DRIVER SEX DIFFERENCES IN AUTOMOBILE ACCIDENTS

Thesis for the Degree of M. S.
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HERBERT ERECH STOCKMAN
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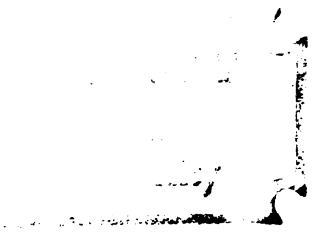

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By

Herbert Erech Stockman

A THESIS

Submitted To
Michigan State University
in partial fulfillment of the requirements
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ABSTRACT

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It is estimated that by 1975 there will be 125 million licensed drivers and almost 120 million registered motor vehicles in the United States. Each of these vehicles will be driven an average of 11,000 miles per year. If present trends continue, this increase in vehicular travel will result in more highway accidents with annual accident costs for 1975 exceeding 11 billion dollars.

Although research of quality has been building up piece-by-piece now for almost a half century, we need to know a great deal more and do a great deal more before we can expect a significant reduction in traffic accidents.

The present study had as its focus a comparison of the characteristics of the automobile accidents of male and female drivers. The sample for this study consisted of all reports of motor vehicle traffic accidents contained in the Michigan State Police files which occured during the years 1966 and 1971 in Berrien County, Michigan. The data consisted of 1,909 single vehicle accidents and 4,250 multiple vehicle accidents for 1966, and 2,167 single vehicle acci-

dents and 4,820 multiple vehicle accidents for 1971. The purpose of the study was to determine and explain driver sex differences on variables contained in the accident reports. The hypothesis adopted at the outset, in contradistinction to previous studies, was that all findings were potentially explainable in terms of hypothesized driving exposure differences between the sexes.

Many statistically significant differences were found for both single and multiple vehicle accidents. Most were explainable by exposure; there were exceptions, however. Females were found to be positively related to the presence of road defects and snow. In combination with other studies, these results indicate that females have more accidents in situations requiring a greater than usual amount of skill. The explanation for this finding was that females tend to drive less frequently under stressful conditions, and hence have less opportunity to learn appropriate responses. Male drivers on the other hand, were more likely to have consumed alcohol previous to the accident. They generally traveled faster and were more often ticketed for speeding violations. The explanation given to these results was in terms of cultural roles and driving confidence rather than in terms of differences between the sexes in driving abilities under the influence of alcohol or at high speeds. Based on the results of the study, practical suggestions regarding differential educational and training procedures for the two sexes were offered.

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And to those members of my family who watched my academic odyssey with apprehension . . . I thank you for your patience and confidence.

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CHAPTER I

INTRODUCTION

The debate between the sexes concerning the superiority of each in driving an automobile has dominated many an evening's parlor discussion. Males are quick to point out the shortcomings of "women drivers", while females are equally quick to counter with harsh criticisms of "impatient men". Automotive insurance companies tend to side with the fairer of the sexes, a fact few women overlook in creating a convincing argument. This is true for even young drivers. There was a time when all drivers under 25 were charged higher rates for insurance premiums; however, insurance companies found the risk to be greater for only young male drivers, and, hence, young female drivers were relieved of at least part of the greater assessment. It is only fair to note, however, that insurance companies are only interested in gross number of accidents and other causes of claims. The well-recognized fact that men on an average drive more and probably during periods of higher potential risk is irrelevant to their purposes. Men, incidentally, are far from unaware of these facts in forming a rebuttal of the feminine interpretation.

The reason that this disagreement has been able to sustain discussion for so long is because there is indeed

no clear cut answer. Possibly in some situations the average man is a better driver than his wife, while in other situations she might prove superior. A blanket statement that one sex is superior to the other is bound to be an oversimplification.

The present study has as its focus a comparison of the characteristics of the automobile accidents of male and female drivers. The specific purpose of the study is to discover and try to explain statistically significant differences between the sexes on variables which are recorded in accident reports. Included in these variables of interest are time and location variables, road, collision, vehicle and driver characteristics, driver behaviors, and weather.

Importance of the Study

There are, of course, more important reasons for conducting this study than merely ascertaining which sex is the better driver. The great number of accidents which are taking place on our highways constitutes a major problem and the integration of motor vehicles into our way of life has become very costly in terms of fatalities, injuries, and damaged equipment. As miles traveled, passengers carried, and tons conveyed have increased, traffic has become more dense. Also speed levels have risen, and there has been an increase in deaths, injuries and monetary costs.

In fact, highway safety has become a matter of pressing national concern.

According to a public opinion survey conducted by the Michigan State University Highway Traffic Safety Center, Michigan citizens feel that crime and traffic safety are the most important problems facing the state.[1] The sheer magnitude of losses from highway accidents demands systematic, carefully planned research studies. Although research of quality has been building up piece-by-piece now for almost a half century, we need to know a great deal more and do a great deal more before we can expect a significant reduction in traffic injuries and deaths.

In the state of Michigan alone, a total of 314,015 reported motor vehicle traffic accidents and 2,152 highway fatalities were recorded by the State Police during 1971. This was the eighth consecutive year and the eleventh time in thirty-four years of record keeping that Michigan traffic deaths have exceeded 2,000 annually.[2] This certainly leaves no room for complacency nor does it indicate that we are making much progress in the overall struggle for safer highways.

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[1] "MSU Conducts Two Surveys," Traffic Safety, (May, 1966, p. 25.

