. Of the nine percent, it is not known whether the investigating officer misjudged the condition of the driver, the test was inaccurate, the driver was impaired due to drugs but tested for alcohol, or the driver was indeed impaired due to alcohol and this BAL was, nonetheless, below .10. In any event, the data clearly show that most DWI's had BAL's equal to or greater than .10 percent.

If the investigating officer is not convinced that the driver will fail a breath test, he is likely to report only that the driver had been drinking, thus placing the driver in the second driver status category. It is also known through informal discussion with the police that the drinking status of such drivers may be ignored or overlooked so that they may, in our data, be classified as normal (assuming no other deficiency).

Thus, DWI's, HBD's, and normals can be characterized in the following ways. On the average, the DWI's could be expected to have higher BAL's than the HBD's. Essentially all drinkers (the DWI's plus HBD's) had consumed alcohol; possible exceptions are those drivers, particularly the HBD's, who had used drugs but were reported by the police officer to have been drinking. One can assume that many of the normals, in fact, had consumed alcohol. Nonetheless, it is reasonable to assume the normals were, on the average, less impaired than the HBD's. Thus, in the remainder of this report it is assumed that the drinkers formed a homogeneous group who in fact had been drinking, and that on the average DWI's were more impaired than HBD's who were more impaired than normals.

Finally, it should be noted that in comparisons across driver status levels, differences are better thought of as the effects associated with drinking drivers rather than with drinking, per se. The reason is that people who drink and drive may be characteristically different than those who do not. Thus, in comparing drinkers to normals, differences may be due to both alcohol consumption and these characteristic differences. Of course, this is as it should be. Since we are interested in the problems of drinking drivers, it would not be realistic to isolate the effects of drinking alone; rather, we are interested in drinking within the context that it occurs in the real world.

Sample Description

Following the procedures described above, a total of 7421 accident reports were collected. Of these, 3579 accidents involved drinking, 3842 did not. The drinking accidents essentially constituted the population of police reported drinking accidents in Western New York. The non-drinking accidents represented some 34578 (3842 x 9) accidents in which drinking was not reported. Table 2 shows the distribution of these accidents in terms of the reported status of the drivers. It shows a very likely under-reporting of drug usage. The "other" category includes accidents for which no drinking or drug use was reported and at least one driver's condition was abnormal or unknown.

TABLE 2

Condition of Drivers in Accidents

Driver Condition	Frequency	Percent
At least one DWI	1948	26.2
No DWI but at least one HBD	1631	22.0
No DWI or HBD but at least one drug charge	2	0.0
All normal	2482	33.4
Other	1358	18.3
Total	7421	100.0

Considering drivers rather than accidents, there was a total of 12734. Of these, 1965 (15.4%) were DWI's; 1700 (13.4%) were HBD's, and 6227 (48.9%) were normal.

As further background information, Tables 3, 4 and 5 give the distribution of police jurisdictions, injury, and number of vehicles involved in the accidents. In preparing these tables, the number of non-alcohol accidents in each category were multiplied by nine, to account for the sampling fraction, and added to the alcohol-related accidents. In this way, estimates were obtained pertaining to the population from which the data were drawn.

Table 3 shows that over half of the police reported accidents in Western New York occurred in Erie County. Approximately 35 percent occurred in the cities of Buffalo and Niagara Falls. The sheriffs' departments, small agencies, and state police, which investigate primarily rural accidents, accounted for almost 30 percent of the accidents.

TABLE 3

Police Jurisdiction

	Estimated Frequency	Percent
Buffalo	10142	26.6
Niagara Falls	3339	8.8
Other Cities	1873	4.9
Erie County excluding Buffalo and Sheriff	10316	27.0
Sheriff's Dept.	5646	14.8
Small Agencies	1047	2.7
Thruway Police	1506	3.9
State Police	4288	11.2
Total	38157	100.0

Table 4 shows the distribution of accidents in terms of injury. Because previous research indicated that injury differentation was not accurate using the K, A, B, C injury reporting system (Garrett, Braisted, and Morris, 1972), only the three categories in the table were used. For 30 percent of the accidents there was at least one non-fatal injury reported. Accidents involving fatal injuries constituted six-tenths of one percent of the total. In the sample, 41 of the 3579 alcohol related accidents (or 1.1 percent) involved fatal injuries. Of the other 3842 accidents, 21 (or 0.5 percent) produced fatal injuries.

TABLE 4

Police Reported Injury

	Estimated Frequency	Percent
No Injury	26465	69.4
At Least One Injury	11462	30.0
At Least One Fatal Injury	230	0.6
Total	38157	100.0

Table 5 shows over thirty percent of the accidents were single vehicle accidents. Together, single vehicle and two vehicle accidents comprised 95 percent of the total.

TABLE 5

Number of Vehicles Involved

No. of Vehicles per Accident	Estimated Frequency	Percent
1	11821	31.0
2	24436	64.0
3	1609	4.2
4	232	0.6
5	44	0.1
6	15	0.0
Total	38157	100.0

FINDINGS

Driver Behaviors and Accident Characteristics

Data pertaining to the nature of accident involvements were cross classified with driver status. The variables studied were the target, the accident configuration, the critical event, and the critical reason. Additionally, some analysis was performed relating police citations to driver status.

In order to maximize the reliability of the driver status codes several restrictions were placed on the data. First, any accidents not investigated by the police at the scene were excluded. This was particularly applicable in Buffalo; there were a large number of accidents which were reported at the station. In such instances not only could one expect an under-reporting of drinking, but the accident description itself would be in doubt. Second, hit and run drivers, if not apprehended, were excluded for the same reasons. Third, parked vehicles were excluded since in many reports it was not clear whether the driver's status regarding drinking was applicable at the time the vehicle was parked. (These last two conditions apply only to the subject vehicles under study, not the vehicles they struck.)

In the following analyses pertaining to the causal structure, only culpable drivers were included. This served two purposes; the first is statistical in nature. In coding the causal structure for multivehicle accidents, there are certain inescapable relationships among the vehicles: If one driver is culpable, the others are not; if one vehicle is involved by continuing, its target is most likely also involved by continuing; the specification of the accident configuration for one vehicle normally bears fixed relationships with the accident configuration of the vehicle it struck, etc. Note that these reciprocal relationships are not induced by the causal structure coding, but rather by the nature of multivehicle accidents. Since there can be no more than one culpable vehicle per accident, restricting analysis to these vehicles assures independence of data points.

The second reason for limiting study to culpable drivers is that it focuses attention on the driver who initiated the accident generation process. As a result, the causal elements pertain to "what went wrong" and the driver who "caused" the accident. Without the culpable behaviors, the accident would *not have occurred.*

The Target

The target is that event which signifies an accident has occurred. It is (1) a collision with a vehicle, pedestrian, object, etc.; (2) a road departure, or (3) a rollover, whichever occurred first. Note that due to this definition, rollovers occurred very seldom, since a rollover in the roadside was classified as a road departure. If one's primary interest were in injury, other definitions might be more suitable. In studying accident causation, a departure from the path intended for vehicles (i.e., the road) is sufficient to designate an accident.

The results of cross classifying driver status and target appear in Table 6 , where targets were grouped into five categories. In this analysis and other similar ones, attention was first given to the drinking driver column where the HBD's and DWI's combined are profiled regarding the variable under study. Next the drinking drivers were compared to the normal drivers. Finally, the DWI's and the HBD's were compared.* Note that the total number of observations may vary somewhat from table to table due to the exclusion of data points which were coded unknown.

---

* Chi-square tests were routinely performed for drinker/normal and DWI/HBD overall comparisons. Beyond that, they were not usually performed for subsections of the tables, since this would result in testing the larger differences, thereby incurring unknown α levels. All tests were performed individually at the .05 level.

TABLE 6

Target by Drinking Status for Culpable Drivers

	Drinking Status							
	DWI		HBD		Normal		Drinker	
Target	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Motor Vehicle	962	59.9	575	45.9	1206	75.6	1537	53.8
Pedestrian, bike, train, animal	17	1.1	16	1.3	37	2.3	33	1.2
Road Departure	584	36.4	634	50.6	312	19.6	1218	42.6
Rollover	2	0.1	4	0.3	9	0.6	6	0.2
Other	40	2.5	24	1.9	31	1.9	64	2.2
TOTAL	1605	100.0	1253	100.0	1595	100.0	2858	100.0

After Deleting Road Departures

Motor Vehicle	962	94.2	575	92.9	1206	94.0	1537	93.7
Pedestrian, bike, train, animal	17	1.7	16	2.6	37	2.9	33	2.0
Rollover	2	0.2	4	0.6	9	0.7	6	0.4
Other	40	3.9	24	3.9	31	2.4	64	3.9
TOTAL	1021	100.0	619	100.0	1283	100.0	1640	100.0

The table shows that approximately one-half of the culpable drinking drivers struck other motor vehicles. Over 40 percent of them ran off the road. (Note that the distinction here is not equivalent to a multivehicle-single vehicle accident difference, since a vehicle leaving the road might eventually strike another vehicle.) Only approximately one percent of the targets for drinkers were pedestrians, bicycles, trains, or animals.*

The culpable normal drivers had a quite different distribution of targets. Three-fourths of their accidents initially involved striking other motor vehicles; only 20 percent were ran-off-road accidents. The differences between the normals and the drinkers were statistically significant (X_4^2 = 250.67, where the subscript gives the degrees of freedom). Obviously, the major contribution was the greater incidence of road departures relative to motor vehicles as targets for the drinking drivers.

All tests were performed assuming an unlimited population. The effective power of the tests could have been increased by using a finite population approach. However, in that case, all conclusions would have been limited to Western New York. While it cannot be said that the findings can be generalized to the nation or other parts of it, at least the reader can decide to what extent his area is different than, or similar to, the eight county area and decide for himself whether the findings apply.

In comparing DWI's to HBD's, the differences were also statistically significant (X_3^2 = 59.88, the rollovers and others combined); again, the primary contribution was due to the differences between collisions with motor vehicles and road departures. Interestingly, however, the trend was not an increasing one from normal, to HBD, to DWI. Rather, the greatest likelihood of a road departure was for the HBD's.

---

*The general composition of this category for all drivers was pedestrians and bikes -- 66 percent; animals 32 percent; and trains -- 2 percent.

Because it could be argued that the drinkers' propensity for ran-off-road accidents could reduce the opportunity for other types of accidents, the analysis was repeated with road departures deleted. The result can be thought of as reflecting the expected targets if all road departures could be prevented. The results are shown in the lower portion of the table. A comparison of the proportions across columns shows very little variation in the relative frequency with which other motor vehicles were targets. In comparing drinkers and normals the differences were statistically significant (X_3^2 = 8.76). The primary contribution here was the "other" category, which was overrepresented for the drinkers. This category was composed primarily of known but unclassified objects in the road or in parking lots. The comparison between DWI's and HBD's was not significant (X_2^2 = 1.84).

In summary, drinking drivers were involved in accidental road departures twice as often as nondrinkers. Just over one-half the accidents for HBD's were ran-off-road types; for DWI's approximately one-third of the accidents were of this type. While striking other vehicles was the predominant accident type for DWI's and normals, for HBD's road departures dominated, although by a small margin.

It should be noted that the effect of differential driving exposure among the driver classes will influence this type of analysis. That is, if one class of driver is more exposed to traffic conducive to multivehicle accidents, there will be a tendency to increase the likelihood of motor vehicles as targets thereby decreasing the relative frequency of road departures. However, in delineating the problems of a particular class of drivers, this is as it should be.

A final note is that it might appear, in ensuing analyses, that many of the effects can be explained by the propensity of drinkers for ran-off-road accidents. However, it should be recognized that the target is the effect of accident generating behaviors; effects cannot explain things previous to their own occurrence. Thus, rather than using this propensity as an explanation, it is the propensity itself which needs to be understood.

Accident Configuration

Accident configuration is a composite variable encompassing the subject vehicle's path, the target's location and its path relative to that of the subject. It describes the relationship of the vehicle and its target immediately before the situation became critical. Accident configuration for culpable drivers within each of the driver status groups appears in Table 7. Of the hundreds of combinations of subject path, target location, and target path in the sample, the first eight rows in the table contain all those configurations which accounted for at least two percent of the configurations in any of the driver status groups. The remainder are grouped together in row nine. This two percent rule was followed for all succeeding tables in this section of the report.

Before discussing configurations in the context of driver status, descriptions and examples of the more important ones follow. In the first configuration, the vehicle was moving forward and struck a stationary target to the front and to the side of his path. This normally represents a road departure, but could also include striking parked vehicles which were not in the subject's path before the situation became critical.

The next row contains vehicles moving forward with a stationary target in its path. Here, the target is normally a parked car and, less frequently, an object. This configuration is distinguished from the previous one in that here the target was in the subject's path before the situation became critical. For example, he was approaching a parked car and failed to change his path to avoid it.

In the third configuration the subject was moving forward and the target was in front of him headed in the same direction. This represents a normal rear end accident. It usually involves the subject continuing into the rear end of a lead vehicle stopped for a traffic control, stopped for other vehicles in front of him, or waiting to make a left turn. It also includes situations in which the lead vehicle decelerates and the subject vehicle responds too late; the subject vehicle may or may not have been tailgating.

Row four contains those accident involvements in which the subject was moving forward and collided with a target to the right front headed left, or to the left front headed right. The target may or may not have been stopped for a traffic signal; the subject was not. This configuration typically occurs at intersections, but may also occur in parking lots.

Row five contains a configuration similar to that in row four except that the subject's path was motion imminent; that is, he was temporarily stopped. This normally is an accident at an intersection where the subject vehicle had stopped, usually in response to a traffic control sign or signal, prior to proceeding.

The configuration in row six is one in which the subject vehicle was moving forward; the target was to his left front and traveling in a parallel but opposite direction. Here the culpable vehicle either turns left in front of the oncoming target at an intersection, or it simply moves to the left, typically unintentionally.

Row seven shows configurations in which the subject was moving forward and the target was to his side in a parallel path headed in the same direction. This configuration usually involves either the culpable driver passing illegally and being struck when the target attempts a left turn, or the subject simply not maintaining his lane with a vehicle next to him.

In the final configuration, in row eight, the subject was moving to the rear and struck either a stationary target or one on an intersecting path. (This configuration does not include those accidents in which the culpable vehicle was stopped with motion imminent and precipitated a collision by starting to the rear.) This accident occurs most frequently at driveways and in parking lots.

TABLE 7

Accident Configuration by Driver Status for Culpable Drivers

	Accident Configuration			Driver Status							
				DWI		HBD		Normal		Drinker	
	Subject Path	Target Location	Target Path	N	%	N	%	N	%	N	%
1.	Forward	FS*	Stationary	656	40.8	668	53.2	322	20.2	1324	46.2
2.	Forward	Forward	Stationary	158	9.8	62	4.9	66	4.1	220	7.7
3.	Forward	Forward	Same	248	15.4	152	12.1	308	19.3	400	14.0
4.	Forward	FS*	Intersecting	131	8.2	62	4.9	192	12.0	193	6.7
5.	MI**	FS*	Intersecting	10	0.6	11	0.9	105	6.6	21	0.7
6.	Forward	Left Front	Parallel-Opposite	178	11.1	95	7.6	188	11.8	273	9.5
7.	Forward	Side	Parallel-Same	31	1.9	30	2.4	84	5.3	61	2.1
8.	Rear	Rear	Intersecting or Stationary	17	1.1	38	3.0	54	3.4	55	1.9
9.	Other			178	11.1	138	11.0	278	17.4	316	11.0
	TOTAL			1607	100.0	1256	100.0	1597	100.0	2863	100.0

*Forward, but to the side of the subject vehicle's path
**Motion imminent; stopped temporarily, not parked

Profiling the drinking drivers, it can be seen that almost one-half of the accidents involved a stationary target (usually the road edge or a parked car) to the side and front of the subject vehicle (row one). Another 14 percent of their involvements were with targets to the front and in the same path; these were rear end accidents (row three). The next most frequent configuration involved targets to the left front moving in a parallel but opposite direction (row six). Next were stationary targets in the subject's path (row two) and targets to the front and side with intersecting paths (row four). These five configurations accounted for 84 percent of the culpable involvements by drinking drivers.

Chi-square tests were performed comparing normal drivers to drinkers and, within the drinking group, DWI's to HBD's; both were significant (X_8^2 = 460.34 and 86.35, respectively). In both instances the major contribution occurred in the first row. Drinkers were much more likely to have stationary targets to the front and side than were nondrinkers; HBD's were involved in this configuration more than DWI's. Reference to Table 7 shows a marked similarity between this configuration and ran-off-road accidents. The second row, involving stationary targets in the subject vehicle's path, shows the same pattern as row one in comparing drinkers to normals. However, since the HBD's had almost the same relative frequency as the normals, the difference was almost solely attributable to the DWI's. It appears that DWI's were particularly troubled by stationary targets in their path.

Regarding row three, the author had often speculated that rear end accidents, being one of the more inane types of accidents, must surely be due to drinking drivers. The data do not support this speculation. Indeed such involvements by HBD's was less than two-thirds that of the normals. If neither the normals nor the drinkers had accidents reflected in row one, then these rear end accidents would have accounted for 24 percent of the nondrinkers accidents and 26 percent for the drinkers. Again, this is hardly an indictment of the drinkers.

An obvious difference between drinkers and nondrinkers appears in row five. These are accidents in which the subject had stopped before being involved with a target to the front and side on an intersecting path; in most cases such accidents were precipitated when the subject vehicle started. While seven percent of the normals were involved in this way, less than one percent of the drinkers were. Among the drinkers, little difference was evident between the DWI's and HBD's, possibly due to the limited number of observations. The nature of the configuration in row four was similar, but here the subject vehicle had not stopped before the critical event. Again, the normals were much more often involved in this way than were the drinkers; here, however, the DWI's had approximately twice the relative frequency as did the HBD's.

The two rows, taken together, show the drinkers were less often involved in intersecting path accidents than were the normal drivers. DWI's had relatively more of this type of involvement than did HBD's.

In row six, the target was to the left front headed parallel to the subject vehicle but in the opposite direction. The only effect of importance was that DWI's were involved via this configuration with a relative frequency approximately 50 percent greater than were HBD's.

Row seven reflects a configuration where the target was to the side of the subject and headed in the same direction. This configuration accounted for two percent of the drinkers involvements, but five percent of the nondrinkers involvements. In these accidents, the subject vehicle may have been passing improperly or may have unwisely or unintentionally moved into an adjacent lane.

Finally, row eight refers to accidents where the culpable vehicle was moving to the rear. The drinkers were troubled by this configuration less than were the normal drivers. However, the difference was primarily attributable to the DWI's, not the HBD's.

Summarizing the information in Table 7 , almost fifty percent of the targets for drinking drivers were stationary and located in front toward the side; the relative frequency of this configuration was highest for HBD's (53 percent). Rear end accidents were next in relative frequency, although they occurred somewhat less frequently for drinkers (14 percent) than normals (19 percent). Accidents involving targets to the left front headed in a parallel but opposite direction comprised ten percent of the drinking drivers accidents; there was little variation across drinking status categories.

Intersecting path accidents accounted for seven percent of the drinker's accidents, but nineteen percent for the nondrinkers; HBD's were somewhat less often involved this way than were DWI's. The drinking drivers were seldom (less than one percent) involved in this configuration if they had stopped before the collision.

While five percent of the normal drivers collided with targets headed in the same direction in a parallel path, only two percent of the drinking drivers were so involved.

Critical Event

The next analysis pertains to the critical event, that behavior which most directly precipitated or allowed the accident to occur. Table 8 shows that the most frequent critical event for the drinkers was a lateral move. The critical event coding allows for three general types of direction change: turn, parallel path (not tabulated due to low frequency), and move. For road traffic, a turn can occur only at intersections, and parallel path refers to a lane change; the remainder of the direction changes were coded as moves. Thus, this code includes lateral movements within lane as well as lane departures which were not known to be the initial action in turning.

Row one shows the second most frequent critical event for drinkers. It is the continuation along one's current path even though a collision course existed. Continues accounted for 30 percent of the drinker's involvements. Thus, moves and continues comprised 86 percent of the culpable drinkers' critical events.

The next most frequent critical events were wide turns and normal left turns (three percent each). A wide turn is one in which the change in effective steer angle in a turn at an intersection is insufficient to take the vehicle into the appropriate lane. A normal left turn is one in which there was no difficulty regarding the geometry of the turn, but rather with the timing or the decision to turn at all. Thus, four critical events (move, continue, wide turn, and normal left turn) accounted for 92 percent of the drinkers' critical events.

The normals were compared to the drinkers and the DWI's to the HBD's; both were statistically significant (X_7^2 = 378.35 and 32.74, respectively). The largest difference between the drinkers and the normals was associated with moves, where the drinkers were so involved for over one-half their accidents and the normals -- less than one-third. While 30 percent of the drinkers were involved by continuing along a collision course, 37 percent of the normals were so involved. The lower involvement rate for drinkers was largely attributable to the HBD's.