[2] Michigan Department of State Police, Michigan Traffic Accident Facts: 1971, (Lansing, Michigan, 1972), p. 1.

If accidents are to be related to highway, vehicle, and human factors in a meaningful fashion it is essential that the relative exposure of people to accidents be measured. One method of accomplishing this is to compare the characteristics of the automobile accidents of male and female drivers.

Looking at accidents is a negative approach to the study of drivers to be sure, but it is not an invalid approach. There is no other time in the driving history of an individual when so much data is collected on a small segment of driving. Nor is any aspect of driving as disruptive, harmful, and in need of reduction as accidents. Any insight gained concerning the general etiology of automobile accidents would seem to be worthwhile.

Review of the Literature

In one of the first studies which addressed itself to the question of sex differences in automobile accidents, M. S. Viteles and H. M. Gardner used District of Columbia taxicab drivers as their subjects. In a sample of approximately 200 men and from 35 to 40 women they found female drivers to be involved in 3.49 times as many accidents per 1,000 miles than male drivers. When considering only serious accidents they found that women were involved in fewer accidents than men but the women caused more accidents on the part of other drivers through the driving tactics they

employed.[3] This rather startling result must be tempered by mention of several uncontrolled variables. The female drivers were not allowed to drive at night. They furthermore did not have to pass a standard driving test which males did. Also fourteen percent of the women were completely inexperienced when hired and had to be trained by the company. In 1927 and 1928 use of the automobile was not widespread and female drivers were rarely encountered at that time. This leads to the suspicion that in addition to the fourteen percent of the women who were completely inexperienced, most of the rest of the women had rather limited experience. Given these shortcomings, the Viteles and Gardner study seems to have little more than historical value.

A. R. Lauer also compared the accident involvement of male and female drivers. His subjects were a sample of 7,692 drivers drawn from the Iowa state records during the years of 1948 and 1949. The accurate mileage data available to Viteles and Gardner was not available to Lauer, so he had drivers estimate their annual mileage both during the day and at night. Using these estimates, he found that females did about ten percent of the driving

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[3]M. S. Viteles and H. M. Gardner, "Women Taxicab Drivers: Sex Differences in Proneness to Motor Vehicle Accidents," Personnel Journal, Vol. 7, (1929), pp. 349-355.

and had about nine percent of the accidents.[4] No differentiations were made concerning the severity of the accidents. In terms of accidents per annual mileage, Lauer found male drivers under thirty contributing a disproportionaly large amount to the accident total. Males also appeared to drive for five years before they exhibited any improvement in their driving record, while female drivers began improving immediately.[5]

Clifford O. Swanson, Lilliam C. Schwenk, and A. R. Lauer studied the drivers of vehicles involved in all the fatal accidents which transpired in Iowa during 1955 and 1956. Driver fatalities showed almost a nine to one ratio of male to female for 1955 and about a six to one ratio in 1956. When the two sexes were equated for estimated annual mileage (gained from drivers still alive), the ratio for the two years combined reduced to 2.49 to 1, male to female. The investigators also found that the fatal accident rate for both sexes decreased until about age thirty-five, stayed level throughout the middle years, and began increasing again around the age of fifty-five. Males had a higher accident rate, for all ages except twenty-five to

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[4] A. R. Lauer, "Age and Sex in Relation to Accidents," Accident Research Methods and Approaches, ed. William Haddon, Edward A. Suchman, and David Klein, (New York: Harper and Row, 1964), pp. 137-138.

[5] Ibid., p. 137.

twenty-nine and sixty to sixty-four when corrected for average annual mileage.[6]

Moving ahead in time and to the West coast, the 1964 California Driver Record Study also compared male and female drivers on accident involvement, as well as conviction frequency. In analyzing the driving records of over 90,000 males and over 65,000 females, the investigators found female involvement to be relatively less frequent than that of males in accidents and traffic violation convictions. Males had a mean of .260 accidents over the 3 years; while females had a mean of .126 during the same period.[7] However, when the accidents were broken down into those reported to the California Highway Department and those not, the difference between males and females was accentuated in the former case and shrunk in the latter, although males still almost doubled females.[8] A small portion of this difference could be attributed to an enforcement differential, however, the magnitude of the difference indicates that males are probably involved in more severe accidents.

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[6]Clifford O. Swanson, Lilliam C. Schwenk, and A. R. Lauer, "Age and Fatal Motor Vehicle Accidents," Highway Research Abstracts, Synopsis Issue, Vol. 27, (Washington, D. C.: National Academy of Science - National Research Council, December, 1957), p. 69.

[7]"Accidents, Traffic Citations and Negligent Operator Count by Sex," The 1964 California Driver Record Study, Part II, (Sacramento: California Department of Motor Vehicles, Report No. 20, March, 1965), p. 19.

[8]Ibid., p. 15.

During the same period of time, males had a mean of 1.103 total convictions, while females had a mean of only .374.[9]

When mean accident frequency was plotted as a function of age separately for single and married males and females, several interesting relationships were apparent. Up to the age of twenty-five, married males actually had a higher average accident frequency than single males. However, beyond that single males were consistently higher. Both curves for males had negative slopes, dropping sharply through the younger ages and more slowly as the age became greater. Both female curves, on the other hand, remained relatively flat over all ages.[10] These results are inconsistent with those of Lauer, reported earlier. Perhaps the discrepancy lies in the fact that Lauer did equate for estimated annual mileage, and the California study used data fifteen years more recent than Lauer. Married females were consistently lower in accident frequency than single females. In fact, beyond the age of thirty the curves of single females and married males were at almost the same level.[11] The results were very similar when mean conviction rate was plotted rather than mean accident rate. The slope for males

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[9] Ibid., p. 19.

[10] "Driver Record by Age, Sex and Marital Status," The 1964 California Driver Record Study, Part V, (Sacramento: California Department of Motor Vehicles, Report No. 20, June, 1965), pp. 4-5.

[11] Ibid.

was a little more sharply negatively decelerated, and married males were a little more consistently lower than single females. Overall, however, the two sets of curves were very similar.[12]

B. J. Campbell studied 32,387 fatal and injury accidents involving only passenger cars and within the jurisdiction of the state highway patrol. (Although not cited explicitly, the state was probably New York). Male drivers accounted for eighty percent of this sample. By looking at male and female accident involvement relative to total involvement of each sex respectively, Campbell found the proportion of accidents for females was higher than that for males on weekdays, while males were higher on weekends. When the data was plotted by time of day, male drivers were found to have proportionately more accidents from 6 P.M. to 6 A.M., with female drivers being proportionately higher during the remaining twelve hours.[13]

Using data from all of the 17,400 accidents contained in the 1957 Michigan State Police records, Terrence M. Allen calculated phi coefficients between all pairs of twenty-three dichotomized variables. Included among these variables was sex (female involved or not). Let it be noted that not all the variables were naturally dichotomous

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[12] Ibid.

[13] B. J. Campbell, "Driver Age and Sex Related to Accident Time and Type," Traffic Safety Quarterly Research Review, Vol. 10, (1966), pp. 36-43.

as is sex. Rather, most had to be artificially dichotomized to make the calculation possible. The phi coefficients were then factor analyzed. Sex loaded most highly (-.45) on factor III (night). Other variables showing high loadings on the same factor were alcohol (.55), daylight (-.77), and rush hour (-.63). The signs of the loadings indicate that females were associated with daylight, rush hour, and absence of alcohol, with males being associated with the converse of these variables. Moderately small loadings for sex were found on factor VI (.21) which Allen named "youth-inexperience", factor V (-.18) referred to as "rural", and factor VIII (-.17), a small factor having vehicle defect as the only variable loading highly.[14]

In another study of California drivers, Hugh S. Penn used 5,203 single vehicle accidents transpiring in September of 1961 and June of 1962 as data. Two previous California studies (unreferenced), one to determine the proportion of each sex in the total driving population and the other to determine the average annual mileage for driving members of each sex, were used to equate males and females on exposure. Unfortunately, the method by which annual mileage was determined was not made explicit. Using this derived index of relative driving distance, the investigators concluded that

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[14]Terrence M. Allen, "A Factor Analysis of Accident Records," Highway Research Record No. 79, (Washington: National Academy of Sciences – National Research Council, January, 1965), p. 20.

if equated for mileage male drivers would have been involved in 53.6 percent of the accidents studied and female drivers would have been involved in the remaining 46.4 percent.[15]

Each accident was placed into one of eleven categories of "causes" or, more accurately, "precipitating factors." The accidents of male drivers were found to be significantly more frequently contained in the categories of speed, drowsiness, and drinking; while female drivers were found more frequently in the categories of faulty driving, adverse driving conditions (emergency situations in the driving environment), and distraction inside of the vehicle. The categories of mechanical failure, distraction outside the vehicle, medical problems, unknown vehicle, and miscellaneous did not differentiate the sexes at a significant level.[16]

The results of a study by Leonard Uhr appear consistent with Penn's finding of a tendency for female drivers to be more frequently involved in accidents precipitated by "adverse driving conditions." The brevity of Uhr's article precluded any precise understanding of the design and conduct of the study. A motor scooter was used to confront drivers with an unusual situation. At the time of his

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[15]Hugh S. Penn, "Causes and Characteristics of Single Car Accidents," Highway Research Record No. 79, (Washington: National Academy of Sciences – National Research Council, January, 1965), pp. 1-16.

[16]Ibid., p. 3.

study motor scooters were newly legalized, and very uncommon. The study was carried out as follows:

> An auto was first judged to be behaving dangerously toward a motor scooter (by cutting across or into the scooter's path from a stop street or alley so that the scooter driver was forced to brake or swerve his vehicle). Only after this judgement was made, the sex of the auto driver was determined. . . Twenty-five such incidents were accumulated, along with twenty-five comparison incidents . . .17

This behavior was found to be highly related to the sex of the driver. Nineteen of the drivers judged to be behaving dangerously were women, while only six men were so designated; of the "safe" drivers, twenty-two were men and only three were women. Thus, female drivers were significantly more likely to make an inappropriate and dangerous response in the presence of this situation.[18]

A preliminary report of a study conducted at Northwestern University by J. Stannard Baker adds further evidence of an adverse driving situation being more likely to terminate in an accident for females than males. Baker found that female drivers have about four times the average likelihood of accidents following flat tires. Females under twenty were found to be twenty-two times as likely, and women between twenty and thirty-five were about five times as likely. Apparently the additional skill needed to avoid

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[17]Leonard Uhr, "Sex as a Determinant of Driving Skills: Women Drivers," Journal of Applied Psychology, Vol. 43, (1959), p. 35.