TABLE 8

Critical Event by Driver Status for Culpable Drivers

Critical Event	Driver Status DWI N	DWI %	HBD N	HBD %	Normal N	Normal %	Drinker N	Drinker %
Continue	544	33.9	321	25.6	587	36.8	865	30.2
Imposed Upon	9	0.6	18	1.4	54	3.4	27	0.9
L turn Move	837	52.1	751	59.8	503	31.5	1588	55.5
Left Turn	48	3.0	41	3.3	131	8.2	89	3.1
Wide Turn	57	3.5	36	2.9	32	2.0	93	3.2
Start	15	0.9	19	1.5	115	7.2	34	1.2
Other	97	6.0	70	5.6	175	11.0	167	5.8
Total	1607	100.0	1256	100.0	1597	100.0	2863	100.0

A number of the other proportions are worthy of note. While one percent of the drinkers were imposed upon, over three percent of the normals were. An example of a culpable driver being imposed upon by the precipitating action of another unit is a tailgating vehicle imposed upon by the deceleration of the lead vehicle. Another example is a vehicle approaching an intersection at very high speed when a stopped vehicle starts into the intersection. Again, the table shows drinking drivers were less often involved this way than were normals.

Drinkers were also less often involved due to left turns and starting than were the normals.

Aside from continuing along a collision course and involvement due to moves, there were no other major differences between the DWI's and the HBD's. In both of the categories the rates for DWI's were closer to the normal drivers than were the rates for the HBD's.

Critical Reason

The next portion of the causal structure to be examined pertains to the critical reason. The critical reason is that condition which elicited or allowed the critical event. Thus, whereas, the critical event specifies what the driver did, the critical reason denotes why he did it. The possibilities include information failures (he did not see it), control failures (he did not keep the vehicle on its intended path), external influence (the other guy pulled in front of him), driver breakdown (he could not provide inputs to the vehicle), vehicle breakdown (the vehicle responded abnormally), and logistic (he did it to get where he wanted to go).*

From one viewpoint, the critical reason may be thought of as the core of the causes of accidents. Indeed such information can be extremely valuable. Unfortunately, it is just about the most difficult judgment the case analyst had to make. This is particularly true when using police data in the absence of a detailed driver interview. Because of this, the coding form contained provisions to record whether the critical reason was reported explicitly or inferred from the data. This was coded whenever the critical reason was an information failure, a control failure, a combination of the two, or logistic, since other categories were not used unless explicitly reported. Of the 7,489 times these codes were used in the full data set, 73 percent were inferred. This does not mean the data are unreliable; in most instances, valid inferences can be made from other information. For example, if vehicle A strikes vehicle B which had been stopped in front of it, the critical reason, in the absence of contrary data, would be coded information failure; this would probably be correct in the vast majority of such cases. If there was a question as to whether the critical reason was an information failure or control failure a special code was available to so indicate.

---

* Logistic reasons could apply to almost any behavior. Thus, it is given the lowest coding priority.

Thus, while the critical reason contains very important information, it must be recognized that the codes were largely based on inferential processes.*

A part of the critical reason information presented below is the critical source. This code was used whenever the critical reason was an information failure or external influence. In the case of an information failure, it specifies what the driver failed to see; for external influence, it identifies the origin of that influence.

The results of tabulating critical reasons as a function of driver status appears in Table 9. Note that there are two types of control failures. An induced control failure was coded when a slippery road surface was thought to be relevant; otherwise, a primary control failure was coded. Because of the frequent use of the information failure/control failure codes, special steps were taken in an effort to remove these combination codes to facilitate interpretation of the data. Specifically, the information failure/primary control failure entries were distributed among the separate information failure and primary control failure codes in a way that would not disturb the relative frequency of these two critical reasons. Concommitantly, the information failure/induced control failure codes were distributed among the information failures and induced control failures. This was done in a way that would not change the percentages in the remainder of the table. The results appear at

---

* While the causal structure provides for the coding of various types of information failure, the level of detail in most police reports precluded routine use of these codes. Thus, they were not used in analysis.

the bottom of the table. This procedure is analagous to one in which an unknown category is removed from a table to provide better estimates of the relative frequencies of the known categories.*

For the drinking driver, the estimated proportion of information failures unfortunately had a broad range from 42 to 61 percent. Primary control failures occurred in from 15 to 21 percent of these accidents and induced control failures, five to seven percent. Information and control failures taken together accounted for 89 percent of the drinkers' culpable involvements. Other critical reasons were relatively infrequent.

Comparing the drinking and nondrinking drivers, it appears likely that drinkers had fewer information failures; the extent of the difference could have been as large as 14 percent. In contrast, the data clearly show the drinkers to have had more primary control failures and fewer induced control failures. The data also show less frequent external influences and vehicle breakdowns for drinkers, but more frequent driver breakdowns. A chi-square was calculated for the original data, and was found to be significant ($X_9^2 = 412.05$).

---

* Starting with P (IF), P (PCF), P (ICF), P (IF or PCF) and P (IF or ICF), A was defined as the sum of these five proportions. Using a prime to indicate the new estimates, the following simultaneous equations were solved for P'(IF), P'(PCF), and P'(ICF).

$$P'(IF) + P'(PCF) + P'(ICF) = A$$
$$P'(PCF)/P'(IF) = P(PCF)/P(IF)$$
$$P'(ICF)/P'(IF) = P(ICF)/P(IF)$$

TABLE 9

Critical Reason by Driver Status for Culpable Drivers

	Driver Status							
	DWI		HBD		Normal		Drinker	
Critical Reason	N	%	N	%	N	%	N	%
Info. Failure (Target)	746	46.4	446	35.5	887	55.5	1192	41.6
Primary Control Failure	187	11.6	245	19.5	114	7.1	432	15.1
Induced Control Failure	45	2.8	98	7.8	187	11.7	143	5.0
Info. Failure (Target), or Primary Control Failure	423	26.3	230	18.3	104	6.5	653	22.8
Info. Failure (Target), or Induced Control Failure	81	5.0	48	3.8	62	3.9	129	4.5
External Influence (Other*)	22	1.4	42	3.3	55	3.4	64	2.2
External Influence (Target)	9	0.6	19	1.5	54	3.4	28	1.0
Vehicle Breakdown	18	1.1	34	2.7	68	4.3	52	1.8
Driver Breakdown	24	1.5	56	4.5	6	0.4	80	2.8
Other	52	3.2	38	3.0	60	3.8	90	3.1
TOTAL	1607	100.0	1256	100.0	1597	100.0	2863	100.0

Mixed Categories Distributed

Info. Failure (Target)	1131	70.4	603	48.0	1011	63.3	1734	60.6
Primary Control Failure	283	17.6	331	26.4	130	8.1	614	21.4
Induced Control Failure	68	4.2	133	10.6	213	13.3	201	7.0

*Pedestrian, bicycle, train, animal, on non-collision vehicle.

In comparing DWI's to HBD's, one can determine which had the higher proportion of information failures only if he can decide whether the adjustments to the data were indeed providing better estimates. The author is not prepared to do so. A stronger indication is present for primary control failures which were a more frequent problem for HBD's than DWI's. Regarding induced control failures, or control failures at least partially attributable to slippery road surfaces, the problem was also greater for HBD's than DWI's. The data show that external influences, vehicle breakdowns, and driver breakdowns were also more frequent for HBD's than for DWI's. The overall difference between the DWI's and HBD's, as tested with the unmodified data, was significant (X^2_9 = 157.48).

Summarizing the critical reasons, while information failures were the most frequent problem for all drivers the only conservative comparison is that the HBD's suffered less from this problem than did the normals. It also seems likely that DWI's had more frequent information failures than did HBD's. *

Regarding the remainder of the critical reasons, both primary control failures and driver breakdowns had the same pattern of occurring most frequently for HBD's and least frequently for normals. Induced control failures, external influences, and vehicle breakdown all showed the same pattern of decreasing proportions from normal to HBD to DWI.

Accident Configuration and Critical Event

The causal variables presented to this point have shown some important interactions with driver status for culpable drivers. In order to gain more understanding of these effects, it was desirable to study the configuration, critical event, and critical reason simultaneously. However, because of the methodological needs in treating the critical reason, it was decided to limit the analysis to the accident configuration and critical event. This also had the advantage of restricting the analysis to causal elements which can be expected to have high validity and reliability. The results are given in Table 10 . As in previous tables, it includes explicitly only those combinations containing at least two percent of the accident involvements in any of the driver status groups.

The data in row one show that for drinkers, 42 percent were involved in the ran-off-road type of accident. (This includes striking parked cars out of the subject's original path.) The rear end accident in row five, because it involves a critical event of continue, excludes the tailgating situation where the following vehicle is imposed upon by the lead vehicle's deceleration; it accounted for 14 percent of the drinkers' involvements. Next in order of incidence was continuing into a stationary target ahead (usually a parked vehicle); eight percent of the drinkers were involved in this way. The fourth most frequent combination was involvement with a target to the left front moving in a parallel but opposite direction due to a move; seven percent of the drinkers were involved this way.

In comparing the drinkers and normals the overall difference was significant (X_9^2 = 444.55). Similarly, there was a significant difference between the DWI's and the HBD's (X_9^2 = 85.73). The largest difference between the normals and drinkers was with regard to the ran-off-road type of accident. (Recall that this type of involvement includes off-path parked cars as targets.) While the rear end accident in row five did not differ greatly between drinkers and normals, there was a considerably greater involvement rate for the normals as compared to the HBD's.

TABLE 10

Accident Configuration and Critical Event By Driver Status for Culpable Drivers

	Subject Path	Target Location	Target Path	Critical Event	Driver Status							
					DWI		HBD		Normal		Drinker	
					N	%	N	%	N	%	N	%
1.	Forward	FS*	Stat.***	Move	586	36.5	609	48.5	289	18.1	1195	41.7
2.	Forward	FS*	Intersecting	Continue	81	5.0	35	2.8	136	8.5	116	4.1
3.	Forward	Left Front	Parallel Opposite	Move	129	8.0	60	4.8	83	5.2	189	6.6
4.	Forward	Left Front	Parallel Opposite	Left Turn	42	2.6	30	2.4	94	5.9	72	2.5
5.	Forward	Forward	Same	Continue	247	15.4	150	11.9	285	17.8	397	13.9
6.	Forward	Side	Parallel-Same	Move	23	1.4	20	1.6	37	2.3	43	1.5
7.	Forward	Forward	Stat.***	Continue	156	9.7	62	4.9	65	4.1	218	7.6
8.	MI**	FS*	Intersecting	Start	10	0.6	11	0.9	104	6.5	21	0.7
9.	Rear	Rear	Intersecting or Stat.***	Continue	14	0.9	33	2.6	51	3.2	47	1.6
	Other				319	19.9	246	19.6	453	28.4	565	19.7
	TOTAL				1607	100.0	1256	100.0	1597	100.0	2863	100.0

*Forward, but to the side of the subject vehicle's path

**Motion Imminent

***Stationary

There is an interesting comparison between rows three and four. In both instances the target was to the left front traveling in a parallel but opposite direction. In row three the critical event was a move which can usually be considered in this type of configuration to be inadvertent; the drinkers were slightly more often involved this way in comparison to the normals. However, when the critical event was a left turn, a planned maneuver, the drinkers were considerably less often involved than the normals.

Another direct comparison is that between rows two and eight. Both involve targets on intersecting paths, and both occurred more frequently for the normals than the drinkers. When the vehicle merely continued along a collision course, the drinkers had a relative frequency near one-half that of the normals. In contrast, when the vehicle had first stopped, then started, the drinkers had a relative frequency near one-tenth that of the normals.

As presented in Table 10 , the data indicate some interesting differences, but it is difficult to see general conceptual effects, if any, implied therein. Thus, an attempt was made to reorganize the data to provide a more unified summary of the information. In order to do so, it was decided to characterize the referenced accidents in terms other than those explicitly contained in the causal structure. This was done by asking a number of questions about each of the structures tabulated. The questions were:

1. Had the driver planned a change in activity? (Using the accident type in row 8 - Yes)

2. Does the situation normally require increased caution? (row 8 - Yes)

3. Does the situation normally require a prior activity? (row 8 - Yes)

4. Would accident avoidance have required an interuption of current activity? (row 8 - No)

5. Would accident avoidance have required a change in plans implied in Item 1 above? (row 8 - Yes)

6. Would accident avoidance have required prior preparation? (row 8 - Yes)

These questions were designed to inquire into the active/passive nature of the situations, the demands placed upon the drivers, and whether the driver could be alerted by the nature of the situation; this, in ways allowing answers on the basis of the causal structure. Note that the questions were designed to obtain the dichotomous answers: yes or no.

In order to best organize the data, an attempt was made to order the accident types and the questions so that in terms of the answers to the questions, similar accident types were near each other and similar questions were near each other. That is, while ignoring the nature of the accident, those with similar answers were placed together; then while ignoring the nature of the question, those with similar answers were placed together. This approach was quite like that originally used in Gutmann scaling (Torgerson, 1958). The results appear in Table 11 .

The following is a specification, with rationale, of answers to the six questions for each of the nine configuration/critical event combinations. For readers primarily interested in the general findings, this discussion can be treated as a footnote.

Parallel Opposite/Left Turn: Here a left turn was planned; it required a deceleration; increased caution is generally required for intersection path changes; accident avoidance would have required scanning for moving vehicles, further deceleration or stopping, and delaying the planned turn.

Rearward/Continue: Stopping (before proceeding forward) was planned; there was a prior start-backward; the need for increased caution is generally recognized when backing; accident avoidance would have required scanning to the rear, and interruption of rearward travel. (This would have preceded the planned stop).

Motion Imminent - Intersecting/Start: A start was planned after a prior stop; increased caution was required for starting in traffic and at intersections; avoidance would have required scanning for other vehicles or delaying the planned start; no interruption of current action would have been required since the vehicle was stopped.

Intersecting/Continue: While the involvement was due to proceeding along a collision course (usually into an intersection), the intention of the driver may have been to go straight ahead or to turn -- the latter would have required a prior deceleration; that the driver was culpable in an intersection-type accident implies he did not have the right of way and that increased caution would have been normal; accident avoidance would have required scanning for other vehicles, deceleration or stopping, and if turning were planned, a delay of plans would have been required.

Rear End/Continue: No change was planned nor prior activity involved (usually); increased caution might have been indicated if the situation was, for example, a busy intersection; accident avoidance would have required increased attention and deceleration or stopping.

Parked Car/Continue: This is similar to the above situation, except that since the driver was generally unaware of the target until it was too late, there was no particular reason in his mind for increased caution.

Parallel-Same/Move: If the move was inadvertent, the characterization is the same as those below. If the move was the initial part of a lane change, then there was a planned change, usually involving some increase in caution; accident avoidance would have required scanning for other vehicles and a delay in the planned lane change; current behavior (going straight ahead) would have been maintained.

Ran-Off-Road/Move: Since the desired behavior was normally to maintain the current path, there was no planned change, prior activity, nor increase in caution; avoidance would have required continuation of current activity only.

Parallel-Opposite/Move: Same as above.

It can first be seen that aside from a few deviations, the data could be so arranged that positive and negative answers clustered and were separate from each other. The positive answers clustered to the top and right, while the negatives were toward the bottom and left. This has several implications. First, the questions, taken together, were able to discriminate the accident types. The accidents near the top of the table had the greatest frequency of

TABLE 11

Characterization and Ordering of Accident Configuration/Critical Event Combinations

Configuration/ Critical Event	Planned Change	Prior Activity	Increased Caution	Interrupt Behavior for Avoidance	Prior Preparation for Avoidance	Change Planned Activity for Avoidance	Percent Configuration/ Critical Event	
							Normal	Drinker
Parallel-Opposite/Left Turn (4)	*	*	*	*	*	*	5.9	2.5
Rearward/Continue (9)	*	*	*	*	*	*	3.2	1.6
MI-Intersecting/Start (8)	*	*	*	·	*	*	6.5	0.7
Intersecting/Continue (2)	?	?	*	*	*	?	8.5	4.1
Rear End/Continue (5)	·	·	?	*	*	-	17.8	13.9
Parked Car/Continue (7)	·	·	·	*	*	-	4.1	7.6
Parallel-Same/Move (6)	?	·	?	·	?	?	2.3	1.5
Ran-off-Road/Move (1)	·	·	·	·	·	·	18.1	41.7
Parallel-Opposite/Move (3)	·	·	·	·	·	·	5.2	6.6

Legend:
* - Yes
· - No
? - Depends on specific situation
\- - Not applicable

Note: Numbers in parentheses refer to rows of Table 10.

affirmative answers, implying the driver was actively involved in his driving and decisions related thereto. Accidents near the bottom of the table, on the other hand, were those in which few active demands were placed upon the driver. The drivers reflected in the table, then, can be viewed as residing on an active/passive continuum.

The last two columns in the table contain values duplicated from the previous table; they give the distributions of accident types for the normal and the drinking culpable drivers. Comparison of the percentages show that toward the top of the table the accident types were overrepresented for the normals; toward the bottom, the accidents were overrepresented for the drinkers. In other words, accidents in which the driver was mentally and/or physically active were underrepresented among the drinkers in comparison to the normals; those in which the driver was passive were overrepresented among the drinkers. The only accident type which apparently deviated from this pattern was that involving a move thereby striking a target in an adjacent lane which was traveling in the same direction. The preponderance of question marks here, however, precludes importance of the deviation.

In considering these findings, it is important to remember that they represent the problems of drinking drivers as weighted by exposure to the problems. Thus, the propensity of drinkers to the more passive condition accidents where demands upon them were low was the result of the combined effects of susceptibility to these situations and exposure to them.

Police Citations

Analyses were performed on rules-of-the-road violations in accidents, measured by police citations, as a function of drinking status. In order to provide a manageable summary of the data, citations were grouped into families involving similar behaviors. Drinking violations were not included. The results are in Table 12 . For testing purposes, the low frequency categories were grouped together (viz., turning, stopping, starting, one-way, and other rules-of-the-road violations). Differences between the normals and the drinkers and those between the DWI's and HBD's were both statistically significant (X_8^2 = 572.96 and 29.85, respectively).*

Regarding the comparison between normals and drinkers, the major difference was that associated with whether any citation at all was received. Among the normals, seven percent were charged with a rules-of-the-road violations; for the drinkers, 23 percent were so charged. This difference was almost wholly accounted for by two categories: high speed or reckless driving, and failure to stay within the driving lane. The higher incidence of lane departures for drinkers is in agreement with earlier findings pertaining to road departures. The speeding problem will be discussed in more detail shortly.

---

* Strictly speaking, these tests were not wholly valid because one driver could appear in more than one violation category, thus precluding complete independence of the data points. However, of the 7,892 data points in Table 12, there were 88, or approximately one percent, which reflected multiple citations. This is not sufficient to substantially change the values of the test statistics.

It should also be noted here that the citation analyses, unlike the previous ones, were not restricted to culpable drivers. One reason was that cited drivers had apparently broken the law even if they were not culpable. Secondly, at least in theory, citations given to drivers in multivehicle accidents should be independent from one driver to the next.

TABLE 12

Police Citations by Driver Status

	Drinking Status							
	DWI		HBD		Normal		Drinker	
Police Citations	N	%	N	%	N	%	N	%
Thru Sign or Signal	34	1.9	26	1.7	34	0.7	60	1.8
Right of Way at Intersection	39	2.2	16	1.0	99	2.2	55	1.6
Following too Closely	15	0.8	16	1.0	37	0.8	31	0.9
High Speed or Reckless Driving	115	6.4	159	10.2	57	1.3	274	8.2
Failure to Stay in Lane	118	6.6	132	8.5	44	1.0	250	7.5
Illegal Passing	40	2.2	25	1.6	18	0.4	65	1.9
Illegal Braking	6	0.3	6	0.4	12	0.3	12	0.4
Illegal Turning	3	0.2	10	0.6	8	0.2	13	0.4
Illegal Stopping	2	0.1	1	0.1	4	0.1	3	0.1
Illegal Starting	0	0.0	2	0.1	2	0.0	2	0.1
One-Way Violation	9	0.5	0	0.0	2	0.0	9	0.3
Other Rules-of-the-Road	9	00.5	3	0.2	9	0.2	12	0.4
No Rules-of-the-Road Violation	1404	78.3	1158	74.5	4218	92.8	2562	76.5
TOTAL	1794	100.0	1554	100.0	4544	100.0	3348	100.0

In comparing the DWI's to the HBD's, the first difference was that 25 percent of the HBD's received at least one citation, while 22 percent of the DWI's did. Among the citations, the largest difference was ten percent high speed or reckless driving charges for the HBD's versus six percent for the DWI's. Although the tabulated distribution for the DWI's was more similar to the HBD's than to the normals, the DWI's, rather than appearing at one of the extremities of the DWI-HBD-normal continuum, more often than not appeared between the HBD's and the normals.

One of the interesting findings pertains to citations for driving the wrong way on a one-way road. The data show there were 11 such charges in the sample. Of these, nine were associated with the drinkers and of those, all were associated with the DWI's. It is clear that the DWI's were more likely to have committed one-way violations than were either the HBD's or the normals; for example, in the samples, DWI's were more than ten times as likely to have such violations in accidents than were the normal drivers.

However, the data also imply that the frequency of one-way violations in accidents was quite limited: 0.5 percent of DWI's, 0.3 percent for all drinkers, and 0.04 percent for normals. For all accidents represented here, 0.06 percent involved one-way violations. Thus, the DWI's seem comparatively susceptible to one-way violations in accidents, but the problem itself occurred very infrequently.

During the conduct of this research, we received a request to investigate the relationship between driver status, speeding, and driver age.* Further impetus was provided for this analysis by the fact that one of the two major differences in citations for drinkers and normals was the combination of reckless driving and speeding. The results appear in Table 13 .

---

*Personal communication from Monroe Snyder, Office of Driver and Pedestrian Research, NHTSA.