[18]Ibid.

a collision in such a situation tended to be found more often with male drivers than female drivers.[19]

In a very ambitious study of accident causation on the Pennsylvania Turnpike, Paul Blotzer, et. al. analyzed over 9,000 State Police Reports compiled during the years of operation of the turnpike. The investigators adopted the model that "Accidents are caused in a vast majority of cases by human error, and to a smaller extent, by vehicle error — both factors influenced by the environmental conditions incountered in the driving operation."[20] Those accidents judged primarily caused by human error, as opposed to vehicle error, were classified into one of eight categories of "causes" or "precipitating factors," based on what was judged to be the primary cause of the accident. When accidents involved more than one vehicle, only the driver of the vehicle judged at fault was entered into the analysis.

The investigators found a significantly greater percentage of female drivers involved in accidents classified in two human error categories — "failure to cope with road conditions" and "deficiencies in routine driving skills."

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[19]Highway Research News Briefs, Highway Research News No. 31, (Washington, D. C.: National Academy of Sciences, Highway Research Board, Spring, 1968), pp. 8-9.

[20]Paul Blotzer, Richard L. Krumm, Donald M. Krus, and Donald E. Stark, Accident Causation — Pennsylvania Turnpike Joint Safety Research Group, (Harrisburg: Westinghouse Air Brake Co., 1954), p. 11.

The "failure to cope with road conditions" category contained mostly skidding accidents with a few resulting from high winds. The "deficiencies in routine driving skills" category contained very similar types of accidents. The difference between the two categories is simply that in the case of the former no judgment of specific driver error was made. "The skidding accidents listed as 'failure to cope with road conditions' would probably be included in the 'deficiencies in routine driving skills' category had sufficient information regarding what the driver did or did not do been included in the accident reports for these accidents."[21] This result seems consistent with the results of Penn and Uhr. Since sex differences were not mentioned in the report for the remaining six categories, it must be assumed no significant differences existed, other than within the "inattentiveness" category, where male drivers were more often found in the "asleep" subcategory.

The investigators isolated four broad environmental variables, "light conditions", "weather conditions", "roadway conditions", and the "roadway element". Male drivers were found to be involved in relatively more accidents at night. Females, of course, were involved in more daytime accidents.[22] No mention was made of sex differences on the

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[21] Ibid., p. 37.

[22] Ibid., p. 94.

other three variables; therefore, again, the assumption must be made that no such differences existed in the data.

Accident Causation

In reporting these studies, the concept of cause has been introduced without adequate discussion. Allen has pointed out that most people are aware that accidents cannot validly be thought of as having a single cause.[23] In speaking of "myths and misconceptions in traffic safety," William E. Tarrants stated, "It is evident . . . that accidents have multiple causes . . ."[24] However, some very thorny definitive and other practical problems in accident research are present when accidents are considered as being caused by more than one factor. Edward A. Suchman defined an accident as ". . . the end product of a sequence of acts or events which result in some 'unanticipated' consequence that is judged as 'undesirable'. . ."[25] What in this sequence of events can be defined as one of the causes, and what can be ignored? The situation is such that changing any one or more of the factors to determine the effect upon

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[23]Allen, op. cit., p. 17.

[24]William E. Tarrants, "Myths and Misconceptions in Traffic Safety," Highway Research News No. 31, (Washington, D.C: National Academy of Sciences, Highway Research Board, Spring, 1968), p. 60.

[25]William Haddon, Edward A. Suchman, and David Klein, Accident Research Methods and Approaches, (New York: Harper and Row, 1964), p. 274.

the end product cannot be accomplished. Furthermore, the unexpected nature of an accident combined with the rapidity with which it transpires makes an accurate assessment of the sequence of acts on events difficult if not impossible. Also, statistical analyses are much simpler if each accident is classified into only one category, even though with the development of high speed computers, this is becoming less of a handicap.

Considerations such as these led many investigators to classify each accident according to what they considered the primary cause, while still maintaining a multiple causation model on a theoretical level. For example, Penn discussed the concepts of accident conditions, factors, and causes originally formulated by Baker. Accident conditions are ". . . environmental or behavioral circumstances which surround the accident, but which may not be a part of the causative process . . . Factors are causative elements, no one of which is usually strong enough to produce an accident. In combination, however, and triggered by some precipitating incident, they will produce a mishap."[26] The "cause" then is the precipitating incident. Blotzer, et. al. emphasized that accidents are ". . . the result of interactions between environmental, vehicular, and human factors."[27] They included a list of possible "antecedent"

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[26]Penn, op. cit., p. 4.

[27]Blotzer, et al., op. cit., p. 35.

factors for each of the "precipitating" factors. Cause within this conceptual scheme became the precipitating factor. However, Tarrants rightly pointed out that "It may be possible to identify proximate and distal causal factors in a particular accident by going back in time or space from the point of impact. However, to identify one of these factors as the primary cause is a very difficult if not impossible task."[28]

The assumption of a single or primary cause does not have to be made at all. When an automobile accident occurs, there are many factors present which may be recorded in an accident report without any mention of which of the factors or what factor caused the accident. Accidents can then be studied to determine which of these factors tend to be related, or, in other words, which variables tend to be associated across accidents and which tend to be independent of each other. The accident can then be analyzed in a manner more congruent with what it is, a complex many-faceted event. Reducing this event to one cause just does not do it justice. For example, the time of day an accident takes place can be an important variable in the over-all understanding of accidents. But the time at which an accident took place would hardly be expected to ever attain the distinction of having "caused" the accident. Likewise the driver judged not at fault in a multiple vehicle accident still played a signif-

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[28]Tarrants, op. cit., p. 59.

icant role in that accident and really does not deserve to be ignored completely. For example, the excessive speed of a driver may be judged as the cause of an accident, but had the other driver judged that speed properly and not pulled out, the accident would not have happened.

The approach taken in the study by Allen, reported earlier, was that of characterizing each accident by the presence or absence of twenty-three variables. Relations between these variables were sought. Thus, notions of causation were not necessary.[29] The shortcoming of that study lay in the necessity for artificial dichotomization of some of the variables; thus limiting the amount of information gained from each variable. Also, because Allen analyzed all accidents at once, he had to place dissimilar accidents into the same categories. For example, single vehicle accidents involving female drivers and multiple vehicle accidents involving either one or two female drivers had to be placed into the same category on the "female involved or not" variable. This was true of other variables as well.[30]

The present study also eliminated any consideration of cause in the accidents studied. The question asked was, how are the two sexes different in terms of the characteristics of the accidents they have? The underlying statistical assumption made was that if the two sexes are not dif-

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[29]Allen, op. cit., p. 18.

[30]Ibid., p. 19.

ferent on a specific variable, then the proportion of accidents for each sex within each category of that variable will be very similar. For example, if male drivers had 60 percent of their accidents in an intersection, while female drivers had 60.1 percent of their accidents in an intersection, then no difference between the sexes on the "intersection or not" variable can be inferred. On the other hand, if the two relative proportions differed greatly, then some relationship appears to be in evidence.

For the example above, a variable was chosen which is naturally dichotomous. This method is not limited to dichotomous variables, but rather is applicable to a larger number of categories within each variable. The present study also gained precision by analyzing the data from single and multiple vehicle accidents separately. Reasons will be discussed in more detail later.

Exposure

Exposure is an equally important concept in accident theory and research. In order for an accident to occur a person has to place himself or be placed in a situation whereby he can become involved. In other words, he has to be exposed to some risk. It is immediately obvious that one who is never near an automobile will never be involved in an automobile accident. It follows that other things being equal the accident rate of a driver will be an increasing function of the amount he drives. This reasoning was made

very explicit by Ross A. McFarland and Roland C. Moore concerning their sample of young male and female drivers. "If boys and young men drive three times more than equal-aged members of the opposite sex, they acquire three times as much exposure to the possibility of accidents . . ."[31] In much of the accident literature exposure is operationally defined as precisely the number of miles driven per unit of time, usually a year. In studies concerned with sex differences, investigators, recognizing that males tend to drive more than females, have attempted to equate the sexes by multiplying by a factor dictated by annual mileage differences.

It must be noted, however, that accurate mileage data are difficult to obtain. Frederick E. Vanosdall obtained exposure data by having 6,358 drivers from the state of Michigan estimate the number of miles they drove during the average week. Male drivers represented 70.35 percent of the drivers in the study sample and female drivers 29.65 percent. The estimates indicated that male drivers drove 88.8 percent of the total miles and female drivers drove 11.2 percent. Males estimated they did sixty-eight percent of their driving in the daytime and thirty-two percent at night. Females, on the other hand, indicated they did seventy-six percent of their driving in the daytime and

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[31]Ross A. McFarland, and Roland C. Moore, Youth and the Automobile, (Golden Anniversary White House Conference on Children and Youth, 1960), p. 469.

only twenty-four percent at night.[32] These findings are consistant with the results of Campbell's study of male and female accident involvement, reported earlier.

Earl Allgaier,[33] and Clifford O. Swanson, et al.,[34] obtained overall exposure data by having drivers estimate the total number of miles they had driven per year. This method, although perhaps better than no data at all, leaves much to be desired. Estimates are likely to be in error, for most drivers do not keep accurate records of the amount they drive.[35] Little trips, such as are common to women, have a tendency to "add up" mileage much more quickly than is sometimes realized.

Like Vanosdall, Siebrecht,[36] and Lauer[37] went one step farther in having members of both sexes estimate their total daytime and nighttime driving. The data collected

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[32]Frederick E. Vanosdall, "An Introductory Study to Show the Relationships Between Michigan Drivers by Age, Sex and Exposure in Miles of Motor Vehicle Operation," (unpublished Master's thesis, Michigan State University, 1966), pp. 69-70.

[33]Earl Allgaier, "Some Road-User Characteristics in the Traffic Problem," Traffic Quarterly, Vol. 4, (1950), pp. 59-77.

[34]Swanson, et al., op. cit., p. 69.

[35]Haddon, et al., op. cit., p. 138.

[36]E. Siebrecht, "A Preliminary Report of Accident Characteristics of Iowa Drivers," Iowa Academy of Science, 1953 Proceedings, 60, pp. 552-557.

[37]Lauer, op. cit., pp. 130-138.

were perhaps even less accurate than estimates of the total mileage driven. It is unlikely that people have the ability to be sufficiently accurate in estimating daytime and nighttime driving, and such data could be more misleading than enlightening.