TABLE 13

Speeding Violations by Driver Status as a Function of Driver Age

	Driver Status											
	DWI			HBD			Normals			Drinkers		
Driver Age	Cited	Not Cited	% Cited	Cited	Not Cited	% Cited	Cited	Not Cited	% Cited	Cited	Not Cited	% Cited
16 and Under	0	10	0.0	1	8	11.1	3	68	4.2	1	76	1.3
17, 18	14	71	16.5	24	106	18.5	11	378	2.8	38	177	17.7
19, 20	11	122	8.3	37	174	17.5	11	428	2.5	48	296	14.0
21- 25	23	285	7.5	43	293	12.8	7	784	0.9	66	578	10.2
26- 35	22	367	5.7	22	309	6.6	7	918	0.8	44	676	6.1
36- 55	14	599	2.3	10	363	2.7	6	1174	0.5	24	962	2.4
55- 65	3	154	1.9	1	91	1.1	2	335	0.6	4	245	1.6
66+	0	29	0.0	1	25	3.8	0	203	0.0	1	54	1.8

It might be noted here that speeding citations were of two types: exceeding the speed limit (usually excessively), and speed too fast for conditions. The table shows that in each of the driver status groups, speeding citations were most frequent in the 17 and 18 age group. The proportion receiving speeding citations decreased rather consistently with increasing age. The table also reflects for almost all age groups the greater likelihood of speeding charges for drinkers versus normals and, to a lesser extent, for HBD's versus DWI's.

Two sets of tests were run with these data; first drinkers were compared to normals, then DWI's were compared to HBD's. The results are shown in Table 14 . (Due to limited observations, the youngest and the two oldest age groups were excluded.) All comparisons were statistically significant. Thus, whether comparing drinkers to nondrinkers or DWI's to HBD's, speeding citations could not be explained by age alone or drinking status alone, rather there was an interactive effect of age and drinking status upon speeding charges.

**

* speedin / DWI comp

If one were to compute a ratio of the proportions of speeding charges for drinking versus normals within each of the tested age groups, he would obtain: (17-18) - 6.3, (19-20) - 5.6, (21-25) - 11.3, (26-35) - 7.6, and (36-55) - 4.8. This shows that drinking drivers in the 21 to 25 age group, in comparison to normals of the same age, were most susceptible to speeding citations. This statistic, however, fails to take into account the differential scope of the problem for the two groups. Therefore, the differences in proportions for drinkers and normals were calculated: (17, 18) - 15 percent, (19-20) - 11 percent, (21-25) - 9 percent, (26-35) - 5 percent, and (36-55) - 2 percent. Here, the speed problem associated with younger drinking drivers is obvious. Considering the comparison of DWI's and HBD's, it can be seen the differences were greatest for ages 19 and 20, although the effect for ages 21 through 25 was still notable.

TABLE 14

Test Statistics for Speeding Citations by Age by Driver Status

Source	Degrees of Freedom	Chi-Square
Drinkers vs. Normals		
Age X Citations	4	99.69
Age X Driver Status	4	19.80
Citations X Driver Status	1	178.25
Age X Citations X Driver Status	4	67.30
Overall	13	365.04
DWI's vs. HBD's		
Age X Citations	4	97.46
Age X Driver Status	4	84.20
Citations X Driver Status	1	19.64
Age X Citations X Driver Status	4	13.15
Overall	13	214.45

Summarizing the data regarding speeding citations, an important part of the increased likelihood of police citations for drinkers was associated with speeding. These citations were also the most important contributor to the higher frequency of citations for HBD's versus DWI's. In general, for drivers 19 and older, speeding citations decreased with age. The groups most often cited for speeding were 17 and 18 year old HBD's (18 percent), 19 and 20 year old HBD's (18 percent), 17 and 18 year old DWI's (16 percent) and 21 through 25 year old HBD's (13 percent). Speeding among drinkers, particularly young drinkers, apparently constitutes a serious problem.

Other findings regarding police citations included the generally higher citation rates for drinkers (23 percent) versus normals (seven percent), and the higher incidence of failure to stay in the proper driving lane - eight percent for drinkers and one percent for normals. While one-way violations were not a major problem, accounting for less than one-tenth of a percent of the violations, it was estimated that DWI's were more than ten times more likely to have had such violations in accidents than were nondrinking driver.

Summary

In summarizing the findings, it is important to recall that the data reflect not only susceptibility of drivers to the conditions and actions under study but also exposure to those conditions or conditions conducive to the actions studied. Thus, the statistics are valid measures of the scope of the various problems of the drinking drivers.

Although many differences were found when comparing the driver status groups, it might first be noted that there were many similarities. Both culpable drinkers and non-drinkers had other motor vehicles as their most frequent target and road departures as their second most frequent target. The important exception was that the HBD's ran off the road more often than striking other vehicles. Regarding critical events, continuing along a collision course, and lateral moves were the most frequent involvement modes in all driver groups. Among the critical reasons, information failures followed by control failures were the most frequent regardless of driver status.

In a related area, it was found that only in approximately half of the comparisons did the DWI's have an extreme relative frequency. That is, one might expect the HBD's to look like the normals more often than the DWI's do; the results showed this to be the case in only approximately one-half the comparisons. This may suggest the DWI's, recognizing their condition, attempted greater compensatory efforts. Some comparisons between DWI's and HBD's support this view. They include fewer run-off-road accidents, primary and induced control failures, driver breakdowns, and high speed and reckless driving citations for the DWI's.

The major findings pertaining to the drinking drivers include the high frequency of run-off-accidents, stationary targets, involvements through lateral moves (other than turns and lane changes), information failures regarding their targets, primary control failures, high speed and reckless driving citations (particularly among the young), and lane departure violations. It was also found that they had relatively more one-way violations that did the normals although the problem was not a frequent one. Notable for its low frequency among drinking drivers were induced control failures.

In a special analysis of accident configurations combined with critical events, it was found that drinking drivers had relatively fewer culpable involvements than normals in situations characterized by higher demands upon the driver, normally occurring increased caution, alerting to current activity by planned maneuvers or prior activities, and a requirement for mental or physical activity for accident avoidance. Conversely, the drinkers had relatively more culpable involvements in situations which demanded little of the driver and involved no special focusing of attention on the driving task.

Situational Variables

The following analyses pertain to the relationships between driver status and characteristics of the situations in which their accidents occurred. As before, the analyses were restricted to culpable drivers who were neither parked nor hit and run drivers; only accidents investigated by the police were included.

While the analyses are straightforward, some introductory discussion may extend their utility. Each table contains two sections. The upper part of the tables contain the same kind of information as the tables in the previous section. That is, it gives the raw data plus the distribution of situations in each driver status group. In addition, estimates of population frequencies are given for the normal drivers. (Recall that for drinking drivers, the accident sample is essentially equivalent to the population.)

The proportions in the upper part of the table can be thought of as the effect of the situation upon drivers in a given driver status group multiplied by the exposure of those drivers to that situation. As such, it measures the extent of the situational problem for drivers in each of the driver status groups.

On the other hand, if one feels that countermeasures responsive to drinking drivers and problematic situations are likely to reside with the situation rather than the driver, the above proportion is of little value. The reason for this is that there remains the possibility that while drinkers have problems with intersections, for example, the proportion of drivers at intersections who are drinkers may be low. As another example, drinkers may have severe problems on hot summer days, but it would not be cost beneficial to increase surveillance unless it were established that on such days there was a reasonably high proportion of drivers who were drinkers.

For this reason, the lower part of the table has been added. Here the proportion of drivers who were drinkers in the specific situation is given. The result is a measure of the effect of driver status upon accident generation rates for the situation, multiplied by the exposure of the situation to drinkers.*

Hence, while the upper portion of the table provides the extent of the situational problem to drinkers (and nondrinkers), the lower portion of the table gives the extent of the drinker problem for the situation. The upper portion is appropriate when considering countermeasures residing with the driver; the lower portion applies when considering countermeasures residing with the situation. It should be noted that when testing any part of a table for statistical significance, one test applies to both situational and driver effects.

---

* If we let S specify the situation and D specify driver status, and let C denote a culpable driver and A denote an accident, then

$$P\ (S \mid D,\ C,\ A) = [P\ (C,A \mid S,\ D)/P\ (C,A \mid D)]\ \ P\ (S \mid D).$$

That is, the proprotions in the upper part of the table are estimates of the effects of S on P (C,A), the accident generation rate, for drivers of status D, multiplied by the exposure of D to S. This is the effect, taking exposure into account, of S upon P (C,A) for D.

For the lower part of the tables, we have $P\ (D \mid S,C,A) = [P\ (C,A \mid S,\ D)/P\ (C,A \mid S)]\ \ P\ (D \mid S)$. This is the effect of D on P (C,A) for S, multiplied by the exposure of S to D. It is the effect, taking exposure into account, of D upon P (C,A) for S. For these calculations, the numbers of normal drivers in the sample were multiplied by nine to reflect the sampling fraction. Of course, all tests of significance were conducted with the observations before this weighting was applied.

Intersections

When the data were being coded, it was thought desirable to specify whether each accident occurred at an intersection. Such coding had been attempted in the past, but not satisfactorily. The difficulty was how to code an accident near an intersection. For example, if a driver makes a turn, loses control and leaves the road, is this an intersection accident? Or, is a rear end accident near an intersection to be coded as an intersection accident? When using police reports, it is not useful to attempt determination of the proper coding on the basis of distance from the intersection. To resolve these problems, we coded whether the accident was intersection related. That is, if the accident would not have occurred had there been no intersection, it was said to be intersection related. Intersections with driveways and alleys were included. The results of cross tabulating this variable with driver status appear in Table 15 .

TABLE 15

Intersection Related by Driver Status

	Driver Status								
	DWI		HBD		Normal			Drinker	
Intersection Related	N	%	N	%	N	9N	%	N	%
Intersection Problem for Drivers									
Yes	499	31.2	359	28.7	868	7812	54.5	858	30.1
No	1098	68.8	891	71.3	726	6534	45.5	1989	69.9
Total	1597	100.0	1250	100.0	1594	14346	100.0	2847	100.0
Driver Problem by Intersection - Non-Intersection									
Yes		5.8		4.1			90.1		9.9
No		12.9		10.5			76.7		23.3

The last column shows that 30 percent of the drinkers were involved in intersection related accidents. In comparison, 54 percent of the normals were involved in intersection related accidents. The difference was statistically significant (X_1^2 = 254.32). The difference between the DWI's and HBD's was small and not statistically significant (X_1^2 = 2.13). These results show that culpable drinking drivers had considerably more difficulty with nonintersection accidents in comparison with normal drivers. This may, or may not, have been due to differential exposure.

The lower portion of the table shows that at intersections only ten percent of the culpable accident drivers were drinkers; for nonintersection accidents, 23 percent were drinkers.

Road Condition

The road surface was reported as dry, wet, or icy and/or snowy. Table 16 gives the cross tabulation of road condition with driver status for culpable drivers. It can be seen that 70 percent of the culpable accident involvements by drinkers occurred on clear roads. Only seven percent occurred on icy or snowy roads. Thus, such slippery roads do not appear to have been a major problem for the drinkers. Of all accidents represented here, only 1.2 percent involved drinking drivers on slippery roads.

In comparing drinkers to normals, a significant interaction was found (X_2^2 = 92.89). The major effect was due to the lesser incidence of slippery road accidents among drinkers as compared to normals; indeed, the proportion of slippery road accidents was twice as great for the normal drivers. The most likely explanations are less exposure of drinkers to icy and snowy roads, or that the drinker, recognizing the threat of slippery roads and the need to avoid the police after drinking, exerted greater caution. If the latter were the case, the wet road data, showing near equality for drinkers and nondrinkers, imply wet roads were far less threatening to drinking drivers than were ice or snow covered roads.

TABLE 16

Road Condition by Driver Status

	Driver Status								
	DWI		HBD		Normal			Drinker	
Road Condition	N	%	N	%	N	9N	%	N	%
Dry	1108	70.2	832	68.3	949	8541	61.5	1940	69.4
Wet	371	23.5	289	23.7	342	3078	22.2	660	23.6
Ice/Snow	99	6.3	97	8.0	251	2259	16.3	196	7.0
Total	1578	100.0	1218	100.0	1542	13878	100.0	2796	100.0
Driver Problem for Road Conditions									
Dry		10.6		7.9			81.5		18.5
Wet		9.9		7.7			82.3		17.7
Ice/Snow		4.0		4.0			92.0		8.0

A test was performed to compare DWI's and HBD's; their differences were not statistically significant ($X_2^2 = 3.17$). Nonetheless, these data tend to support, although in a weak way, the findings above. Specifically, if drinkers were concerned about the hazards of slippery roads particularly in view of the threat of a drunk-driving arrest, then one could expect greater preventive action by those drivers who had consumed the most alcohol. In this regard, the data show relatively fewer slippery road culpable involvements among the DWI's as opposed to the HBD's. *

The lower portion of the table shows that in slippery road conditions, HBD's and DWI's accounted for an equal proportion of the accidents with the total for the two being only eight percent. This can be contrasted with a total of approximately 18 percent for dry and wet roads.

Day Versus Night

Light condition was reported as dawn, day, dusk, night with street lighting, night without lighting, and night with unknown lighting. When the light condition was not reported, tables based on sunrise and sunset for each month were employed to give day/night information. In these tables buffers for dawn and dusk were used, but to be conservative only the day and night categories were coded. Since the dawn and dusk categories appeared infrequently in any of the data, they were excluded from analysis. The first analysis was performed to compare day to night. The night category includes lighted and unlighted roads as well as those in which the presence of street lighting was unknown. The results appear in Table 17 .

TABLE 17

Day-Night by Driver Status

	Driver Status								
Light Condition	DWI		HBD		Normal			Drinker	
	N	%	N	%	N	9N	%	N	%
			Day-Night Problem for Drivers						
Day	286	18.6	213	17.5	931	8379	61.3	499	18.1
Night	1252	81.4	1002	82.5	587	5283	38.7	2254	81.9
Total	1538	100.0	1215	100.0	1518	13662	100.0	2753	100.0
			Driver Problem for Day-Night						
Day		3.2		2.4			94.4		5.6
Night		16.6		13.3			70.1		29.9

As might be expected, drinkers initiated accidents much more often at night than during the day. Over 80 percent of their accidents occurred at night. The comparison of drinkers to nondrinkers was statistically significant (X_1^2 = 820.10). The lower part of the table shows, of the accidents represented here, fully 30 percent of the nighttime accident involved culpable drinkers. From another viewpoint, of the total of 16,415 accidents, 14 percent involved drinking drivers at night; only three percent involved drinkers during the daytime. Whether drinking drivers have increased accident generation proclivities at night cannot be determined from these data. Clearly, one major influence is the fact that most drivers do their drinking at night.

The difference between HBD's and DWI's was tested and found not to be statistically significant (X_1^2 = 0.52). Examination of the relative frequencies shows near equality of the two groups.

Roadway Lighting

The light condition data were also used to examine the relationship between driver status and road lighting for drivers culpably involved in nighttime accidents. The results are shown in Table 18 . Lighted roads were somewhat overrepresented for drinking drivers; 57 percent of the culpable drivers had their accidents on such roads. The difference between normals and drinkers was statistically significant (X_1^2 = 5.49). It can be seen that although the drinkers had fewer of their accidents on unlighted versus lighted roads; the decrease in culpable involvements on unlighted roads was even greater for the nondrinking drivers. Thus drinkers, as a group, had more problems on unlighted roads than did normal drivers.

TABLE 18

Road Lighting by Driver Status for Nighttime Accidents

	Driver Status								
Roadway Lighting	DWI		HBD		Normal			Drinker	
	N	%	N	%	N	9N	%	N	%
			Lighting Problem for Drivers						
Lights	500	63.4	440	51.5	254	2286	63.7	940	57.2
No Lights	289	36.6	414	48.5	145	1305	36.3	703	42.8
Total	789	100.0	854	100.0	399	3591	100.0	1643	100.0
			Driver Problem by Lighting Conditions						
Lights		15.5		13.6			70.9		29.1
No Lights		14.4		20.6			65.0		35.0

In comparing the DWI's to the HBD's, the difference was significant (X_1^2 = 23.52). Indeed the DWI's and HBD's differed more than did the drinkers versus the nondrinkers. By looking at the upper part of the table as a whole it can be seen that the DWI's were quite similar to the normals, and that the difference between the normals and the drinkers was wholly attributable to the HBD's.

These results, showing the HBD's had more of their culpable accidents on unlighted roads than did either the DWI's or the normals, may reflect greater exposure of HBD's to unlighted roads.

The lower portion of the table gives the magnitude of the drinking problem on lighted and unlighted roads. It shows that on lighted roads, drinkers accounted for 29 percent of the accident problems; this was almost evenly split between DWI's and HBD's. For unlighted roads, 35 percent of the accidents were attributable to drinkers, with 21 percent due to the HBD's.

<u>Road Type</u>

Road type was coded as ramp, limited access, other divided, one way, multilane, two lane, unknown number of lanes, driveway and/or alley, and lot (parking lot, gas station, etc.). In the following analysis only non-intersection related accidents were included. Furthermore, due to low frequencies, many road type categories were excluded. Only limited access, multilane, and two lane roads, along with lots remained. The results appear in Table 19 .

TABLE 19

Road Type by Driver Status

	Driver Status									
Road Type	DWI		HBD		Normal			Drinker		
	N	%	N	%	N	9N	%	N	%	
Road Problem for Drivers										
Limited Access	58	6.0	22	2.7	55	495	8.7	80	4.5	
Multilane	249	25.9	103	12.7	154	1386	24.4	352	19.9	
Two Lane	625	64.9	647	80.0	377	3393	59.7	1272	71.8	
Lots	31	3.2	37	4.6	46	414	7.3	68	.38	
TOTAL	963	100.0	809	100.0	632	5688	100.0	1772	100.0	
Driver Problem for Roads										
Limited Access		10.1		3.8			86.1		13.9	
Multilane		14.3		5.9			79.7		20.3	
Two Lane		13.4		13.9			72.7		27.3	
TOTAL		6.4		7.7			85.9		14.1	

The results show that 72 percent of the culpable drinkers had their accidents on two lane roads, 20 percent were on multilane roads, and the remainder were almost evenly split between limited access roads* and lots. The comparison between drinkers and normals was statistically significant (X_3^2 = 40.66). The contributors to the difference were several. Normals had relatively fewer of their culpable accidents on two lane roads, with more on limited access roads and in lots. Looking at the lower portion of the table, it can be seen that two lane roads had the greatest drinking driver problem; 27 percent of the accidents were due to the drinkers. On multilane roads, 20 percent of the accidents were generated by drinking drivers. This means that if countermeasures applicable to drinkers could be applied to multilane or two lane roads with equal costs, the greater potential for improvement would reside with the two lane roads.

Within drinkers, the differences between DWI's and HBD's were also statistically significant (X_3^2 = 64.77). Again, the primary differences were associated with multilane roads versus two lane roads. Note that the multilane accidents accounted for twice as many of the DWI accidents as the HBD accidents. Again, it can be seen in these comparisons that the DWI's were almost identical to the normals, with the HBD's alone accounting for the difference between the drinkers and the nondrinkers. Thus the major effects shown in the table are the relatively fewer accidents on multilane roads and more accidents on two lane roads for HBD's versus normals.

---

* *While the figures were* not available, it is probably safe to assume that most thruway traffic in Western New York is local, and therefore made up of relatively short trips.

Horizontal Alignment

Accidents were coded as to whether the roads were straight or curved. The results of cross tabulating driver status and road alignment appear in Table 20.

TABLE 20

Horizontal Alignment by Driver Status

	Driver Status								
	DWI		HBD		Normal			Drinker	
Horizontal Alignment	N	%	N	%	N	9N	%	N	%
	Alignment Problem for Drivers								
Straight	953	79.4	852	73.9	1142	10278	88.1	1805	76.7
Curve	248	20.6	301	26.1	154	1386	11.9	549	23.3
Total	1201	100.0	1153	100.0	1296	11664	100.0	2354	100.0
	Driver Problem for Alignment Conditions								
Straight		7.9		7.1			85.1		14.9
Curve		12.8		15.6			71.6		28.4

The ratio of straight road culpable accident involvements to such involvements on curves was approximately three to one for drinkers. This primarily reflects the fact that straight roads account for much more roadway mileage than do curved road segments. Testing the difference between drinkers and nondrinkers showed a significant result ($X_1^2 = 70.33$). The interaction effects can be seen in the row for curves. It shows that drinkers had twice the proportion of accidents on curves than did nondrinkers. Thus, while drinkers had most of their accidents on straight roads, curves were a greater problem for them than for normal drivers. It seems unlikely that the exposure of drinkers to curves could be twice that of normals to curves. If this is correct, one can conclude a greater effect on the rate of accident generation due to curves for drinkers as compared to nondrinkers. The lower portion of the table shows that drinkers constituted 28 percent of the accident problem on curves. That is, if drinkers in curves were accident free, there would be 28 percent fewer accidents in curves.

A significant difference was also found between DWI's and HBD's ($X_1^2 = 9.79$). The effect was a greater relative frequency of culpable accident involvements on curves for HBD's than for DWI's. Thus, as has been seen in some earlier tables, the DWI's were more similar to the normals than the HBD's were.

Accident Location

Information relating to accident location was coded in terms of (1) each of the eight counties with a separate code for Buffalo, (2) location class [city or village, township], (3) area type [urban, rural], and (4) reporting agency. In order to obtain relatively homogeneous location categories (urban/rural is too ambiguous), all four codes were used to create the following groups: Buffalo and Niagara Falls, Buffalo suburbs, other cities with populations exceeding 15,000, smaller cities, and rural areas. The cross tabulation of driver status with these location types for culpable drivers appears in Table 21 .