The inaccuracy of the estimates is not the only reason why it is not adequate to consider the sexes equalized on exposure by merely dividing accident frequencies by average annual mileage. There is no basis for concluding that annual mileage directly reflects accident risk independent of other factors such as where an individual drives and the experience gained while driving under different circumstances. Ross A. McFarland observed that drivers ". . . differ widely in their exposure, even though they have equal records, one may have driven under vastly different circumstances."[38] Insofar as there are differences in the amount of driving done by the sexes in factors which have an influence upon risk, there will be differences in the actual exposure to accidents which are not reflected by annual mileage alone. It is well documented, for example, that limited access freeways are less dangerous per mile driven than two-lane roads. Also, per mile driven more "serious" accidents happen after dark than during the daylight hours. To say, then, that an individual driving one

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[38]Ross A. McFarland, Roland C. Moore, and A. Bertrand Warren, Human Variables in Motor Vehicle Accidents, (Boston: Harvard School of Public Health, 1955), p. 12.

hundred miles at night on a two-lane road is exposed to the risk of an accident equally with another individual driving one hundred miles on a freeway in the middle of the day is obviously not true.

The discussion of exposure has been actually tangential thus far, since the present study is not particularly interested in total accident involvement but rather sex differences in attendant variables recorded in accident records. Within each sex a great deal of variance is exhibited in driving habits leading to overlap on any exposure variable. This will be discussed in more detail below. In spite of the overlap, there are believed to be stable differences between the sexes taken as two distinct populations. These differing driving habits lead to differing levels of exposure to accidents of a certain type. For example, as was previously pointed out, in this culture men do a higher proportion of their driving at night than women. Given this information, male drivers would be expected to have a higher proportion of their accidents at night than female drivers. A difference on this variable in that direction is at least partially explainable by the exposure difference. If such a difference was not accompanied by a similar difference in exposure, an alternative explanation, probably concerned with how males and females drive rather than when or where they drive would be warranted.

An example of a conclusion which did not take exposure into account is found in the California study of sin-

gle car accidents.

> . . . men's aggressiveness, daring, and rebelliousness make for reckless and often unlawful behavior. As women's psychological make-up embodies the obverse of these traits, they are comparatively low in accidents due to speed, drinking and perhaps the aftermath of recreational activities — drowsiness.[39]

This explanation was put forth in response to the finding that males had significantly more accidents caused by speed, drowsiness, and drinking. The explanation is in terms of psychological determinants of the way people drive. A wholly more parsimonious explanation, it would seem, is that of exposure. Males tend to drive relatively more in high-speed situations. Likewise males drive relatively more frequently at night, thus leading to more accidents involving drowsiness. Males probably also drive relatively more frequently in the presence of alcohol, not necessarily because of a difference in psychological makeup, but rather because of cultural roles and expectations. More will be said concerning these expected differences in exposure later in the paper.

Lilliam C. Schwenk utilized an explanation similar to that of Penn when she discussed her finding of a tendency for males at younger ages to be killed than females, both as drivers and pedestrians. She wrote, ". . . this may be due to the masculine characteristic of aggressive-

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[39]"Driver Record by Age, Sex and Marital Status," The 1964 California Driver Record Study, Part V, Report No. 20, (Sacramento: California Department of Motor Vehicles, June, 1965), p. 4.

ness."[40] This explanation also ignored exposure differences. It is the contention of this researcher that this type of reasoning only clouds the issue. A realization of which differences may or may not be accounted for by consideration of exposure is essential for an understanding of the data.

Driving Habits of the Two Sexes

It would be good at this point to use past studies to determine the driving habits of males and females. However, to this researcher's knowledge, there are no suitable studies available. As a suggestion for future research, a method whereby this needed information could be accurately obtained is in the form of personal interviews. Participants should be requested to state exactly where and when they drove during the immediate past. The number of past days for which people can accurately remember their driving would have to be determined, and then this limitation could not be exceeded. A large number of interviews, repeatedly with the same subjects or with different subjects, would be necessary, but an accurate and meaningful pattern could be expected to emerge which could then serve as reliable exposure data for use in this study and in other similar studies concerned with sex and other biographical variables.

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[40] Lilliam C. Schwenk, "Age and Sex in Relation to Fatal Traffic Accidents for 1957 – A Continuation Study," Iowa Academy of Science, 1958 Proceedings, 65, p. 425.

This study must content itself with reasoning from observed differences in the roles of the two sexes in this culture. The following discussion and the specific predictions which follow are of an armchair quality which leaves the reader the choice of accepting the reasoning as logical and congruent with his own observations or rejecting all or parts of the reasoning. The main thrust of the report is based on these suspected differences in the driving habits of the two sexes, and the conclusions reached will be invalid insofar as the premises are rejected.

As was previously mentioned, the driving habits of the two sexes exhibit a great deal of overlap. In general, although in physical terms sex is almost completely a dichotomous variable, such is not so nearly the case from a psychological point of view. The distribution of the two sexes have been found to be overlapping on all measurable psychological variables. On any given attribute, some males will be found more "feminine" than some females and vice versa. This is certain to be true of driving habits. For example, it is very possible for an unmarried female to develop driving habits which are more similar to a man's than to another member of her own sex. She may be going to and coming from work at the same time as males and also doing a great deal of driving at night and on the highways. The driving of a certain male salesman, on the other hand, might be characterized by short, daytime trips in the city, a pattern of driving which is more typical of female driv-

ers. These overlaps must be kept in mind as discussion turns to suspected differences in exposure and to specific predictions as to how the sexes will differ as a result of these differences. The typical male and the typical female will be referred to often, indicating some sort of average or normal member of each group who, in fact, has no real existence. The rule is rather relatively small mean differences and relatively large amounts of overlap. For this reason, small but significant differences become important, and the underlying relationships must be sought with care.

How can the driving habits of male and female drivers be characterized? Some differences seem immediately apparent. Men tend to drive to work in the morning, returning in the late afternoon. The female, in the meantime, has taken the children to school, gone shopping, and performed a myriad of other small chores necessitating short trips. In the evenings, the male of the household is more likely to do the driving, especially as the hour gets later. Certainly if adult members of both sex travel together the male is more likely to be the one driving.

If alcohol is present it was probably preceded by a trip to a bar or the home of friends. Masculine escorts usually accompany women in both of these pastimes, in which case the male is more likely to be the one driving if he is able. It is relatively rare for a woman to attend a bar alone or with female companions compared to that activity by males.

Though members of both sexes commonly drive in town, the driving of a female is probably more typically non-rural, since she tends to stay less far away from home and since the shopping is usually done in highly populated areas. Men, on the other hand, might be expected to do more of the rural driving. Family trips usually find the male doing most of the driving. Males would seem more likely to be driving on weekends, with females driving relatively more on the weekdays while males are working.

Since female truck drivers are still a rare sight, a straightforward assumption is that male drivers drive vehicles other than passenger cars relatively more than female drivers. In our culture, timidity is more characteristic of females which leads to the assumption that females are less likely to drive under adverse driving conditions, such as snow, rain, etc. As a group they are probably more prone toward waiting for the weather to improve or for a man to do the driving.

Among young drivers an automobile is much more important to the status of a male than a female. Young males own their own vehicles in more cases than young females, as well as more frequently borrowing the family car. Once behind the wheel, it seems reasonable that boys would tend to drive greater distances than girls. Certainly it is a strong American custom for the male to do the driving on dates. Boys probably also tend to begin driving earlier than girls. The sixteenth birthday of the average boy is

marked by increasing eagerness until he can get his driver's license, while a girl is more likely to patiently postpone her license while letting her "boyfriend" do the driving.

Specific Predictions

The reader can probably think of other cultural sex differences which lead to suspected differences in driving habits. Given these basic assumptions about the nature of the sex differences in driving habits, what relationships between sex and the variables of interest can be hypothesized? To present an answer to the question, each of the classes of variables will be examined separately.

Time Variables

Since it is thought that females drive relatively more in the daytime, and males at night, a relationship between sex and both time of day and light condition is expected, with females having relatively more accidents in the daylight hours and men having relatively more accidents at night. An exception to this is predicted during the rush hours (7 - 9 A.M. and 4 - 6 P.M.). Men are expected to have relatively more accidents during these times than during the rest of the daylight hours than females. A further prediction is that female drivers have relatively more accidents on weekdays, with men taking precedence on the weekends.

Road Characteristics

The theory based on exposure predicts that female drivers have relatively more accidents on city streets. Male drivers, on the other hand, are expected to have relatively more accidents on U. S. and State highways. It is not clear what to predict concerning county roads. It could be that many of the short errand-type trips that the female is suggested as frequently making is in large part on county roads. Many suburban streets are actually considered county roads because they exist outside the city limits.

As for road geometry, since the more urbanized areas are characterized by a preponderance of straight, level streets and roads as opposed to the more often curved and graded rural highways, it is predicted that females have relatively more accidents on straight, level roads, with the converse being true of male drivers.

Location

Male drivers should have relatively more accidents occurring in rural areas according to the above reasoning. Because intersections are more common in urban areas, it is expected that relatively more of the accidents of female drivers are at an intersection.

Collision Characteristics

It is hypothesized that females are associated with intersections, which leads to the expectation that female

drivers are also associated with "entering from angle" in multiple vehicle accidents. Since same direction and opposite direction accidents can take place at locations other than intersections, male drivers might be expected to be slightly higher proportionately on these categories than female drivers. In single vehicle accidents, the pedestrian category is difficult to predict since pedestrian accidents are probably associated both with night and urban locations; thus leading to opposite predictions. Therefore, no prediction can be made with any certainty.

An association between sex and fatal accidents is expected, with males being relatively higher in the fatal category. This prediction is made on the strength of the expectation that males drive more at night, after having consumed alcohol, at higher speeds, and on rural roadways. All these variables contribute to conditions in which a fatal accident is more likely to happen.

Vehicle Characteristics

It is straightforward to predict that females are involved in relatively more accidents involving passenger vehicles with the opposite, of course, being true of male drivers.

Driver Characteristics

It would seem that male drivers would tend to have relatively more accidents during the younger years than fe-

males, perhaps up to age twenty-five, according to reasoning based on assumed exposure differences. It is also expected that inexperienced males have relatively more accidents than inexperienced females. In terms of registration, since males are assumed to do relatively more driving on long trips, the prediction follows that they are found relatively more frequently in the "outstate" category.

Driver Behavior

Since speeding violations can occur any place at any time, no prediction can be made based on exposure for this variable. Right-of-way violations probably are most common in urban driving; thus, it is predicted that female drivers are ticketed relatively more often for this violation.