Of course, the percentages given in the table are peculiar to Western New York, but two purposes are served by these data. First, they further describe the data in this study. Second, comparisons within rows (i.e., within location type) may have applicability to similar location types elsewhere.

TABLE 21

Location by Driver Status

	Driver Status								
	DWI		HBD		Normal			Drinker	
Location	N	%	N	%	N	9N	%	N	%
Location Problem for Drivers									
Buffalo and Niagara Falls	420	26.1	233	18.6	481	4329	30.1	653	22.8
Buffalo Suburbs	612	38.1	446	35.5	533	4797	33.4	1058	37.0
Cities	90	5.6	32	2.5	109	981	6.8	122	4.3
Small Cities	63	3.9	48	3.8	77	693	4.8	111	3.9
Rural	422	26.3	497	39.6	397	3573	24.9	919	32.1
TOTAL	1607	100.0	1256	100.0	1597	14373	100.0	2863	100.0
Driver Problem for Location									
Buffalo and Niagara Falls		8.4		4.7			86.9		13.1
Buffalo Suburbs		10.5		7.6			81.9		18.1
Cities		8.2		2.9			88.9		11.1
Small Cities		7.8		6.0			86.2		13.8
Rural		9.4		11.1			79.5		20.5

Results show that 37 percent of the drinkers had their accidents in the suburbs of Buffalo, 32 percent were rural, and 23 percent in Buffalo or Niagara Falls. The remainder were evenly split between the other cities and the small cities. The distribution was significantly different from the normal drivers ($X_4^2 = 58.62$). The major effect in comparing drinkers to normals is that the drinkers had fewer of their culpable involvements in Buffalo and Niagara Falls, and more in rural areas.

The differences between DWI's and HBD's were also significant ($X_4^2 = 73.39$), with the major effect again pertaining to Buffalo and Niagara Falls, and to rural accidents. Generally speaking, once again the DWI's were more similar to the normals than to the HBD's.

The lower part of the table shows that the Buffalo suburbs and rural areas had the most trouble with culpable drinking drivers. On the other hand, the ratio of DWI's to HBD's was highest in Buffalo and Niagara Falls, Buffalo suburbs, and other cities.

Rain

The final analysis in this section pertains to the effects of rain. It was decided to exclude snow because of its possible correlation with road surface conditions which were studied elsewhere. While rain obviously correlates with wet raods, this was not thought to be a problem since the effect of wet surfaces in an earlier analysis was of limited magnitude. Hence, if differences were found in the following comparisons, they could reasonably be attributed to precipitation effects rather than wet road effects. The results are shown in Table 22.

TABLE 22

Rain by Driver Status

	Driver Status								
	DWI		HBD		Normal			Drinker	
Precipitation	N	%	N	%	N	9N	%	N	%
				Rain Problem for Drivers					
None	860	86.3	825	83.4	986	8874	85.5	1685	84.9
Rain	136	13.7	164	16.6	167	1503	14.5	300	15.1
TOTAL	996	100.0	989	100.0	1153	10377	100.0	1985	100.0
				Driver Problem by Rain Condition					
None		8.1		7.8			84.0		16.0
Rain		7.5		9.1			83.4		16.6

The data show that in comparing rainy weather to clear, only 15 percent of the culpable drinking drivers had their accidents in the rain. Furthermore, the percentage of accidents in the rain remained quite constant from one driver group to the next, thereby indicating no particular effect of rain as a function of driver status. The chi-squares for drinkers versus nondrinkers and for DWI's versus HBD's were not significant ($X_1^2 = .23$ and $X_1^2 = 3.32$, respectively).

Summary

For the combined drinking group (DWI's plus HBD's), the conditions in which 70 percent of their culpable accident involvements occurred were dry roads, nighttime, two lane roads, straight roads, nonintersection related accidents, and no precipitation.

The most notable differences between culpable drinkers and culpable normals are shown in Table 23 .

TABLE 23

Incidence of Accidents for Situational Variables - Drinkers as Compared to Nondrinkers

Higher Incidence for Drinkers	Lower Incidence for Drinker
Night	Day
Unlighted Roads	Lighted Roads
Rural	Buffalo and Niagara Falls
Two Lane Roads	Limited Access Roads and Lots
Curves	Straight Roads
Nonintersection Accidents	Intersections
Dry Roads	Icy and/or Snowy Roads

The table suggests several points. First is the rural character of situations in which culpable drinking drivers were overrepresented. In addition to rural areas themselves, unlighted roads, two lane roads, curves, and nonintersections were included. Second, but certainly not independently, low traffic density situations are suggested by nighttime, unlighted roads, rural roads, two lane roads, and nonintersections.

The major differences between the DWI's and the HBD's was under-involvement by the DWI's in accidents on unlighted roads, two lane roads, curves, and rural roads. In fact, regarding road lighting, two lane roads, and rural areas, the DWI's had proportions very close to the normals. Thus, much of the rural characterization of the drinkers' accidents was attributable to the HBD's, not the DWI's.

Regarding the DWI's and the HBD's more broadly, in the vast majority of comparisons, the proportions of accident conditions showed greater similarity between the DWI's and the normals, than between the HBD's and the normals. That is, if one simply counts the occurrences, in the upper portions of the tables, in which the proportions for DWI's were closer to those for the normals (as opposed to the HBD's being closer to the normals), he will find that overall the DWI's looked more like the normals than the HBD's did. This may imply, as was noted with earlier results, that the DWI's may have attempted to compensate for their condition, and were sufficiently successful that their accident patterns began to approach those of the normals. Conversely, the HBD's having had less to drink may have felt no impairment and no need for compensation. One could speculate that joy riding in rural areas by the HBD's may be an example.

Culpability Rates

The same variables analyzed in the situational studies were examined in a different way. In the previous section, situational effects and driver status effects were studied for culpable drivers. In this section, culpability becomes the dependent variable. That is, the proportion of drivers who were culpable was studied as a function of driver status and accident situations. These proportions, or culpability rates, being computed within driver status and accident situation, are not a function of exposure. As before, only accidents investigated by the police on scene were included. Similarly, hit and run vehicles and parked vehicles were excluded.

Intersection Related Accidents

The first analysis pertains to accidents which were intersection related versus those which were not. The results are in Table 24. In studying culpability rates, it was necessary to separate single vehicle and multivehicle accidents. The reason for this will become clear when the lower portion of the table is discussed.

Regarding single vehicle accidents with drinking drivers, the table shows the culpability rate was .95 for both intersection and nonintersection related accidents. (It will be seen that such extremely high culpability rates were characteristic of the drinkers in all situations.) Thus, drinkers in single vehicle accidents appeared equally as culpable for intersection and nonintersection related accidents. A test for differences was not significant ($X_1^2 = .27$).

The normal drivers were somewhat more often culpable in intersection accidents than in nonintersection accidents. However, a chi-square test here also failed to show significance ($X_1^2 = 1.52$).

TABLE 24

Culpability Rate by Driver Status and Intersection vs. Nonintersections

Single Vehicle Accidents

Intersection Related?	Drinking				Normal				Culpability Ratio [P(C|Dr)÷P(C|N)]
	Culp	Not Culp	Total	% Culp	Culp	Not Culp	Total	% Culp	
Yes	154	9	163	94.5	77	42	119	64.7	1.46
No	1078	52	1130	95.4	298	211	509	58.5	1.63

Multivehicle Accidents

	Drinker Culpable Normal Not	Normal Culpable Drinker Not	Total	% (Drinker Culpable, Normal Not)
Yes	544	56	600	90.7
No	442	33	475	93.1

Next, the drinkers were compared to the normals in order to determine if the increase in culpability associated with drinking was different for intersection versus nonintersection accidents. In interpreting these results, it was useful to incorporate a summary variable which was called the culpability ratio. It is the ratio of two culpability rates, the numerator being the culpability rate for drinking drivers and the denominator the culpability rate for normal drivers. Typically, the culpability ratio is greater than one, reflecting the greater likelihood of culpability for drinking, as compared to nondrinking, drivers. Note, for example, that a culpability ratio of 1.30 indicates drinking drivers were 30 percent more likely to have been culpable than were nondrinking drivers.

Table 24 shows the culpability ratio in intersection-related accidents was 1.46, while for nonintersection-related accidents, it was 1.63. This reflects a somewhat greater increase in culpability for drinkers in non-intersection (single vehicle) accidents. However, the chi-square test was not significant ($X_1^2 = .18$).*

---

* There was some difficulty in testing the difference in culpability ratios. The test statistic referenced here was a chi-square test for three-way interactions in a three-way table. The fact that it did not yield a significant result was sufficient to state no significant difference between the culpability ratios. However, this test is responsive to the null hypothesis of no three-way interactions; since the comparison of culpability ratios is a specific three-way interaction, a significant chi-square is not sufficient to specify that the culpability ratios are different. That is, rejecting the hypothesis of no interactions implies that some interactions were significant, but the one under study may not be. Since no appropriate test procedure for the specific hypothesis of equal culpability rates could be found, the following strategy was adopted.

First, the hypothesis of no three-way interactions was tested. If it was not significant, it implied the equal culpability ratio hypothesis could not be rejected. If the initial three-way test was significant, we then reconsidered the two-way tests, one for the drinkers and one for the normals. If one of these tests was significant and the other not, or if both were significant but two tables had opposite "signs", it was concluded that drinking status interacted with the influence of the situation upon culpability. Third, if the culpability ratios themselves differed only slightly, it was concluded that the effect, significant or not, was unimportant.

The lower portion of the table shows results for multivehicle accidents. They required special procedures due to the fact that the behavior of one vehicle in an accident may not be independent of other vehicles in the same accident. This is particularly true of culpability since, by definition, if one vehicle is culpable the others cannot be. This problem was overcome by using the accident, rather than the individual vehicle, as the statistical unit. For example, in row one of Table 24, there are 600 multivehicle accidents, all intersection related. Only the first two vehicles in each accident were considered.* Furthermore, the sample was restricted to those accidents in which one of the first two vehicles was culpable and one of them involved a drinker while the other did not. Returning to row one, of the 600 such accidents, it was the drinker who was culpable in 544 or 91 percent of them. The finding of greater culpability for the drinking driver in intersection related accidents, was clearly significant (X_1^2 = 396.91). Similarly, the data in the second row showed that the drinking driver in multivehicle accidents which were not intersection related was more often culpable (X_1^2 =352.17).

The major point of interest here, however, was not whether the drinkers were more often culpable (They clearly were.), but whether the situation influenced the degree of culpability relative to nondrinkers. The aim is the same as that in comparing culpability ratios in the single vehicle analyses. The question tested here was whether 90.7 percent was significantly different from 93.1 percent. If so, it could be concluded that in multivehicle accidents the increased culpability associated with drinkers was further magnified in nonintersection related accidents. An ordinary chi-square test of the two-by-two table showed the difference was not significant (X_1^2 = 1.99).

---

* Vehicles were numbered according to the following: #1, first striking vehicle; #2, first struck vehicle; #3, second struck vehicle, etc. The culpable vehicle was almost always number 1 or 2.

Thus, data in Table 24 show that although drinkers were more likely to be culpable than nondrinkers, the difference in rates did not vary significantly for intersection versus nonintersection-related accidents. Or, equivalently, the effect of intersection versus nonintersection-related accidents on culpability was not significantly different for drinkers and nondrinkers.

Thus data in Table 24 show that, although drinkers were more likely to be culpable than nondrinkers, the difference in rates did not vary significantly for intersection versus nonintersection-related accidents. Or, equivalently, the effect of intersection versus nonintersection-related accidents on culpability was not significantly different for drinkers and nondrinkers.

Road Condition

Table 25 contains data for the analysis of culpability rates as a function of road surface conditions. The differences among culpability rates for drinkers were small and not statistically significant (X_2^2 = .41). On the other hand, a comparison of normal drivers showed them to be most culpable on icy and snowy roads and least culpable on dry roads. The differences were statistically significant (X_2^2 = 39.19).

A test for culpability by driver status by road condition interactions was statistically significant (X_2^2 = 40.89). In addition, the culpability ratios differed considerably. They show the greatest increase in culpability from normals to drinkers occurred in dry road accidents; the smallest increase occurred on icy or snowy roads. Notice that the variation in culpability ratios was not attributable to differences in culpability among the drinkers but, rather, due to differences among the normal drivers. It appears that the drinking drivers' propensity toward culpable behaviors in accidents so dominated their accident involvements that road condition effects upon culpability were negligible.

TABLE 25

Culpability Rates by Driver Status and Road Condition

Single Vehicle Accidents

Road Condition	Drinking Culp	Drinking Not Culp	Drinking Total	Drinking % Culp	Normal Culp	Normal Not Culp	Normal Total	Normal % Culp	Culpability Ratio [P(C | Dr)÷P(C|N)]
Dry	823	42	865	95.1	199	189	388	51.3	1.85
Wet	289	16	305	94.8	92	45	137	67.2	1.41
Ice/Snow	104	4	108	96.3	71	11	82	86.6	1.11

Multivehicle Accidents

Road Condition	Drinker Culpable Normal Not	Normal Culpable Drinker Not	Total	% (Drinker Culpable, Normal Not)
Dry	666	58	724	92.0
Wet	235	19	254	92.5
Ice/Snow	65	7	72	90.3

Nonetheless, the data clearly show a large increase in culpability for drinkers on dry roads (85 percent), and a small increase on slippery (ice/snow) roads (11 percent). Thus, the drinkers effectively converted a comparatively safe situation into one which was as dangerous as an inherently hazardous one.

Looking at the multivehicle accidents, the very high incidence of culpability for drinking drivers was evident. There was no statistically significant change from one road surface condition to another ($X_2^2 = 0.38$). This, again, demonstrates the dominance of the drinking effect over road condition effects.

Day Versus Night

The culpability rates for drinkers and nondrinkers, and hence, the culpability ratios, are given in Table 26 for daytime versus nighttime accidents. It can be seen that the culpability rates for drinkers in the two situations were almost equal; a chi-square showed no significance (X_1^2 = .24). Similarly, the difference in rates for normal drinkers was not significant (X_1^2 = .11). Therefore, it is not surprising that the culpability ratios were almost equal.

TABLE 26

Culpability Rate by Driver Status and Night Versus Day

Single Vehicle Accidents

	Drinking				Normal				
Light Condition	Culp	Not Culp	Total	% Culp	Culp	Not Culp	Total	% Culp	Culpability Ratio [P(C|Dr)÷P(C|N)]
Day	173	7	180	96.1	179	114	293	61.1	1.57
Night	1030	51	1081	95.3	178	120	298	59.7	1.60

Multivehicle Accidents

Light Condition	Driver Culpable Normal Not	Normal Culpable Drinker Not	Total	% (Drinker Culpable, Normal Not)
Day	234	14	248	94.4
Night	704	71	775	90.8

For the first two vehicles in multivehicle accidents the proportion of culpable drinkers was somewhat higher in daytime than in nighttime accidents. However, the difference was not significant (X_1^3 = 3.05).

We can conclude that the increase in culpability associated with drinkers was not shown to differ for daytime versus nighttime accidents. Thus, while drinkers have most of their accidents at night, there is no evidence that their susceptibility to culpability was greater then.

Roadway Lighting

Table 27 gives the data for culpability by driver status and street lighting for nighttime accidents. It shows that for single vehicle accidents, drinking drivers had essentially equal culpability rates on both lighted and unlighted roads (X_1^2 = .02). The normal drivers were more often culpable on lighted roads, but the difference was not significant (X_1^2 = 1.83). Because of the normal driver difference, the culpability ratio was greater on unlighted roads. A chi-square test of the three-way interactions was significant (X_1^2 = 5.83). However, because the culpability rates were essentially equal for the drinkers and not significantly different for the normal drivers, it appears that the specific interaction involving the culpability ratios is best treated as not significant.

For multivehicle accidents, the greater culpability of the drinkers increased only slightly from lighted to unlighted roads. The change was not significant (X_1^2 = .48). Thus, it was concluded that road lighting did not differentially influence drinkers and nondrinkers with regard to culpability.

TABLE 27

Culpability Rates by Driver Status for Roadway Lighting in Nighttime Accidents

Single Vehicle Accidents

Roadway Lighting	Drinking				Normal				Culpability Ratio [P(C|Dr)÷P(C|N)]
	Culp	Not Culp	Total	% Culp	Culp	Not Culp	Total	% Culp	
Lighted	352	17	369	95.4	57	32	89	64.0	1.49
Not Lighted	494	25	519	95.2	81	66	147	55.1	1.73

Multivehicle Accidents

Roadway Lighting	Drinker Culpable Normal Not	Normal Culpable Drinker Not	Total	% (Drinker Culpable, Normal Not)
Lighted	141	17	158	89.2
Not Lighted	201	19	220	91.4

Road Type

Due to limited numbers of observations, only two road types (two lane roads versus multilane roads) were included in this analysis. The data appear in Table 28 . For the single vehicle accidents, the culpability rates were almost identical for the drinkers but significantly different for the normals (X_1^2 = 0.00, and X_1^2 = 4.90, respectively). This implied a differential effect of road type on culpability for drinkers and nondrinkers. Considering this, along with a significant test for three-way interactions (X_1^2 = 12.84) and a sizable difference in culpability ratios, it was concluded that road type differentially influenced the relationship between driver status and culpability. Specifically, the increase in culpability for drinkers was greater on multilane roads than on two lane roads. As before, the effect was not noted in terms of differences in culpability rates for drinkers. Rather, the advantage that multilane roads offered to normal drivers was lost for drinking drivers -- at least regarding single vehicle accidents. For multivehicle accidents, the type of road did not have a significant effect on the relationship between driver status and culpability ($X_1^2 = 1.56$). Thus, the drinker effect was greater on multilane roads than on two lane roads, but only for single vehicle accidents.

TABLE 28

Culpability Rate by Driver Status and Road Type

Single Vehicle Accidents

	Drinking				Normal				
Road Type	Culp	Not Culp	Total	% Culp	Culp	Not Culp	Total	% Culp	Culpability Ratio [P(C|Dr)÷P(C|N)]
Two Lane	798	41	839	95.1	191	134	325	58.8	1.62
Multilane	118	6	124	95.2	29	37	66	43.9	2.17

Multivehicle Accidents

Road Type	Drinker Culpable Normal Not	Normal Culpable Drinker Not	Total	% (Drinker Culpable, Normal Not)
Two Lane	234	11	245	95.5
Multilane	108	9	117	92.3

Alignment

The effect of straight versus curved roads is analyzed in Table 29. For drinkers in single vehicle accidents, the culpability rate was significantly higher on curves than on straight roads ($X_1^2 = 9.11$); note, however, that the difference was not large. For normal drivers, the effect was in the same direction and also significant ($X_1^2 = 15.59$); here, however, the change in culpability rate was much larger.

TABLE 29

Culpability Rates by Driver Status and Road Alignment

Single Vehicle Accidents

	Drinking				Normal				
Road Alignment	Culp	Not Culp	Total	% Culp	Culp	Not Culp	Total	% Culp	Culpability Ratio [P(C | Dr)÷P(C|N)]
Straight	698	42	740	94.3	226	177	403	56.1	1.68
Curve	409	8	417	98.1	90	28	118	76.3	1.29

Multivehicle Accidents

Road Alignment	Drinker Culpable Normal Not	Normal Culpable Driver Not	Total	% (Drinker Culpable, Normal Not)
Straight	745	70	815	91.4
Curve	98	4	102	96.1

The difference in culpability ratios shows that although curves, in comparison to straight roads, were a greater problem for both drinkers and nondrinkers, the increase in culpability associated with drinkers was greater on straight roads. The test for three-way interactions was statistically significant ($X_1^2 = 25.40$), indicating a lack of independence among alignment, culpability, and driver status. Because the culpability ratios were considerably different, it was concluded that the increase in culpability associated with drinkers was greater on straight roads than on curved roads. Thus, the drinkers were more likely to be culpable on curves, but in comparison to normals they had more incremental culpability on straight roads.

For multivehicle accidents, the relative frequency of the drinking driver being the culpable one was higher on curves than on straight roads. While the difference was not statistically significant ($X_1^2 = 2.66$), the direction of the relationship opposed that for single vehicle accidents. This may be a random effect, or it may reflect the fact that one can be involved in single and multivehicle accidents in quite different ways.

Location

Table 30 shows the data for different accident locations. For single vehicle accidents, the differences in culpability rates as a function of location were not statistically significant for either the drinkers or the normals ($X_3^2 = 2.79$ and 1.35, respectively). Thus, there was no evidence that the likelihood of being culpable changed from location to location; this, for both the drinkers and the normals. A test of the three-way interactions was significant ($X_3^2 = 11.76$); however, the above findings, along with limited differences among the culpability ratios, led to the conclusion that the specific interaction (the differential effect of location upon culpability ratios) had not been demonstrated.

TABLE 30

Culpability Rate by Driver Status and Accident Location

Single Vehicle Accidents

	Drinking				Normal				
Location	Culp	Not Culp	Total	% Culp	Culp	Not Culp	Total	% Culp	Culpability Ratio [P(C|Dr)÷P(C|N)]
Buffalo and Niagara Falls	134	8	142	94.4	78	61	139	56.1	1.68
Buffalo Suburbs	435	27	462	94.2	118	75	193	61.1	1.54
Cities*	107	5	112	95.5	34	19	53	64.2	1.49
Rural	565	22	587	96.3	145	98	243	59.7	1.61

Multivehicle Accidents

Location	Drinker Culpable Normal Not	Normal Culpable Drinker Not	Total	% (Drinker Culpable, Normal Not)
Buffalo and Niagara Falls	224	14	238	94.1
Buffalo Suburbs	445	51	496	89.7
Cities*	76	5	81	93.8
Rural	244	19	263	92.8

*Cities and small cities were combined.

For multivehicle accidents, the differences among the proportion culpable were not significant ($X_3^2 = 5.29$). Thus, the proportion culpable did not significantly vary as a function of location for drinking drivers, nondrinking drivers, or both taken together.

Rain

The effects of rain on culpability rates and ratios are given in Table 31. As has been the case in most of these analyses, the difference in culpability rates for drinkers in single vehicle accidents was not significant ($X_1^2 = 0.26$). For normal drivers, however, there was a statistically significant increase in culpability in rainy weather accidents ($X_1^2 = 8.43$). As a result, the difference in culpability ratios were relatively large.

TABLE 31

Culpability Rate by Driver Status and Precipitation

Single Vehicle Accidents

	Drinking				Normal				
Precipitation	Culp	Not Culp	Total	% Culp	Culp	Not Culp	Total	% Culp	Culpability Ratio $[P(C\mid Dr)\div P(C\mid N)]$
Clear	771	36	807	95.5	206	176	382	53.9	1.77
Rain	137	5	142	96.5	45	16	61	73.8	1.31

Multivehicle Accidents

Precipitation	Drinker Culpable Normal Not	Normal Culpable Drinker Not	Total	% (Drinker Culpable, Normal Not
Clear	598	57	655	91.3
Rain	113	8	121	93.4

The test for three-way interactions was significant ($X_1^2 = 10.07$). Because of the near equality of the drinkers, the difference among the normals, and the difference in the culpability ratios, it was concluded that in single vehicle accidents the increase in culpability for drinkers versus normals was greater when it was not raining. Again, this was a case of the inherently safer situation being brought to the same level as a more hazardous one by drinking drivers. For multivehicle accidents, the effect of rain was not statistically significant.

Summary

The major finding in this section is that the culpability of the drinkers was so dominant that it overwhelmed almost all situational effects. For example, all of the culpability rates fell between 94 and 98 percent for the drinkers in single vehicle accidents. In contrast, the range was 44 to 87 percent for the nondrinkers. While the culpability of normal drivers in single vehicle accidents was influenced by road surface conditions, two lane versus multilane roads, horizontal alignment, and rain, only horizontal alignment significantly affected the culpability of drinking drivers: they were more often culpable on curved, as opposed to straight roads.

Regarding the interactive effects of situations and driver status upon culpability, four situational variables were thought to be important. The increase in culpability for drinkers compared to normals was greatest for dry roads and least for icy or snowy roads; it was high for multilane versus two lane roads; it was high for straight roads compared to curves; and it was high in clear weather compared to rain. In no instance, however, were these interactions due to differential culpability rates for the drinking drivers. Rather, in every instance, it was a matter of the drinkers losing the benefits of situations inherently advantageous to nondrinkers. For example, in single vehicle accidents on dry roads, 51 percent of the normal drivers were culpable. The effect of icy and snowy roads was profound for the normals; the culpability rate increased to 87 percent. Yet for the drinking drivers the culpability rate was only one percent lower on dry roads than slippery ones.

A technical note is added here regarding the meaning of a culpability rate. When the culpability rate is high, it implies a dangerous situation for the driver, but in a special way; after all, if there are many accidents, the situation was dangerous even for the nonculpable drivers. The culpability rate specifically measures the proportion of accidents which were initiated by the driver or his vehicle; this, as opposed to accidents initiated by other drivers or situational events. For example, in a rural setting where animals often precipitate accidents, the culpability rate will have a tendency to be low. Thus, a high culpability rate implies the drivers and their vehicles initiated most of the accidents. As such, the results pertaining to single vehicle accidents show the drinking driver was more hazardous (primarily to himself) on curves than on straight roads.

In this regard, the fact that the culpability rates were so much higher for the drinkers than the nondrinkers, implies that the contribution of the driver to the initiation of accidents was extremely high for drinkers, whereas for the normals, there was a greater mix of environmental accident precipitators along with the driver contribution. It is obvious, therefore, that if one can find a way to improve drivers, the potential gains to be made with drinkers is enormous. It is well to keep in mind that if the culpable behaviors could be prevented, the percentage reduction in accident involvements would be equal to the culpability rate.

Driver and Vehicle Characteristics

In the following, the relationships of driver status to two driver characteristics (sex and age), and one vehicle characteristic (vehicle type) are examined for culpable accident drivers. Following that, results pertaining to driver histories are presented. As before, only accidents investigated on scene by the police were included; hit and run drivers and parked vehicles were excluded. It is well to bear in mind that vehicle characteristics may reflect more about the nature of the driver than about the effect of the vehicle, per se.

As in the situational analyses, proportions were computed two ways. In the upper portion of the table, the percentages reflect the effect of age, for example, given driver status. The percentages in the lower part of the table reflect the effect of driver status given age. Thus, the percentages in the upper part of the table are applicable to the consideration of countermeasures residing with a particular driver status group, while those in the lower part are applicable to the consideration of countermeasures residing with particular age groups.

Driver Sex

Table 32 gives the cross tabulation of driver status and driver sex. It shows that among the drinkers, 90 percent were males. In comparing the drinkers and normals, it is clear that the males were more highly represented among the drinkers; this was statistically significant (X^2_1 = 231.59). The lower part of the table shows 20 percent of the culpable males were drinkers, while only seven percent of the culpable females were drinkers.

Regarding HBD/DWI differences, these were also significant (X^2_1 = 12.40). The females constituted 12 percent of the HBD's, but only eight percent of the DWI's. The lower part of the table shows that while the females were rather evenly split among the DWI's and HBD's, more of the males were cited for DWI.

TABLE 32

Driver Sex by Drinking Status for Culpable Drivers

	Driver Status								
	DWI		HBD		Normal			Drinker	
Sex	N	%	N	%	N	9N	%	N	%
Driver Sex Effect									
Male	1477	92.0	1103	88.0	1162	10458	72.8	2580	90.2
Female	129	8.0	150	12.0	434	3906	27.2	279	9.8
TOTAL	1606	100.0	1253	100.0	1596	14364	100.0	2859	100.0
Driver Status Effect									
Male		11.3		8.5			80.2		19.8
Female		3.1		3.6			93.3		6.7

Driver Age

The data relating driver age and driver status for culpable drivers are shown in Tables 33 and 34. While it was desirable to employ age groups with equally sized ranges so that proportions would not be distorted by range size effects, it was also desirable to use smaller ranges for younger drivers because the nature of young people changes more rapidly over time. First, the raw data are presented at the top of Table 33 with unequal age ranges. Here, it can be seen that the major influence on the percentages was the size of the age range. Since the proportions at the bottom of the table were computed within age groups, the differential range sizes have no effect. In Table 34, the data in the upper part of the first table are repeated but the percentages were divided by the size of each range.

TABLE 33

Driver Age by Driver Status for Culpable Drivers

	Driver Status								
	DWI		HBD		Normal			Drinker	
Driver Age	N	%	N	%	N	9N	%	N	%
Driver Age Effect									
16	10	0.6	8	0.6	44	396	2.8	18	0.6
17, 18	82	5.2	110	8.8	188	1692	11.9	192	6.8
19, 20	123	7.8	174	14.0	181	1629	11.5	297	10.5
21 - 25	273	17.2	274	22.0	261	2349	16.6	547	19.3
26 - 35	356	22.5	270	21.7	310	2790	19.7	626	22.1
36 - 55	569	35.9	314	25.2	378	3402	24.0	883	31.2
56 - 65	143	9.0	77	6.2	119	1071	7.6	220	7.8
66+	28	1.8	19	1.5	95	855	6.0	47	1.7
Total	1584	100.0	1246	100.0	1576	14184	100.0	2830	100.0
Driver Status Effect									
16		2.4		1.9			95.7		4.3
17, 18		4.4		5.8			89.8		10.2
19, 20		6.4		9.0			84.6		15.4
21 - 25		9.4		9.5			81.1		18.9
26 - 35		10.4		7.9			81.7		18.3
36 - 55		13.3		7.3			79.4		20.6
56 - 65		11.1		6.0			83.0		17.0
66+		3.1		2.1			94.8		5.2

TABLE 34

Driver Age by Driver Status for Culpable Drivers Corrected for Age Range

Driver Age Effect

	DWI		HBD		Normal		Drinker	
Driver Age	N	%/Yr.	N	%/Yr.	N	%/Yr.	N	%/Yr.
16	10	-	8	-	44	-	18	-
17, 18	82	2.6	110	4.4	188	6.0	192	3.4
19, 20	123	3.9	174	7.0	181	5.7	297	5.2
21 - 25	273	3.4	274	4.4	261	3.3	547	3.9
26 - 35	356	2.2	270	2.2	310	2.0	626	2.2
36 - 55	569	1.8	314	1.3	378	1.2	883	1.6
56 - 65	143	0.9	77	0.6	119	0.8	220	0.8
66+	28	-	19	-	95	0	47	-
Total	1584		1246		1576		2830	

Looking first at Table 34, it can be seen that the most highly represented ages among the drinkers were 19 and 20. Next were the drivers in the 21 to 25 year group, followed by the 17 and 18 year old drivers. In general, as age increased beyond 20 years, the accident generation problem became less severe. The pattern was quite similar for the normal drivers, but some differences were evident. Most notably, the problem was greatest for the 17 and 18 year old drivers among the normal drivers. A chi-square test showed the difference to be statistically significant (X_5 = 54.15).* The general pattern of differences showed the young drivers (under 21) were a greater problem among the normals than among the drivers.

---

* Percent/year was not computed for the youngest and oldest age groups because the appropriate range size was unknown. The test was based on the data given in the upper portion of Table 33. This was appropriate since age range size was consistent across driver status groups. The data used in testing also excluded the youngest and oldest drivers. Had they been included, we would have obtained X^2_7 = 150.89. Obviously, the youngest and oldest culpable drivers also contributed to the difference between drinkers and normals, with both being under represented among the drinkers.

The age group most troublesome among the drinkers, as compared to the normals, extended from 21 to 55. Although the difference was not large, this range did include over 70 percent of the culpable drinking drivers. Finally, among the drinkers the oldest age group presented less of a problem than they did among the normals (cf. previous footnote).

Differences among the HBD's and DWI's in the 17 to 65 age groups were also statistically significant (X^2_5 = 80.55; if all age groups are included, X^2_7 = 80.83, implying that the oldest and youngest age groups added little to the difference). These data show the primary difference to have been an overrepresentation of the young drivers among the HBD's in comparison to the DWI's.

Looking at the lower part of Table 33, it can be seen that drivers in the 21 to 65 age range had relatively more drinking/accident problems than did older and younger drivers. The first two columns show that these are the ages where DWI charges tended to be high, both in an absolute sense and in comparison with HBD's. Thus, one of the problems in this age group may well be simply that they include more drinkers, and that when they drink, they consume larger amounts.

One can conclude that among the culpable drinkers, the young had the most serious accident problem. On the other hand, the same was true for the non-drinkers. Indeed, the drinkers had proportionately more culpable involvements than the normals only for the large group of drivers from ages 21 to 55, or perhaps 65. These drivers were more often reported as drinking and, in the 26 to 65 group, were more often cited for DWI as opposed to simply reported as HBD. It is important to note that this does not imply the young should be ignored regarding countermeasures. Although they represented a small part of the problem -- only three percent of the culpable drivers were drinkers under 21 [(18 + 192 + 297) ÷ (14184 + 2830) = .03] -- it may be best to treat them before they grow older.

Vehicle Type

The next analysis is a comparison of automobiles, light trucks, and heavy trucks. The upper portion of Table 35 shows that among these culpable drivers, six percent were driving trucks with almost all of them driving light trucks. Among non-drinking drivers, nine percent were driving trucks; they were evenly split between light and heavy trucks. The differences between the normals and the drinkers were statistically significant ($X^2_2 = 88.63$), with the major effect obviously due to the contribution of the heavy trucks.

TABLE 35

Vehicle Type by Driver Status for Culpable Vehicles

	Drinking Status								
	DWI		HBD		Normal			Drinker	
Vehicle Type	N	%	N	%	N	9N	%	N	%
Cars	1473	94.0	1141	93.3	1397	12573	90.7	2614	93.7
Light Trucks	83	5.3	79	6.5	72	648	4.7	162	5.8
Heavy Trucks	11	0.7	3	0.2	71	639	4.6	14	0.5
Total	1567	100.0	1223	100.0	1540	13860	100.0	2790	100.0
Cars		9.7		7.5			82.8		17.2
Light Trucks		10.2		9.8			80.0		20.0
Heavy Trucks		1.7		0.5			97.9		2.1

The differences are most meaningfully portrayed at the bottom of the table. Here it can be seen that while 17 percent of the automobile drivers were drinking, and 20 percent of the light truck drivers were, only two percent of the heavy truck drivers were drinking.

In comparing the DWI's to the HBD's, the cars were not significantly different from the trucks ($X^2 = 0.58$), but there was a significant difference between the light and heavy trucks ($X_1^2 = 3.87$). While among the light trucks, drivers were evenly split between DWI and HBD, for heavy trucks there was over a three-to-one ratio of DWI's to HBD's. While both figures were low, this suggests that drivers of heavy trucks, if they decide to drink at all, decide to drink in quantity.

Thus, the main finding here is that culpable drivers of heavy trucks were far less likely to have been drinking than either drivers of light trucks or automobiles. This, by a factor of nearly ten to one. One might consider that part of this could be accounted for by reduced police reporting of drinking in sympathy for a person who makes his living by driving, but this could apply to drivers of both large and small trucks, and yet the estimated incidence of drinking among light truck drivers was even greater than that for drivers of cars. Furthermore, it is extremely unlikely that reporting biases could account for a ten-to-one differential. Thus, there can be only two explanations. First, drivers of heavy trucks may drink and drive less than other drivers. Second, the effect of drinking upon accident generation may be less for drivers of heavy trucks. In either case, why should these differences exist? There appears to be several possibilities. First, it is likely that the drivers of the heavy trucks were better trained drivers than others. Second, it is likely that they perceive the opportunity for a greater economic loss if charged with drinking or being in an accident. If these are the basic reasons, it suggests better training and more rigorous application of the laws involving economic loss would benefit other drivers as well. Of course, there could be a third explanation; truckers hired by large firms may have been selected so as to exclude those with drinking problems. If so, this may have implications for licensing practices for drivers of other vehicles.

Driver History

Some additional driver oriented analyses were performed using data from Calspan's 1973 merged accident tape. This is a file from the New York State Department of Motor Vehicles in which, where possible, driver license and vehicle registration information has been merged with accident records. Because many police agencies do not forward their accident reports to DMV, most of the accidents in the sample for this study did not appear in this merged tape.

By matching county, month and date for the accidents, and driver age and sex, and vehicle model year, a new file was created which contained both the driver license information and the basic data obtained for this study. A total of 1,773 accidents appear in this file. The variables of primary interest were the frequencies of accidents, convictions, alcohol convictions, and alcohol convictions in accidents. This historical driver information was compiled from 1968 up to but not including the date of the accident in the study sample. In the analyses that follows, only drivers 24 years old and older at the time of the accident were included. Since these are 1973 accidents, all such drivers were at least 18 in 1968. (In New York State a driver can obtain a learner's permit at the age of 16 and an ordinary operator's license at 17 or 18, depending on whether he has had a driving instruction course.) It was thought that by excluding drivers under 24, the problem due to younger drivers having less opportunity to develop a driver history would be minimized.

It should be noted that the state police and the sheriff's departments tend to send most of their reports to DMV. Other agencies, for the most part, send only reports of the more severe accidents. Thus, the findings tend to be weighted toward rural, injury-producing accidents. As in most previous analyses, the following were limited to accidents investigated on scene; hit and run drivers as well as drivers of parked vehicles were excluded. The analyses were not restricted to culpable drivers.

The first analysis was performed to study relationships between drinking status in the 1973 accident sample and number of previous accidents. The results are in Table 36. A chi-square test was applied to compare the DWI's to the HBD's and the difference was not significant ($X^2_3 = 3.22$). However, a comparison of drinkers (HBD's plus DWI's) with normals was statistically significant ($X^2_3 = 15.77$)*. The table clearly shows an increase in the proportion of drinkers in the 1973 accidents as the number of previous accidents increased. The proportions increased from seven percent for no previous accidents to approximately twelve percent for two or more previous accidents. Thus, the data support the conclusion that likelihood of drinking in current accidents was greater for those drivers who had more previous accidents.

TABLE 36

Driver Status by Previous Accidents

Driver Status	Number of Accidents							
	None		One		Two		More	
	N	%	N	%	N	%	N	%
DWI	111	3.3	85	5.6	25	6.5	8	4.9
HBD	121	3.6	66	4.4	25	6.5	11	6.7
Drinkers	232	6.9	151	10.0	50	13.1	19	11.7
(Normal)	(349)		(151)		(37)		(16)	
9 x Normal	3141	93.1	1359	90.0	333	86.9	144	88.3
TOTAL	3373	100.0	1510	100.0	383	100.0	163	100.0

---

* As in other tests, the actual number of normal drivers in the sample was utilized. In the table, all proportions are based on the weighted observations.

The next analysis was an attempt to relate drinking status to previous accidents in which the driver was convicted of an alcohol related violation. The results appear in Table 37. Because of the limited number of observations (there were only 18 drivers with previous alcohol convictions in accidents), neither the comparison of drinkers to normals, nor DWI's to HBD's was significant (X^2_1 = 3.48 and 2.92, respectively). However, if there is a trend, its direction is clear: Of those drivers with no alcohol/accident convictions, eight percent were drinking in the 1973 sample; for those who had a previous accident-related alcohol conviction, 18 percent were drinking.

TABLE 37
Driver Status by Previous Alcohol/Accident Convictions

Driver Status	Number of Alcohol/Accident Convictions			
	None		One	
	N	%	N	%
DWI	220	4.1	9	13.6
HBD	220	4.1	3	4.5
Drinkers	440	8.2	12	18.2
(Normal)	(547)		(6)	
9 x Normal	4923	91.8	54	81.8
Total	5363	100.0	66	100.0

An analysis was performed to examine the relationship between the number of non-alcohol-related convictions and drinking status.* The results are in Table 38. The comparison between normals and drinkers was significant and that between DWI's and HBD's was not (X^2_3 = 59.93 and 6.57, respectively). That drinking occurred most frequently for accident drivers with more previous convictions was clearly evident. The proportion of drinkers increased from five percent for those with no previous convictions to 16 percent for those with three or more convictions; this, although only non-drinking convictions were included. (Of course, many of these convictions may have been the result of plea bargaining.)

TABLE 38

Driver Status by Previous Non-Alcohol Convictions

	Number of Non-alcohol Convictions							
Driver Status	None		One		Two		More	
	N	%	N	%	N	%	N	%
DWI	70	2.3	32	3.0	57	8.6	37	8.6
HBD	80	2.7	42	3.9	37	5.6	32	7.5
Drinkers	150	5.0	74	6.8	94	14.2	69	16.1
(Normal)	(317)		(112)		(63)		(40)	
9 x Normal	2853	95.0	1008	93.2	567	85.8	360	83.9
TOTAL	3003	100.0	1082	100.0	661	100.0	429	100.0

The last driver history variable is previous alcohol-related driving convictions. The data appear in Table 39. Because there were only eight drivers with more than one conviction, the data were dichotomized to drivers with no previous convictions and those with at least one.

The results are most emphatic. While those accident drivers with no previous drinking convictions were found to be drinking in eight percent

---

* All convictions considered in this analysis were restricted to violations of the New York Vehicle and Traffic Law, but excluded any individuals having previous V and T convictions pertaining to drinking.

of their accidents. Those with at least one such conviction were drinking in 36 percent. The difference was statistically significant (X^2_1 = 42.00).

In comparing the DWI's to the HBD's, the DWI's were over-represented among those drivers with previous convictions; however, the difference was not statistically significant (X^2_1 = 2.18).

TABLE 39

Driver Status by Previous Alcohol Convictions

Driver Status	None N	None %	At Least One N	At Least One %
DWI	196	3.7	33	21.4
HBD	201	3.8	22	14.3
Drinkers	397	7.5	55	35.7
(Normal)	(542)		(11)	
9 x Normal	4878	92.5	99	64.3
Total	5275	100.0	154	100.0

An analysis was performed to determine whether drivers with previous drinking convictions were more likely to be culpable in their 1973 accidents. The analysis was performed for all drivers, and then separately for drivers who had and had not been drinking in their 1973 accidents. The results are in Table 40.

The first part of the table shows the relationship between culpability in the 1973 accidents and previous drinking/driving convictions. While 38 percent of those without convictions were culpable, 56 percent of those with previous convictions were culpable.

TABLE 40

Culpability by Previous Alcohol Convictions

Culpable?	Convictions			
	None		At Least One	
	N	%	N	%
	All Drivers (Corrected for Sampling Fraction)			
Yes	2012	38.1	87	56.5
No	3263	61.9	67	43.5
Total	5275	100.0	154	100.0
	Normal Drivers			
Yes	184	33.9	4	36.4
No	358	66.1	7	63.6
Total	542	100.0	11	100.0
	Drinking Drivers			
Yes	356	89.7	51	92.7
No	41	10.3	4	7.3
Total	397	100.0	55	100.0

The remaining parts of the table contain the same data separately for drinking and non-drinking drivers. In both instances, the culpability rate was quite similar for drivers with and without previous drinking convictions.* Thus, when driver status in the accident was controlled, the higher culpability rate for convicted drivers was lost.

---

* Unfortunately, rigorous tests of these effects could not be performed. This would have required the separation of single and multi-vehicle accidents to avoid the dependence problems associated with culpability analyses. In attempting to do so, it quickly became apparent that the resultant number of observations were too small to provide meaningful results. The chi-squares for the three parts of Table 40 were 16.59, 0.03, and 1.78, each with one degree of freedom.

These findings imply that drivers with previous driving-related drinking convictions were more likely to be culpable in ensuing accidents. But, because there was no evidence that drivers with previous convictions were more culpable when driver status was held constant, the explanation lies in the facts that convicted drivers were more likely to have been drinking, and drinking drivers were more likely to be culpable.

Summary

The major findings in this section pertain to driver age, drivers of heavy trucks, and drivers with previous accident and convictions for traffic violations.

Regarding driver age, it was found that among culpable drinkers, the 19 and 20 year group had the highest accident frequency. On the other hand, the age group most troubled by accidents and drinking was between 21 and 55. Drinking drivers under 21 comprised 3 percent of all culpable accident drivers.

Regarding vehicle type, only two percent of the culpable heavy truck drivers had been drinking. This can be compared with 17 percent for automobiles and 20 percent for light trucks. This suggested that either drinking - accident generation can be avoided if the driver has a perceived need to do so, or that drivers can be selected as to minimize such problems.

The driver history data implied that previous driver experience was an important indication of their drinking status in later accidents. Among accident drivers, the proportion drinking increased from 7 to 13 percent as a function of previous non-alcohol convictions, and from eight to 37 percent as a function of previous alcohol convictions. It was also shown that the culpability rate increased from 38 to 56 percent as a function of previous alcohol convictions; this was attributed not directly to the history of convictions, per se, but rather to continued drinking.

The vehicle type data and those relating to driver history can be usefully considered together. The findings pertaining to heavy trucks implied either a driver could avoid an alcohol-accident problem if it was important to do so, or drivers could be selected so as to minimize this problem. The driver history data indicated greater alcohol-accident problems for drivers with previous accidents and convictions, particularly drinking convictions.

These findings complement each other in suggesting that driver selection, and therefore licensing methods, can be important in reducing the alcohol-accident problem. It appears that driver histories are a good tool for doing so.

Secondly, if one believes that the truck data imply the drinking-accident problems can be minimized if the driver perceives sufficient economic risk, the driver history data indicate the perceived risk was not sufficient for drivers even though they had previous convictions. Perhaps an increase in the economic penalty would be beneficial, assuming the courts would cooperate.

Driver Interviews

Culpable drivers, randomly selected from the 1973 accidents in Erie County, were called on the telephone for interviews. Because approximately one-half of the drivers could not be interviewed (three-eighths could not be contacted and one-eighth refused), the sample size was limited to 391 interviews. For the same reasons, it is unlikely that the random nature of the sample was preserved. While one cannot demonstrate that the interview sample was or was not random, the following was encouraging. Among the 344 interviews in which driver status could be identified as DWI, HBD, or normal from the police reports, the percentages were: DWI-35.5, HBD-18.3, and Normal-46.2. Among the 2,964 police reported culpable drivers in Erie County accidents, the corresponding percentages were 39.2, 18.1, and 42.7; the differences were not statistically significant ($X_2^2 = 2.04$). Thus, one can conclude that the interview sample was reasonably representative of the sample from which it was drawn, at least with regard to driver status.

Because of the limited sample size, only a small number of analyses are reported here. The first analysis is a comparison of driver status, as determined from the accident report, with amount of drinking as reported in the interview. The amount of drinking as used here was simply by the number of drinks, irrespective of the type (beer, wine, mixed drink, etc.). The results are in Table 41 .

It can be readily seen that some of the interviewed drivers were not totally honest. For example, of the 180 who reported no drinking, 19 were cited for DWI, and 22 were reported as HBD. Of the three refusals for this question, all were cited for DWI. Of those who said they did not know how much they drank, almost three-fourths were cited for DWI and one-fifth were reported as HBD's.

TABLE 41

Driver Status by Number of Drinks Reported in the Interview

Number of Drinks	DWI		HBD		Normal		Drinker		Total	
	N	%	N	%	N	%	N	%	N	%
None	19	10.6	22	12.2	139	77.2	41	22.8	180	100
1, 2	22	50.0	16	36.4	6	13.6	38	86.4	44	100
3, 4	23	71.9	4	12.5	5	15.6	27	84.4	32	100
5, 6	10	50.0	7	35.0	3	15.0	17	85.0	20	100
More	23	65.7	8	22.9	4	11.4	31	88.6	35	100
Refused	3	100.0	0	0.0	0	0.0	3	100.0	3	100
Unknown	22	73.3	6	20.0	2	6.7	28	93.3	30	100

However, the primary interest here was not in the quality of the interview information but, rather, in the police reporting. The concern was that the police may have often failed to report drinking. Looking at the second through fifth rows, it can be seen that for those instances when the driver said he had been drinking, the police had also reported either DWI or HBD in 84 to 89 percent of the cases. While this does indicate some amount of underreporting by the police, the problem was not large in magnitude and not conducive to serious biases in the results of the study.

Regarding the driver status among the drinkers, if a driver admitted to more than seven drinks, it is quite likely that his BAL exceeded .10 percent; yet only two-thirds of these drivers were cited for DWI.

The proportion of DWI's among the drinkers was computed for each of the interview response classes. They are: None - .46, 1 or 2 - .58, 3 or 4 - .85, 5 or 6 - .59, and 7 or more - .74. Except for the middle category, the proportion of DWI's increased monotonically with the amount of drinking as stated by the driver.

Generally speaking, it appears that the police reporting of drinking was far more reliable than one might have expected. While it appears that DWI's citations were not always given when they could have been, the reporting of DWI and HBD, taken together, was quite good.

The next two analyses refer to the nature of the trip in which the accident occurred. Table 42 gives the stated distance from home of the accident within each driver status category. The percentages are based on cumulative frequencies. For the purposes of testing, chi-square tests were applied to the original frequencies with the last two rows combined. Comparing the normals to the drinkers, it can be seen that the cumulatives never differed by more than a few percentage points, and the differences were not significant ($X_4^2 = 1.67$).

TABLE 42

Distance from Home by Driver Status

	Driver Status							
Distance	DWI		HBD		Normal		Drinker	
(Miles)	N	C.%	N	C.%	N	C.%	N	C.%
1 or less	27	22.3	16	25.4	43	27.4	43	23.4
2, 3	34	50.4	9	39.7	32	47.8	43	46.7
4, 5	23	69.4	8	52.4	22	61.8	31	63.6
6-10	27	91.7	14	74.6	34	83.4	41	85.9
11-50	9	99.2	15	98.4	20	96.2	24	98.9
More	1	100.0	1	100.0	6	100.0	2	100.0
Total	121		63		157		184	

In comparing the DWI's and the HBD's, however, differences are apparent, and the test was significant (X_4^2 = 13.14). The data show that while 69 percent of the DWI's had their accidents within five miles of their homes, only 52 percent of the HBD's did. This 17 percent differential held up for accidents within 10 miles as well. When considering accidents within 50 miles, the differences were minor. Thus, the HBD's tended to have their accidents further from home than did the DWI's. Specifically, the HBD's had more accidents in the 11 to 50 mile range.

Regarding the absence of differences between drinkers and normals, the table shows that the DWI's and the HBD's tended to straddle the normals. That is, while 83 percent of the normals had their accidents within 10 miles of their homes, 92 percent of the DWI's did, but only 75 percent of the HBD's did. This sort of relationship was true for accidents within five miles and even within three miles. That the HBD's had an overinvolvement in accidents in the 11 to 50 mile range correlates well with the earlier findings in which they were overrepresented in rural accidents and ran-off-road accidents.

The next analysis is related to the last. It involves the frequency with which the interviewees said they had previously driven on the road where the accident occurred; this can be thought of as a measure of familiarity with the road. The results are in Table 43 . Again, the percentages reflect relative cumulative frequencies. There were no large discrepancies in the percentages either when comparing drinkers to normals or DWI's to HBD's, and the tests did not indicate statistical significance (X_4^2 = 1.79 for drinkers vs. normals, and X_2^2 = 0.68 for DWI's vs. HBD's after combing rows 2 and 3, and rows 4 and 5).

TABLE 43

Road Familiarity by Driver Status

	Driver Status							
	DWI		HBD		Normal		Drinker	
Frequency	N	C.%	N	C.%	N	C.%	N	C.%
Few times per week or daily	88	72.1	42	66.7	118	76.1	130	70.3
Few times per month	15	84.4	9	81.0	17	87.1	24	83.2
Few times per year	5	88.5	4	87.3	6	91.0	9	88.1
A few times	11	97.5	5	95.2	9	96.8	16	96.8
Never before	3	100.0	3	100.0	5	100.0	6	100.0
TOTAL	122		63		155		185	

Thus, while the HBD's had their accidents further from home, there was no important decrease in their familiarity with the roads on which the accidents occured. This seems to indicate that the HBD's more habitually drove in the 11 to 50 mile range. That earlier results had shown the culpable HBD's to be younger than culpable DWI's tends to complement this result. It is quite believable that younger drivers, particularly those that drink, characteristically traveled within a larger radius than did older drivers.

A second point of interest regarding Table 43 is the fact that in any of the driver status groups, a large portion of the accidents occurred on roads familiar to the drivers. Over 70 percent of the accidents occurred on roads which the drivers traveled at least a few times per week. Approximately 85 percent occurred on roads which the drivers used at least a few times per month. Thus, lack of familiarity with the road had only limited opportunity to influence the accidents; in particular, there was no reason to believe it had differential effects as a function of driver status.

The final analysis of the interview data pertains to the relationship between educational level and driver status. The data appear in Table 44. The percentages were computed within rows and reflect the proportion of the driver status given the educational level. The differences between the drinkers and nondrinkers were significant ($X_3^2 = 9.39$; the last two rows were combined). The difference between DWI's and HBD's, although it grew smaller with increasing education, was not significant ($X_2^2 = 0.76$; the last three rows were combined).

TABLE 44

Driver Status by Educational Level

	Driver Status							
	DWI		HBD		Normal		Drinker	
	N	%	N	%	N	%	N	%
Did not finish high school	34	46.6	15	20.5	24	32.9	49	67.1
Graduated from high school	48	36.4	24	18.2	60	45.5	72	54.5
High school plus vocational training or college	32	29.4	19	17.4	58	53.2	51	46.8
Bachelor's Degree	4	25.0	3	18.8	9	56.3	7	43.8
Graduate Degree	1	14.3	1	14.3	5	71.4	2	28.6

Thus, there was a monotonically decreasing incidence of drinking with increasing educational level. While driver age might have been a factor here (there were too few observations to study this directly), it is quite unlikely. Recall that early findings showed drinkers to be overrepresented among culpable drivers in the 21 to 55 age groups. These were the very drivers who had the greater opportunity to attain higher educational levels.

Summary

From a technical viewpoint, the most important result in this section is that the police failed to report a drinking driver for only approximately 15 percent of those drivers who said they did drink before the accident. Thus, the opportunity for biases due to police reporting were quite limited. It is possible that a number of drinkers were reported as nondrinkers in both the interview and the police report; nontheless, the finding was encouraging, particularly in view of the fact that, among the drivers who said they were not drinking, the police reported 23 percent were.

Other results showed the HBD's had their accidents further from home than did the DWI's. On the other hand, no difference was found among the driver status groups regarding familiarity with the road. This suggested HBD's typically take longer trips. It was also found that approximately 85 percent of the drivers had accidents on familiar roads, regardless of their drinking status.

The final analysis showed that among culpable drivers interviewed, the likelihood of being reported as drinking in their accidents decreased with higher educational levels.

Composite Analysis

In order to look at the drinking accidents in more detail, they were cross tabulated for driver characteristics (age, sex, driver status) and conditions (day/night and location) simultaneously. The results are in Table 45 . It includes 2503 accidents in which the drinking driver was culpable and the five variables listed above were known. As before, only accidents investigated at the scene were included; unidentified hit-and-runs and parked cars were excluded; only culpable drivers were included.

The first two tabular blocks include all the raw data plus some grouped data. Location was collapsed to give day and night frequencies. Also, time was collapsed to give location frequencies. Because of limited observations in other locations, only urban (Buffalo and Niagara Falls), suburban (specifically, suburban Buffalo), and rural areas were used. These two blocks also reflect eight driver groups defined by driver status, age, and sex. Driver age was dichotomized so that the young group contained all drivers under 21 years. This grouping was based on earlier results showing a greater drinking-accident problem for drivers over twenty; it also allowed further study of the young since this is of current interest.

In the lower blocks of the table the driver-related variables are combined to provide summary data. DWI's and HBD's were combined, young and old were grouped allowing comparisons of males and females, males and females were combined allowing age comparisons, and finally, the data were collapsed over all driver characteristics.

It can be seen that of the 2,503 accidents, there were 2,054 nighttime accidents and only 449 during the day, 2,047 older drivers and only 456 young, and 2,262 males and only 241 females. Thus, the data set was dominated by older males in nighttime accidents. The intersection of these three sets contained 1,482 (or 59 percent) of all the accidents. The smallest subset defined in terms of sex, age, and time was two young females in daytime accidents. In fact, there were only 44 young females altogether; this is only two percent of the data set. In comparison to those variables, location and driver status were more uniformly distributed.

Considering first the problems of the young drinkers, 405 (89 percent) of their accidents occurred at night, and 403 (88 percent) were in either suburban or rural areas with the difference between the two being small. Thus, the young had most of their accidents in suburban and rural areas at night (78 percent). Similarly, during the day, they had more of their accidents in suburban and rural areas, but this constituted a much smaller part of their problem. These patterns applied to both young males and young females, but because the number of young females was small, the major trends were determined by the males.

Considering the old drivers (i.e., 21 and older), 1,649 (81 percent) of their accidents occurred at night. Their accidents were more uniformly divided over location than were the young drivers. While the young had only 12 percent of their accidents in urban areas, the old drivers had 27 percent there. Furthermore, while the young favored rural areas, the old drivers had more accidents in suburban areas. In the daytime, the accidents of the old drivers were approximately evenly distributed over location. Females constituted ten percent of the old drivers; almost half their accidents were suburban, both during the day and at night. Whether this high incidence of suburban accidents for females reflects women that live there is unknown.

TABLE 45

Drinking Accidents for Cross-Classifications of Driver and Situational Variables

Driver Variables			Situational Variables											
			Day				Night				Day Plus Night			
Age	Sex	Driver Status	Urban	Sub.	Rural	Total	Urban	Sub.	Rural	Total	Urban	Sub.	Rural	Total
Young	Male	DWI	1	6	10	17	23	80	56	159	24	86	66	176
Old			76	67	74	217	264	370	238	872	340	437	312	1089
Young	Female		0	0	1	1	4	3	5	12	4	3	6	13
Old			4	8	4	16	17	43	20	80	21	51	24	96
Young	Male	HBD	1	12	19	32	20	73	111	204	21	85	130	236
Old			40	55	56	151	139	224	247	610	179	279	303	761
Young	Female		0	0	1	1	4	14	12	30	4	14	13	31
Old			3	6	5	14	19	39	29	87	22	45	34	101
Young	Male	-	2	18	29	49	43	153	167	363	45	171	196	412
Old			116	122	130	368	403	594	485	1482	519	716	615	1850
Young	Female		0	0	2	2	8	17	17	42	8	17	19	44
Old			7	14	9	30	36	82	49	167	43	96	58	197
-	Male	-	118	140	159	417	446	747	652	1845	564	887	811	2262
	Female		7	14	11	32	44	99	66	209	51	113	77	241
Young	-	-	2	18	31	51	51	170	184	405	53	188	215	456
Old			123	136	139	398	439	676	534	1649	562	812	673	2047
TOTAL			125	154	170	449	490	846	718	2054	615	1000	888	2503

Comparing the HBD's to the DWI's, it can be seen that for young males, rural accidents were more frequent for the HBD's (55 percent) than for the DWI's (38 percent). For the old males, the figures were 40 percent and 29 percent, respectively. For the females, the respective figures were 36 percent and 28 percent. Thus, in general, the HBD's had more rural accidents than did the DWI's. This may well imply that if a driver planned to drive in rural areas, he may have limited his drinking to some extent. (In rural accidents, 54 percent were HBD's as opposed to DWI's; this can be compared with 42 percent in suburban accidents, and 37 percent in urban accidents.)

Comparing daytime and nighttime drinking accidents, the young had 11 percent of their accidents during the day and the females had 13 percent then. In contrast, the males had 18 percent during the day and the older drivers had 19 percent then. In the extreme, the young females had five percent during the day and the older males had 20 percent during the day. This may reflect differential drinking habits, or less availability of cars to women and young drivers during the day.

Finally, to provide general measures of the scope of the drinking accident problem, we can look at the third data block for the highest frequency combinations of age, sex, time of day, and location. The most frequent combinations were the 594 (or 24 percent) accidents involving men over 20 in suburban areas at night. Next were 485 (19 percent) accidents involving these drivers in rural areas. Following that closely were the 403 of the same driver types in urban accidents (16 percent). Next were young males in rural (167 - seven percent) and suburban (153 - six percent) nighttime accidents. Following that were rural, suburban, and urban daytime accidents for the older men (each five percent). These eight groups accounted for 2,170 (or 87 percent) of the accidents in this data set. That the older drivers were overrepresented was, in large part, a function of the fact that this group included all drivers over 20. On the other hand, it is important to recognize, as noted earlier, that at least in the Western New York area in 1973, the young drinking drivers accounted for a limited part of the drinking driver problem.

In the next analysis, eight accident types, defined in terms of the accident configuration and critical event, were cross-tabulated with driver age and sex, time and location. In all instances, the target was either a vehicle or the edge of the road. Because of its high frequency, the first listed accident (class R) will be discussed in more detail shortly. It includes both ran-off-road accidents and striking an off-path parked vehicle due to a lateral move. The last specified accident, involving a vehicle continueing to the rear, also included both vehicles and road departures as targets. All the remaining accident types had only other motor vehicles as targets.

The accident types were cross tabulated only with one variable at a time due to limited numbers of observations. Where justified by sufficient frequencies, the text contains results for the variables in combination. The results are in Table 46 . The last row gives the proportion of accidents at each level of the independent variables. The percentages in the table are proportions of each accident type within levels of the independent variables.

First, it is clear that the class R accidents occurred most frequently, *irrespective of the independent variable.* It constituted 41 *percent of all* accidents in the data set. The next most frequently occurring accident was the rear end accident in which the subject failed to avoid a slower or, more usually, stopped but not parked vehicle ahead. This was the second most frequently occurring accident type among the drinkers regardless of the independent variable. Nonetheless, there were some differences among them. The rear end accident occurred least frequently among the young drivers and in rural areas. The latter was probably due to the lower frequency of stopped vehicles on rural roads. Because young drinking drivers had more accidents on rural roads than on either urban or suburban ones, this may also account in part for the lower frequency of rear end accidents for them.

TABLE 46

Accident Types by Driver and Situational Variables-Bivariate Analyses

		Driver Age		Driver Sex		Time		Location			
	Accident Type	Young	Old	Male	Female	Day	Night	Urban	Sub.	Rural	Total
1.	Front Side - Stationary (Class R)	58.3	37.1	40.8	42.7	31.4	43.0	24.7	37.5	56.1	41.0
2.	Rear End	7.2	14.9	13.4	13.7	18.0	12.5	17.9	15.9	7.7	13.5
3.	In Path Parked Vehicle	3.7	7.1	6.8	4.1	4.0	7.1	14.5	5.5	2.1	6.5
4.	Parallel Opposite - Move	3.5	7.1	6.1	9.1	8.0	6.1	5.7	7.4	5.9	6.4
5.	Parallel Opposite - Left Turn	1.3	3.0	2.6	3.3	3.6	2.5	2.6	3.6	1.7	2.7
6.	Intersecting Path - Continue	2.6	4.0	3.9	2.5	6.0	3.3	5.2	4.0	2.5	3.8
7.	Intersecting Path - Start	0.0	0.8	0.7	0.8	0.7	0.7	0.3	1.0	0.6	0.7
8.	Rearward - Continue	1.3	1.8	1.7	1.7	2.4	1.5	2.6	1.4	1.4	1.7
9.	Other	21.9	24.3	24.0	22.0	25.8	23.4	26.5	23.7	22.2	23.9
10.	Total Frequency	456	2047	2262	241	449	2054	615	1000	888	2503
11.	Proportion	18.2	81.8	90.4	9.6	17.9	82.1	24.6	40.0	35.5	100.0

The likelihood of rear end accidents among the drinkers' accidents was high for the older drivers, during the daytime, and in urban and suburban areas. Again, the latter is predictable on the basis of more traffic controls in the nonrural areas. (Most rear end accidents occur at intersections where a vehicle is stopped for a traffic control or waiting to make a left turn.) That rear end accidents should have occurred more frequently for daytime drinkers was not expected. It may have been due to rush hour traffic in urban areas, or it might reflect greater contrast of rear lights at night.

The data in Table 46 reflect driver and situational characteristics separately. When considering only accidents for older drivers in urban and suburban areas during the day (i.e., when the three conditions existed simultaneously), 61 out of 259, or 24 percent, were rear end accidents.

The next accident type involves vehicles striking parked vehicles in their paths. Not unexpectedly, this accident type was most frequent for drinkers in urban areas; this is where cars are most often parked on the road. Whereas this constituted almost 15 percent of the drinking accidents in urban areas, it accounted for only two percent of the accidents in rural areas. This accident type also occurred more frequently among culpable drinkers at night than during the day. This may reflect decreased attention-getting value of a parked car at night.

In addition to urban and nighttime accidents, this accident type also occurred more frequently for older drivers and for males. There were 403 drinking accidents which met these criteria; of them, 73 or 18 percent, involved striking parked vehicles in the subject vehicle's path.

The next accident type involves a driver moving, not turning, to his left thereby striking an oncoming vehicle. This type of accident was most frequent for females, for daytime accidents, and to a lesser degree, for suburban accidents. While this pattern suggests a suburban shopper, the reason for these findings is unknown and no hypotheses are offered. There were only 14 daytime accidents involving female drivers in the suburbs. Of these, three, or 21 percent, involved moving out one's path to strike an oncoming vehicle. Obviously, the problem was not a major one. Row five contains similar accidents except that the critical event was a left turn. The only notable effects here are the low relative frequencies among rural accidents and young drivers. The former is probably a direct result of fewer intersections in rural areas. That young drinking drivers had fewer accidents of this type, agrees with their increased incidence of rural accidents.

The next two accident types involve intersecting paths. In the first, the driver simply continued until a collision occurred; in the second he had stopped, and precipitated an accident by starting. As had been noted earlier, the second type occurred much less frequently for drinkers than did the first. Those intersecting path accidents in which the subject vehicle continued occurred more frequently for drinkers in the daytime than at night. This may be due to ready detection of the headlights or headlight beams on the road at night. These accidents were less frequent in rural areas, again, presumably due to fewer intersections. Finally, they occurred relatively less often for young drinkers than old. Indeed, all three intersection accident types (rows 5, 6, and 7) were underrepresented for young drinkers. It is possible that these drivers were less callous with regard to the hazards of intersections. On the other hand, this may simply be due to the high proportion of class R accidents for the young drinking drivers suppressing the relative frequencies of other accident types.

Last are the accidents involving a continue along a rearward path. The major differences here involve the higher relative frequencies during the day and in urban areas. Because the numbers of observations are quite low here, it is felt that no hypotheses are called for.

The single most frequently occurring accident type for the drinkers was the class R type. That is, the vehicle was proceeding forward; the target was to the left front or right front, and was stationary; the target was either the road edge or a parked vehicle; the critical event was a move as opposed to a turn. Because of the high frequency of this accident type, it was studied separately within the full context defined by: (1) night versus day; (2) accident location; (3) driver sex; (4) driver age; and (5) drinking status.

The results appear in Table 47 . The entries in the table are the number of class R accidents divided by the total number of drinking accidents within each cell. The denominators appear in Table 45; the numerators are given in Appendix E. Proportions were computed only if the denominators reflected at least 20 observations. The lower portions of the table show the effects after collapsing over driver variables in the same format applied in Table 45.

In the lower left, it can be seen that when considering the full set of 2503 accidents, 41 percent were of the class R type. The conditions in which class R accidents constituted the largest proportion of accidents for drinkers were rural nighttime accidents by young male DWI's; the proportion was 71 percent. For rural accidents, including both day and night for the same drivers, the proportion was 70 percent; the change was small because less than 20 of those drivers had their accidents during the daytime. For the HBD's among young, culpable males, 67 percent of the rural nighttime accidents were in class R; for all rural accidents for these drivers, the proportion was 65 percent.

Therefore, looking at the third block down where DWI's and HBD's are combined, we have 68 percent of the rural, nighttime accidents and 66 percent of the all rural accidents by young men were of class R. Furthermore, because there were so few young women in this data set, their contribution was small. Thus, for all young drinking, culpable drivers in rural nighttime accidents, 68 percent were of class R. Finally, for all young drinking, culpable drivers in all rural accidents, 66 percent were of class R.

TABLE 47

Class R Accidents by Driver and Situational Variables

Driver Variables			Situational Variables											
			Day				Night				Day Plus Night			
Age	Sex	Driver Status	Urban	Sub.	Rural	Total	Urban	Sub.	Rural	Total	Urban	Sub.	Rural	Total
Young	Male	DWI	-	-	-	-	21.7	52.5	71.4	54.7	20.8	50.0	69.7	53.4
Old			18.4	28.4	40.5	29.0	20.5	28.4	51.7	32.3	20.0	28.4	49.0	31.7
Young	Female		-	-	-	-	-	-	-	-	-	-	-	-
Old			-	-	-	-	-	37.2	60.0	43.8	38.1	33.3	50.0	38.5
Young	Male	HBD	-	-	-	46.9	45.0	64.4	66.7	63.7	42.9	61.2	64.6	61.4
Old			20.0	27.3	44.6	31.8	31.7	43.8	59.9	47.5	29.1	40.5	57.1	44.4
Young	Female		-	-	-	-	-	-	-	63.3	-	-	-	61.3
Old			-	-	-	-	-	35.9	48.3	39.1	27.3	33.3	52.9	38.6
Young	Male	[redacted]	-	-	55.2	44.9	32.6	58.2	68.3	59.8	31.1	55.6	66.3	58.0
Old			19.0	27.9	42.3	30.2	24.3	34.2	55.9	38.6	23.1	33.1	53.0	36.9
Young	Female		-	-	-	-	-	-	-	61.9	-	-	-	61.4
Old			-	-	-	23.3	36.1	36.6	53.1	41.3	32.6	33.3	51.7	38.6
-	Male	-	18.6	28.6	44.7	31.9	25.1	39.1	59.0	42.8	23.8	37.4	56.2	40.8
-	Female	-	-	-	-	25.0	38.6	41.4	56.1	45.5	35.3	38.1	54.5	42.7
Young	-	-	-	-	54.8	45.1	35.3	58.8	67.9	60.0	34.0	56.4	66.0	58.3
Old			18.7	26.5	42.4	29.6	25.3	34.5	55.6	38.9	23.8	33.1	52.9	37.1
TOTAL			18.4	27.3	44.7	31.4	26.3	39.4	58.8	43.0	24.7	37.5	56.1	41.0

Therefore, young people who drive on rural roads would be a valid target group for countermeasures applicable to class R accidents. In this data set of 2,503 accidents with 1,025 class R accidents, the young drivers in rural accidents numbered 215; of these 142 were of class R.

Looking for a broader target group, it can be seen that in every row of Table 47, the highest proportions are for rural nighttime accidents, and the second highest were for all rural accidents. The difference between the two was small because of the few drinking accidents in the daytime. There were 718 rural nighttime accidents, of which 422 were class R; there were 888 rural accidents (both day and night), of which 498 were class R.

Generally speaking, the differences between young and old drivers exceeded that between males and females. For the young drivers, suburban nighttime accidents were also a problem, but of somewhat lesser magnitude; for them, the day/night dimension had little effect.

While accidents of class R were almost always the largest problem for the drinkers, the table shows that in some conditions the problem was much less than that discussed above. Of all daytime drinking accidents, class R constituted 31 percent. In urban accidents at night, it accounted for 26 percent of the accidents, and during the day 18 percent. Another relatively low figure was obtained for suburban daytime accidents -- 27 percent. Thus, class R accidents constituted a relatively smaller problem for drinkers in urban areas and during the daytime, with the lowest relative frequency occurring in the combination of the two factors. In daytime accidents, the young males had a relatively high class R rate, but there were sufficiently few young men in daytime accidents that the overall effect was small.

It is important to remember that these results are based on proportions computed within each cell of Table 47, and therefore, reflect the extent of the class R problem given an accident defined by the cell descriptions. As noted earlier, the simple frequencies of class R accidents appear in Appendix E. These frequencies show, once again, that simply because the older males constitute a larger group than young ones, most class R accidents involved drinking males above 20 years of age.

While the primary purpose of this section was to describe some of the problems of drinking drivers, a special analysis was included here which compares drinkers to nondrinkers. Earlier results pertaining to accident types had shown drinking drivers to have more often initiated accidents in passive ways in low demand conditions. After that, it was shown that the situations which were overrepresented for drinkers had rural characteristics. These findings produced a basic question. Recognizing that rural roads are less likely to place specific demands on drivers, were drinkers' accidents more often rural because they had low demand accidents, or were drinkers' accidents more often of a low demand type because they were rural? The analysis in Table 48 is an attempt to resolve this issue.

In the table, accident types are crossed with location for drinking and nondrinking drivers. The left-hand part of the table gives the proportion of the drivers who were drinking within each accident type by location combination. The eight accident types discussed earlier in this section were utilized, and were ranked from high demand to low demand using the order appearing in the section on driver behaviors and accident characteristics.

There are some irregularities in the table; for example, the erratic proportions for intersecting path-start accidents. Furthermore, the ranking indicated here on empirical grounds is somewhat different than the original ranking which was rationally determined. Nonetheless, the table does serve to answer the question at hand. Looking within each of the three left hand columns, there is a definite trend toward increasing representation of the drinking driver for the passive involvement accidents. Even in urban areas, the drinkers were overrepresented among the passive involvement accidents.

TABLE 48

Drinking Status as a Function of Accident Type and Location

Accident Type	Drinkers			Normals			Proportion* Drinkers (%)		
	Urban	Sub.	Rural	Urban	Sub.	Rural	Urban	Sub.	Rural
Parallel Opposite - Left Turn	16	36	15	23	37	18	41.0	49.3	45.5
Rearward - Continue	16	14	12	18	11	9	47.1	56.0	57.1
Intersecting Path - Start	2	10	5	33	27	26	5.7	27.0	16.1
Intersecting Path - Continue	32	40	22	45	39	25	41.6	50.6	46.8
Rear End	110	159	68	75	96	54	59.5	62.4	55.7
In Path Parked Vehicle	89	55	19	22	12	4	80.2	82.1	82.6
Class R	152	375	498	58	80	104	72.4	82.4	82.7
Parallel Opposite - Move	35	74	52	17	32	26	67.3	69.8	66.7

*These proportions were not corrected for sampling fractions and should not be used for population estimates.

Regarding location effects, the results were not quite so obvious. It can be seen that the higher proportions of drinkers occurred in both suburban and rural accidents for most accident types; rear end accidents, parked vehicles in the subject's path, and moving to striking oncoming vehicles were exceptions. Thus, the location effect was applicable to most accident types.

In general, then, the drinkers retained their propensity toward passive, low demand accidents irrespective of location, but they also retained, for most accident types, their overrepresentation in suburban and rural accidents. While it cannot be claimed, therefore, that either factor is necessarily more basic than the other, it is important to note that accident type accounted for a much greater part of the variation in the proportion of drinkers than did location. That is, there was a greater distinction between culpable drinkers and culpable nondrinkers based on accident type than location.

Summary

All of these analyses, except the last, were conducted using only culpable drinking drivers; this, in an attempt to delineate their problems in more detail. There was a definite preponderance of males, drivers older than 20, and nighttime accidents. Drivers in accidents fitting these three characteristics accounted for 59 percent of the 2,503 accidents studied here. Drivers in accidents lacking these characteristics (namely, young females in daytime accidents) accounted for less than one-tenth of a percent of accidents.

While the accidents of older drinking males were reasonably uniformly distributed over urban, suburban, and rural areas, young drinking males had increasing accident frequencies from urban to suburban to rural areas. The females had most of their accidents in suburban areas.

Daytime accidents accounted for 18 percent of the total. This was close to the 20 percent figure when considering old males alone. The minimum value, five percent, was found for young female drinkers.

In general, the most frequent accident combinations, considering driver age and sex, location, and time, were males over 20 at night in any location, young males at night in suburban and rural accidents, and older males during the day in any location.

When studying accident types given driver and situational conditions, it was found that class R accidents had the highest relative frequency irrespective of age, sex, time, or location. Rear end accidents were problems most frequently for older drivers in daytime urban and suburban accidents, and least frequently for young drivers and for drivers in rural areas. Striking parked cars in one's path was a problem primarily for urban drivers. The highest realtive frequency of such accidents was for older males at night in urban areas. Female drinkers had a disproportionately high involvement, as did all daytime drinkers, in accidents they generated by moving to the left and striking oncoming vehicles.

Regarding class R accidents alone, they accounted for 66 percent of all accidents by young drivers in rural areas. This was mainly due to young males in rural, nighttime accidents. For every driver age, sex, and driver status combination, the proportion of class R accidents was highest among rural, nighttime accidents; they were lowest for daytime, urban accidents.

Finally, an analysis of accident type by location for drinkers and nondrinkers showed that the drinkers' greater propensity for passive accident involvement in low demand situations was not simply a result of overinvolvement in suburban and rural accidents. The tendency toward these passive accidents was maintained even in urban areas.

REFERENCES

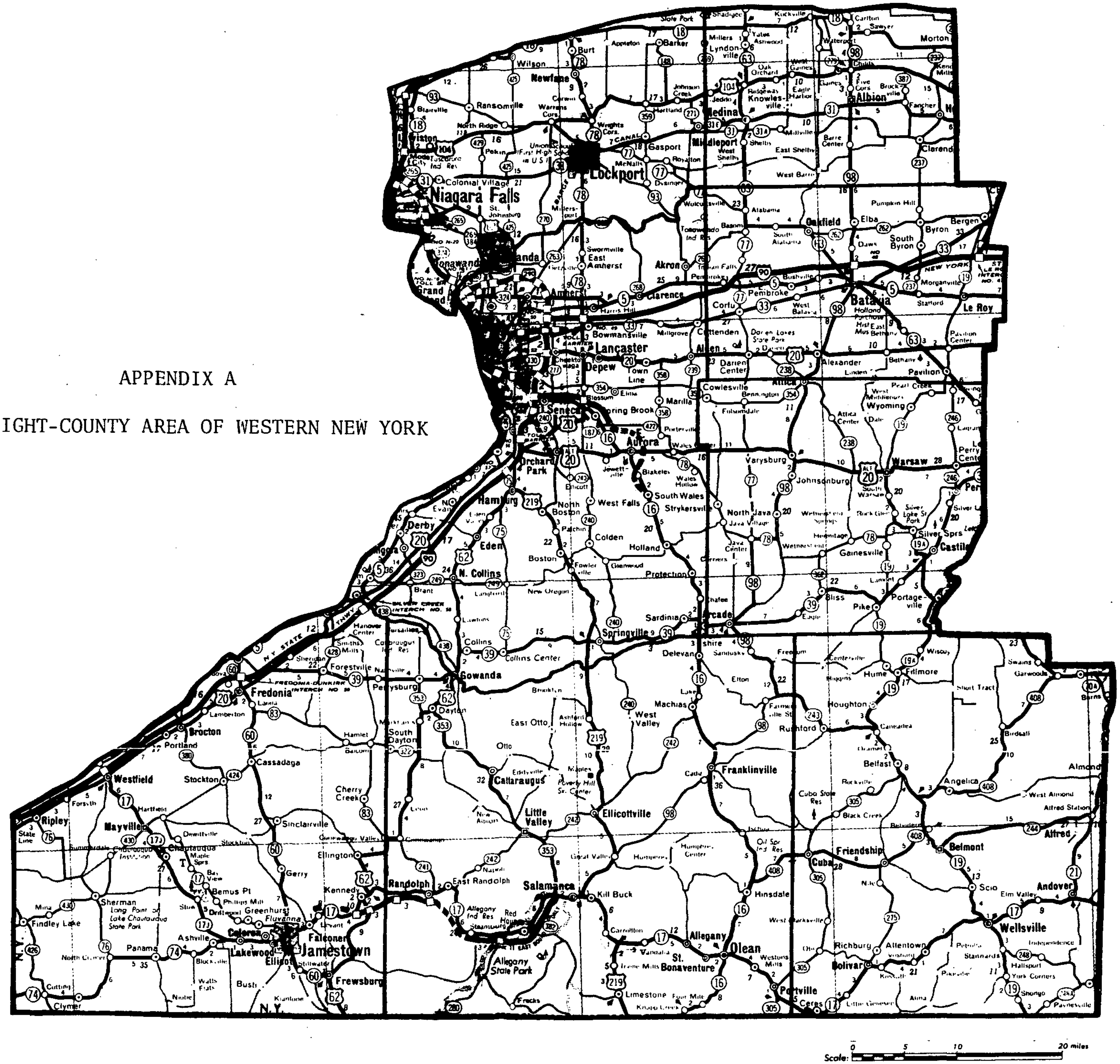
Garrett, J.W., Braisted, R.C., and Morris, D.F., "Tri-Level Accident Research Study", Calspan Report No. VJ-2893-V-2, May 1972, DOT Contract FH-11-7098.

Perchonok, K., "Accident Cause Analysis", Calspan Report No. ZM-5010-V-3, July 1972, DOT Contract No. HS-053-1-109.

Torgerson, W.S., "Theory and Methods of Scaling", published by John Witey and Sons, Inc., New York, 1958, p. 307.

APPENDIX A

EIGHT-COUNTY AREA OF WESTERN NEW YORK



APPENDIX B

INTERVIEW FORM

INTERVIEW

Alcohol Study

Ax. No. _ _ _ _

Driver No. _

Driver Age _ _

Driver Sex _ M-1, F-2, Unk.-3

Interview Status	1	Completed
	2	Refused Interview
	3	Unable to Contact

NAME:

PHONE:

Accident Information

Vehicle Type

Auto:	Sports	01
	Subcompact	02
	Compact	03
	Intermediate	04
	Standard	05
	Luxury	06
	Jeep	07
	Unknown Auto	08
Truck:	Light, Van, MH	09
	Heavy, Bus, Special	10
	Unknown Truck	11
Motorcycle		12
Unknown		13

Foreign Car?

Yes	1
No	2
Not car	3
Unknown	4

Vehicle Model Year

	Code
1972	72
1965	65
'	'
'	'

Accident Trip

		To (Intended Destination)				
		W	H	Sh	R or S	U
	Work	01	02	03	04	05
	Home	06	07	08	09	10
FROM:	Shopping	11	12	13	14	15
	Recreation or social	16	17	18	19	20
	Unknown	21	22	23	24	25

Business trip	26
Emergency	27
Other	28
Unknown	29

Accident Trip (continued)

How long had you been driving before the accident occurred? (Since last out of car.)

Parked or just starting	1
1-7 minutes	2
8-12 minutes	3
13-19 minutes	4
20, 25 minutes	5
30, 55 minutes	6
1 hour, but less than 2	7
More than 2 hours	8
Unknown	9

How far were you from your home when the accident occurred?

1 mile or less	1
2 or 3 miles	2
4 or 5 miles	3
6 to 10 miles	4
10 to 50 miles	5
More than 50 miles	6
Unknown	7

How often had you driven on that road before the accident occurred?

Never before	1
A few times	2
One or more times/year	3
One or more times/month	4
One or more times/week or daily	5
Unknown	6

Had you been drinking before the accident?

Yes	1
No	2
Refused	3
Unknown	4

Accident Trip (continued)

How much?

Amount

Beer-	1_
Wine-	2_
Liquor-	3_
None	44
Refused	55
Unknown	66

Over what period of time?

1/2 hour or less	1
1 hour	2
1 1/2 hours	3
2 hours	4
3, 4 hours	5
More than 4 hours	6
Not drinking	7
Refused	8
Unknown	9

Had you been using prescription or other drugs before the accident?

Yes	1
No	2
Refused	3
Unknown	4

Driver Education

Type:	High school	1
	Military	2
	Commercial driving school	3
	Industrial training	4
	Other	5
	No formal training	6

When?	After 1973	8
	1973 (2 years ago)	1
	1972 (3 " ")	2
	1971 (4 " ")	3
	66-70 (5-9 years ago)	4
	61-65 (10-14 years ago)	5
	51-60 (15-24 years ago)	6
	1950 or earlier (25 or more years ago)	7
	No driver education	8
	Unknown	9

General Education (highest level)

Completed high school?	No	1
	Yes	2
Vocational training beyond high school		[✓ 3]
Attended college		3
Bachelor's degree		4
Graduate degree		5

Drinking Habits

How often do you drink any alcoholic beverages?

Never	1
Few times/year	2
Few times/month	[✓ 3]
Few times/week	4
Refused	5
Unknown	6

How much do you usually drink?
(Fill in one)

Amount	
Beer-	1_
Wine-	2_
Liquor-	[✓ 3_]
Doesn't drink	44
Refused	55
Unknown	66 __________

When you drink more than your usual amount, how much do you drink?
(Fill in one)

Amount	
Beer-	1_
Wine-	2_
Liquor-	[✓ 3_]
Doesn't drink	44
Refused	55
Unknown	66 __________

Drinking Habits (continued)

About how many drinks do you think the average driver can have without impairing his driving?

(Fill in one)

	Amount	
Beer-		1_
Wine-		2_
Liquor-	________________	3_
None		44
Refused		55
Unknown		66

Have you ever used marijuana?

One or more times/week	1
" " " " /month	2
Seldom ________________	3
Never	4
Refused	5
Unknown	6

APPENDIX C

ACCIDENT AND VEHICLE FORMS FOR ROUTINE CODING

ACCIDENT CARD

1. Acc. No. 1 2 3 4

2. Month (5-6)

Jan	01
Feb	02
Mar	03
Apr	04
May	05
June	06
July	07
Aug	08
Sept	09
Oct	10
Nov	11
Dec	12

3. Date 7 8

4. Day (9)

Sun	1
Mon	2
Tue	3
Wed	4
Thur	5
Fri	6
Sat	7
Unk	8

5. Hr. (10-11)

1:00- 1:59	01
2:00- 2:59	02
3:00- 3:59	03
4:00- 4:59	04
5:00- 5:59	05
6:00- 6:59	06
7:00- 7:59	07
8:00- 8:59	08
9:00- 9:59	09
10:00-10:59	10
11:00-11:59	11
12:00-12:59	12

6. AM/PM (12)

AM	1	1
PM	2	2
Unk	3	3

7. Location (13)

Buff	1
Alleg	2
Catt	3
Chaut	4
Erie	5
Gen	6
Niag	7
Orleans	8
Wym	9

8. Loc. Class (14)

City or Village	1
Town	2
Unk	3

9. Area Type (15)

Urban	1
Rural	2
Unk	3

10. Traffic Control (16)

None	1
Police	2
Stop Lite	3
Stop Sign	4
Yield	5
Other	6
Unk	7

11. Lighting (17)

Day	1
Dawn or Dusk	2
Nite:	
Lites	3
No Lites	4
Unk	5
Unk	6

12. Weather (18)

Clear	1
Rain	2
Fog	3
Snow	4
Other	5
Unk	6

13. Road Cond. (19)

Dry	1
Wet	2
Ice/Snow	3
Other	4
Unk	5

14. Horizontal Alignment (20)

Straight	1
Curve	2
Unk	3

15. Vertical Alignment (21)

Level	1
Grade	2
Hillcrest	3
Unk	4

16. Intersection Related? (22)

Yes	1
No	2
Unk	3

17. Minor Cross Road (23)

Road	1
Ramp	2
Driveway	3
Alley	4
No inter.	5
Unknown	6

18. Major Road Type (24-25)

Ramp	01
Lim. Access	02
Other	
Divided	03
1-Way	04
Multi Lane	05
2 Lane	06
Unk Lane	07
Diway/Alley	08
Park Lot	09
Unk	10

19. Severity (26)

No injury	1
Injury	2
Fatal	3
Unk	4

20. No. of Vehicles (27)

	1
	2
	3
	4
	5
	6
	7
8 or More	8
Unk	9

21. Investigated at Scene

Yes	1
No	2
Unk	3

VEHICLE CARD

1. Acc. No. $\overline{1}\ \overline{2}\ \overline{3}\ \overline{4}$

2. Vehicle No. (Police) $\overline{5}$

3. Driver Age $\overline{6}\ \overline{7}$

4. Driver Sex (8)

M	1
F	2
Unk	3

5. License Type (9)

Oper/Chauf	1
Learner	2
Interim	3
None	4
Unk	5

6. Driver Cond. (10)

Normal	1
Ill	2
Defect	3
Sleep	4
HBD	5
Unk	6

7. Vehicle Type (11-12)

Auto	01
Truck	
Light	02
Van/MH	03
Heavy	04
Special	05
Unk	06
Recreation	07
Motorcycle	08
Unk, Not Auto	09
Unk	10

8. Body Style (13-14)

10, 19	Sports	01
4,9,18	Subcomp	02
6,8	Compact	03
1,7,17	Intermed	04
2	Standard	05
3,5	Luxury	06
14, 17	Jeep	07
	Unk Auto	08
	Not Auto	09
	Unk if Auto	10

9. Foreign Make? (15)

Yes	1
No	2
Unk	3

10. Model Year $\overline{16}\ \overline{17}$

11. Towed? (18)

Yes	1
No	2
Unk	3

12. Driver Injury (19)

None	1
Injured	2
Killed	3

13. Vehicle Injury (20)

None	1
Injured	2
Killed	3

14. DWI Violation (21)

1192-1	1
1192-2	2
1192-3	3
1192-4	4
1192-5	5
1192	6
None	7

Other Charges

H&R No Charges	7777
No Charges	8888
Unknown Charge	9999

15. $\overline{22}$ — — $\overline{25}$

16. $\overline{26}$ — — $\overline{29}$

17. $\overline{30}$ — — $\overline{33}$

18. Road Type (34)

Ramp	1
Driveway	2
Alley	3
1-Way	4
None of above	5
Unk	6

19. Calspan No. $\overline{35}$

APPENDIX D

CODING FORM FOR CAUSAL STRUCTURE AND DESCRIPTION OF CAUSAL ELEMENTS

The Causal Structure

The causal structure is a description of the conditions and events leading to each accident, coded in such a way as to be computer readable. The elements of the causal structure, or causal elements, are coded for each motor vehicle in the accident; this, then, allows statistical analyses to be performed either by driver/vehicle unit or by accident. While the causal structure cannot provide complete detail for each accident, it does allow for the description of the essentials of the accident generation process. The coding sheet to be used appears below and is followed by a description of the elements of the causal structure. The coding sheet consists of several checklists; in describing a vehicle's accident involvement, one element is selected from each listing.

The driver-vehicle unit being coded at any point in time is called the subject vehicle.

Target

This is the thing struck or the event that defines the occurrence of an accident for the subject vehicle.

(01-09)	Vehicle number ____. Each vehicle contacted in the accident is assigned a number with the first striking vehicle being number one, etc.
10.	Pedestrian or bike
11.	Train
12.	Animal
13.	Road departure
14.	Rollover
15.	Other
16.	Unknown

Target Location

The location of the target (or target event) relative to the vehicle's path immediately prior to the occurrence of subject critical event.* (On a curved road, a target in the travel lane ahead is coded as forward).

1. Forward
2. Right Front
3. Right
4. Right Rear
5. Rear
6. Left Rear
7. Left
8. Left Front
9. Other
10. Unknown

Target Path

The path of the target relative to that of the subject vehicle's path immediately prior to the occurrence of the critical event. (On curved road, a vehicle ahead moving in the same direction is coded as same. If the target is stopped with motion imminent, its path is the direction which it is facing.)

1. Same
2. Opposite - same lane, opposite direction
3. Parallel path, same direction
4. Parallel path, opposite direction
5. Right Front
6. Right
7. Right Rear

---

* See discussion below preceding the critical event codes.

8. Left Rear
9. Left
10. Left Front
11. None - The target is immobile or a parked vehicle
12. Other
13. Unknown

Subject Path

The subject vehicle's path to the critical event. If the vehicle is proceeding in a traffic lane, the subject path describes that lane. If it is turning at an intersection, or driveway, etc., that is described. In a parking lot, the path describes the effective steering angle.

1. Forward
2. Right Curve
3. Right Turn
4. Left Curve
5. Left Turn
6. Curve, direction unknown
7. Rear
8. Right Rear
9. Left Rear
10. Path ends - For example, a "T" intersection or lane drop
11. Motion imminent - stopped but not parked
12. Motion imminent/forward - couldn't determine if vehicle came to full stop
13. None - stopped with no motion imminent (usually parked)
14. Other
15. Unknown

Thus, the target location and target path give the relative locations and directions of movement of the vehicles involved before the situation became critical. The subject path describes, in absolute terms, the motion of the subject vehicle.

A situation is said to be critical when an accident is essentially inevitable; that is, when normally practiced driving maneuvers will not prevent its occurrence. The behavior of the subject vehicle which elicits a critical situation is called the critical event. Accidents can be generated in one of two ways: (1) An existing collision course is maintained; or (2) When no relevant collision course exists, a vehicle can act so as to create one which is immediately critical. Thus, a vehicle can be involved in an accident in one of three ways: (1) Continuing along an existing collision course, (2) Precipitating an immediately critical collision course, or (3) Being imposed upon by the precipitating action of another vehicle or agent.

Critical Event

What the subject unit did to produce a critical condition.

1. Imposed upon - Another agent acted upon the subject unit to create a critical condition; there was no relevant collision course prior to that activity.
2. Continue - There was a collision course, which was not disrupted, so that a collision ensued.
3. Continue steer angle - The subject unit maintained its effective steer angle, while the road configuration changed. (Usually a vehicle going straight while the road curved.)
4. Change speed - A critical condition resulted when this vehicle changed speed (Choose specifics below.)
5. Change direction - A critical condition resulted when this vehicle changed direction (Choose specifics below.).

6. Continue/Imposition - Used when choice is not clear.
7. Continue/Change speed - Used when choice is not clear.
8. Continue/Change direction - Used when choice is not clear.
9. Other
10. Unknown

Change Speed (To give specific type)

1. Start
2. Stop
3. Accelerate
4. Decelerate
5. Start backward
6. Other
7. Unknown
8. Not applicable (No speed change)

Change Direction (To give specific type)

1. Normal turn (at intersection, driveway, etc.)
2. Wide turn (at intersection, driveway, etc.)
3. Cut turn short (at intersection, driveway, etc.)
4. Protracted turn (at intersection, driveway, etc.)
5. Other or unknown turn (at intersection, driveway, etc.)
6. Move
7. Parallel path (usually lane change)
8. Other
9. Unknown
10. Not applicable (no direction change)

Direction (For direction change)

1. Right
2. Left
3. Unknown
4. Not applicable (no direction change)

Critical Reason That event or condition which most directly elicited the critical event.

1. External influence - Critical event was in response to external demands. Also used when critical event was "imposed upon".
2. Secondary - Target was already involved in previous collision, road departure, or rollover.
3. External Influence/Passive - Used when the critical event equals continue/imposition.
4. Vehicle breakdown - A sudden malfunction of the vehicle so that it would no longer respond normally to control inputs.
5. Driver breakdown - A sudden malfunction of the driver so that he can no longer provide intended inputs to the vehicle.
6. Information failure - Accident would not have occurred if the driver had validly processed information about the vehicles, objects, and roadway in his vicinity. (Chose specifics below.)
7. Information failure - Control failure combination - similar to control failure below, but involved apparent breakdown of visual/control system; basically sloppy control as opposed to loss of control. (This code was experimental and received little use.)
8. Control Failure - Driver failed to guide his vehicle along his currently intended path. (Choose specifics below.)

9. Information failure/control failure - Used when choice is not clear.
10. Logistic - Subject's behavior was based solely on reasons relating to where he was going and how he wanted to get there (Choose specifics below).
11. Other
12. Unknown

Information Failure[1] (To give specific type)

1. Presentation error - Information was obscured and therefore not available to the driver.
2. Sensing error - Information was transmitted to the general area of the driver, but did not reach the appropriate sensory receptors. (E.g., driver didn't look in required direction.)
3. Recognition error - Information was sensed but driver remained unaware of the source conditions.
4. Projection error - Driver was aware of external conditions but did not appropriately process the information to draw valid conclusions about ensuing events. (Usually speed/distance misjudgments.)
5. Conflict error - The driver's action was based on existing but misleading conditions.
6. Other
7. Unknown
8. Not applicable (No information failure).

---

[1] In using police data, as opposed to in-depth reports, the particular type of information failure is often unknown thus leading to frequent use of code 7. Codes 1 through 6 remain available for use in the event they are reported.

Control Failure (To give specific type)

1. Primary control failure - as stated under critical reason.
2. Induced control failure - as above, but induced at least in part by a slippery road surface or other roadway condition; i.e., accident would not have occurred if the road had been free of ice, snow, etc.
3. Unknown whether primary or induced.
4. Not applicable (No control failure).

Logistic (To give specific type)

1. Proceed - Passively continue along path with no relevant collision course.
2. Before turn (Usually refers to deceleration).
3. To pass (Usually refers to direction change: Parallel path.)
4. Park - Either vehicle was parked or reason for critical event was pre-parking or parking maneuver.
5. Other
6. Not applicable (Reason was not logistic.).

Category

When critical reasons were information failures, control failure, or logistic. This list was used to specify whether the information was reported on inferred. Codes 3 and 4 were used if a combination information failure/control failure required it.

1. Reported
2. Inferred
3. Information failure was reported, control failure was inferred.
4. Control failure was report, information failure was inferred.
5. Not applicable.

When the critical reason is external influence, a critical source is also given; it specifies the external agent to which the subject vehicle responded. When the critical reason is secondary, the source is coded "target". Whenever the critical reason is information failure, a critical source is also given; it specifies the source of the information which was not properly processed. Thus, a critical source is given if, and only if, the critical reason is external influence, *secondary*, or information failure.

Critical Source

(01-09). Vehicle number ____. A vehicle involved in the accident but not the target for the subject vehicle.
10. Target - The critical source is the same as the target.
11. Non-accident vehicle
12. Pedestrian or bike
13. Train
14. Animal
15. Traffic control signal
16. Traffic control sign
17. Road
18. Other
19. Unknown
20. Not applicable (Critical reason is not external influence, secondary or information failure.)

These codes, starting with critical event and ending with critical source, describe the critical phase of the accident. These codes can also be used to describe a prior phase if it helps to better describe the accident. For example, a driver might decelerate to avoid a stopped vehicle, then lose control on ice and slide off the road to the right. In this instance the codes would reflect in the prior phase deceleration (prior event), external influence (prior reason), and non-accident vehicle (prior source). The target is road departure, its location is right front, the subject path is forward. The *critical phase* reflects a move to the right (critical event) due to an induced control failure (critical reason); no critical source is required.

Thus, as stated above, a prior phase is coded if it produces a more complete description of the accident. The codes used are the same as those given above for the critical phase, with the following exception. The code, imposed upon, cannot be used in the prior phase since it implies a situation which is immediately accident producing.

The final set of elements to be coded relates to responsibility for the accident. The coding here is based on the concept of an abnormal situation; this is defined to be a condition where the expectations of a hypothetical, normal driver would be violated.

Culpability

1. Culpable - A driver/vehicle unit is said to be culpable if it is the first unit to create an abnormal situation.
2. Culpable/contributory - Used when choice is not clear.
3. Contributory - The situation is already abnormal, but the subject could have avoided involvement in the accident by normally practiced maneuvers.
4. Contributory/Not culpable - Used when choice is not clear.
5. Not culpable
6. Unknown

Culpable Behavior

1. PE/CE - The behavior inducing the abnormal situation is that specified by the prior event or the critical event.
2. Police chase
3. Excessive speed or acceleration
4. Low or erratic speed
5. Erratic direction changes or wrong side of road
6. Turn from wrong lane

7. Wrong way driving
8. Thru stop sign or signal, or early start from signal
9. Driving on shoulder or median
10. Tailgating
11. Driving without headlights
12. Stopped or parked in dangerous location
13. Other
14. Not applicable (Not culpable)

Culpable Phase

1. Prior event - The culpable behavior was the prior event.
2. Critical event - The culpable behavior was the critical event.
3. Prior phase - The culpable behavior was not the prior event, but occurred before the critical event.
4. Critical phase - The culpable behavior was not the critical event but occurred at the same time.
5. Not applicable.

Other Data Elements

The following listings specify the data elements to be used in addition to those given above. They are grouped according to the source of the information. The data elements were selected to achieve the following. Environmental characteristics were chosen to allow the determination of specific problems for drinking drivers (curves, intersections, slippery roads, reduced visibility, etc.); in addition, combinations of such factors can yield analyses measuring the adaptability of drinking drivers to more demanding situations. Driver data will, in conjunction with interview data, characterize the driver in terms of socioeconomic status and drinking status; in addition, some factors relating to the accident trip are included. Accident reports will provide injury information in addition to information on the accident generation process.

Acc. No. 1 2 3 4
Sample 5
Acc. Mo. 6 7
Acc. Date 8 9
County 10
Sub. No. 11
D. Age 12 13
D. Sex 14

Prior Event (15-6)

Continue	02
Cont. S.A.	03
Ch. Speed	04
Ch. Direction	05
Cont./C.S.	07
Cont./C.D.	08
Other	09
Unk.	10

Ch. Speed (17)

Start	1
Stop	2
Accel.	3
Decel.	4
Start - Back	5
Other	6
Unk.	7
NA	8

Ch. Direction (18-9)

Turn	
Normal	01
Wide	02
Cut short	03
Protracted	04
Other/Unk.	05
Move	06
Parallel path	07
Other	08
Unk.	09
NA	10

Direction (20)

Right	1
Left	2
Unk.	3
NA	4

- - - - - - - - - - -

Prior Reason (21-2)

Ext. infl.	01
Secondary	02
EI/Pass.	03
Veh. breakdown	04
Dr. breakdown	05
Info. failure	06
IF-CF comb.	07
Cont. failure	08
IF/CF	09
Logistic	10
Other	11
Unk.	12

Info. Failure (23)

Pres.	1
Sense	2
Rec.	3
Proj.	4
Conflict	5
Other	6
Unk.	7
NA	8

Cont. Failure (24)

Primary	1
Induced	2
Unk.	3
NA	4

Logistic (25)

Proceed	1
Before turn	2
To pass	3
Park	4
Other	5
NA	6

Category (26)

Reported	1
Inferred	2
IF-R, CF-I	3
CF-R, IF-I	4
NA	5

Prior Source (27-8)

Veh. No.	0__
Target	10
Nonacc. veh.	11
Ped. or bike	12
Train	13
Animal	14
T. signal	15
T. sign	16
Road	17
Other	18
Unk.	19
NA	20

- - - - - - - - - - -

Target (29-30)

Veh. No.	0__
Ped. or bike	10
Train	11
Animal	12
Road Dep.	13
Roll	14
Other	15
Unk.	16

Target Location (31-2)

Front	01
Right front	02
Right	03
Right rear	04
Rear	05
Left rear	06
Left	07
Left front	08
Other	09
Unk.	10
NA	11

Target Path (33-4)

Same	01
Opposite	02
Par - Same	03
Par - Opp.	04
Right front	05
Right	06
Right rear	07
Left rear	08
Left	09
Left front	10
None	11
Other	12
Unk.	13
NA	14

Subject Path (35-6)

Forward	01
R. curve	02
R. turn	03
L. curve	04
L. turn	05
Curve, dir., unk.	06
Rear	07
Right rear	08
Left rear	09
Ends	10
Mot. imm.	11
MI/For - Rr	12
None	13
Other	14
Unk.	15

Critical Event (37-8)

Imposed upon	01
Continue	02
Cont. S.A.	03
Ch. speed	04
Ch. direction	05
Cont./Imp.	06
Cont./C.S.	07
Cont./C.D.	08
Other	09
Unk.	10

Ch. Speed (39)

Start	1
Stop	2
Accel.	3
Decel.	4
Start - Back	5
Other	6
Unk.	7
NA	8

Ch. Direction (40-1)

Turn	
Normal	01
Wide	02
Cut short	03
Protracted	04
Other/Unk.	05
Move	06
Par. path	07
Other	08
Unk.	09
NA	10

Direction (42)

Right	1
Left	2
Unk.	3
NA	4

- - - - - - - - - - -

Critical Reason (43-4)

Ext. Infl.	01
Secondary	02
EI/Pass.	03
Veh. breakdown	04
Dr. breakdown	05
Info. failure	06
IF-CF comb.	07
Cont. failure	08
IF/CF	09
Logistic	10
Other	11
Unk.	12

Info. Failure (45)

Pres.	1
Sense	2
Rec.	3
Proj.	4
Conflict	5
Other	6
Unk.	7
NA	8

Cont. Failure (46)

Primary	1
Induced	2
Unk.	3
NA	4

Logistic (47)

Proceed	1
Before turn	2
To pass	3
Park	4
Other	5
NA	6

Category (48)

Reported	1
Inferred	2
IF-R, CF-I	3
CF-R, IF-I	4
NA	5

Critical Source (49-50)

Veh. No.	0__
Target	10
Nonacc. veh.	11
Ped. or bike	12
Train	13
Animal	14
T. signal	15
T. sign	16
Road	17
Other	18
Unk.	19
NA	20

- - - - - - - - - - -

Culpability (51)

Culpable	1
Culp./Contrib.	2
Contributory	3
Cont./Non-culp.	4
Non-culpable	5
Unk. or NAC	6

Culp. Behavior (52-3)

PE/CE	01
Police chase	02
High-speed acc.	03
Low or erratic speed dec.	04
Erratic dir., *wrong side*	05
Wrong lane turn	06
Wrong way	07
Disobey stop sign, yield or signal	08
On shoulder mdn.	09
Tailgating	10
No headlights	11
Park or stop	12
Other	13
NA	14

Culp. Phase (54)

PE	1
CE	2
P. phase	3
C. phase	4
Unk.	5
NA	6

APPENDIX E

CLASS R ACCIDENT FREQUENCIES BY DRIVER AND SITUATIONAL VARIABLES

Driver Variables			Situational Variables											
			Day				Night				Day Plus Night			
Age	Sex	Driver Status	Urban	Sub.	Rural	Total	Urban	Sub.	Rural	Total	Urban	Sub.	Rural	Total
Young	Male	DWI	0	1	6	7	5	42	40	87	5	43	46	94
Old			14	19	30	63	54	105	123	282	68	124	153	345
Young	Female		0	0	1	1	1	2	4	7	1	2	5	8
Old			1	1	0	2	7	16	12	35	8	17	12	37
Young	Male	HBD	0	5	10	15	9	47	74	130	9	52	84	145
Old			8	15	25	48	44	98	148	290	52	113	173	338
Young	Female		0	0	0	0	3	9	7	19	3	9	7	19
Old			0	1	4	5	6	14	14	34	6	15	18	39
Young	Male	-	0	6	16	22	14	89	114	217	14	95	130	239
Old			22	34	55	111	98	203	271	572	120	237	326	683
Young	Female		0	0	1	1	4	11	11	26	4	11	12	27
Old			1	2	4	7	13	30	26	69	14	32	30	76
-	Male	-	22	40	71	133	112	292	385	789	134	332	456	922
	Female		1	2	5	8	17	41	37	95	18	43	42	103
Young	-	-	0	6	17	23	18	100	125	243	18	106	142	266
Old			23	36	59	118	111	233	297	641	134	269	356	759
TOTAL			23	42	76	141	129	333	422	884	152	375	498	1025