No prediction is made concerning following-too-close violations, while male drivers are expected to be charged with passing violations relatively more often than female drivers because exposure predicts that males do more rural driving. Again the expectation that females do more urban driving leads to the prediction that they are involved in relatively more turning violations.

Consideration of exposure leads to the assumption that male drivers tend to drive at higher speeds, and, hence, to the prediction that they are involved in accidents at higher rates of speed. The assumption that males tend to drive relatively more at night leads to the prediction that males are guilty of sleeping behind the wheel

relatively more often than females. Exposure also directly leads to the prediction that males are relatively more often guilty of having consumed alcohol prior to an accident.

Weather Variables

Because the weather conditions are largely independent of time of day and location, i.e. the rain falls on everybody, and so does the snow, only a prediction of a small relationship between weather and sex, and surface condition and sex can be made. The fact that the feminine role dictates that females be a little more hesitant to drive under adverse conditions, as well as being more often able to wait until the road and weather clears, suggests the prediction that female drivers are relatively less likely to be involved in an accident in rainy, snowy, or foggy conditions.

CHAPTER II

THE DATA

The accident records maintained by the Michigan State Police include all reported motor vehicle traffic accidents occuring in the state excluding the city of Detroit. The sample selected for this study consisted of all reports of motor vehicle traffic accidents contained in the Michigan State Police files which occured during the years 1966 and 1971 in Berrien County, Michigan. The data consisted of 1,909 single vehicle accidents and 4,250 multiple vehicle accidents for 1966, and 2,167 single vehicle accidents and 4,820 multiple vehicle accidents for 1971.

The discriptive variables regarding motor vehicle traffic accidents, which were selected as the basis for this study, were determined by their appearance on the standard Michigan accident report form. Prior to this selection, a personal observation of the reports was made at the Michigan State Police accident records section in Lansing to verify their completness. Consultation with personnel at the records section provided assurance that the reports offered the most reliable official motor vehicle traffic accident information available.

Twenty-nine variables in eight separate classes taken from the accident report form were found to be on record in usable form. These variables are:

Time Variables

- Light condition
- Time of day
- Day of week

Road Characteristics

- Highway classification
- Road geometry
- Road surface
- Road defects

Location

- Intersection
- Locality

Collision Characteristics

- Directional analysis
- Fatal

Vehicle Characteristics

- Vehicle type
- Vehicle defects
- Vision obscured

Driver Characteristics

- Sex
- Age
- Experience
- Registration

Driver Behavior

Speed violation

Right-of-way violation

Following-too-close

Passing violation

Turning violation

Traffic control violation

Violation other than speeding or drinking

Alcohol

Sleep

Speed

Weather Variables

Weather

Surface condition

(A list of the categories within each variable is found in the Appendix.)

The data were collected and recorded by the State Police for their own purposes and not for the purposes of this study. Therefore, some of the variables recorded are not as relevant as one might hope, some are not grouped so as to gain maximum information, and some variables which would be of great interest are not included. An example of such a deficiency is that the age variable was grouped so that drivers between the ages of twenty and twenty-five were placed in the same category. This grouping is unfortunate since the legal drinking age (during the two sample years) falls right in the center. Thus, alcohol is a large

factor in part of the group, a smaller but perhaps not negligible factor in the other part, and there is no way to separate the two.

On the other hand, the accident records kept by the Michigan State Police contain a great deal of information, and care is exercised in the collection and assessment of those records. This is definitely not second-class data, particularly in relation to that collected by other states.

Despite the care which is taken by Michigan law enforcement organizations, there is a bias which can creep into any accident record. Since only one person fills out the report for a given accident, no reliability check is available. This makes the data in general somewhat suspect. Specific to this study, an implicit assumption which the investigating officer may have concerning sex differences in driving abilities or habits can influence the way he fills out his report.[41] For example, the implicit feeling that female drivers are less likely to be under the influence of alcohol can lead to a smaller likelihood of a female being judged in such a condition than a male driver, other things being equal. This is a very subtle bias, the effect of which can not be assessed. It may very well be that some results which will be reported are merely a result of the working of this bias and have no actual basis in reality.

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[41] Haddon, et al., op. cit., p. 139.

CHAPTER III

METHOD OF ANALYSIS

Chi square contingency table analyses were applied to the data in order to compare the relative proportions of each sex within the categories of each variable. A significant chi square value indicates dependence between the two variables in question, which is equivalent in the present study to saying that the proportions of the male drivers are statistically significantly different from those of the female drivers. Let it be emphasized that the comparisons between the sexes throughout this report are relative to the total number of accidents for each sex. The fact that males had almost three times as many accidents as females makes a straight comparison meaningless.

For each variable crossed with sex, separate analyses were done for each year. Within years, the data were analyzed separately for single and multiple vehicle accidents; and within multiple vehicle accidents, analyses were done separately for driver one and driver two. Thus, in all six separate analyses were done for each variable.

Separate analyses were done to permit an examination of the results in terms of replicability. To illustrate, a significant relationship, as indicated by the chi square value, in the data from one year which did not hold up for

the other year would be considered suspect, unless a trend in the same direction was evident. On the other hand, comparable results for both years added confidence to the conclusion drawn from the data.

In all cases, single and multiple vehicle accidents were analyzed and discussed separately. There are several reasons for this. It allows drivers in the case of multiple vehicle accidents to be analyzed separately. If all accidents were grouped together, this could not reasonably be done. Also, some categories within variables are applicable to only one type of accident. For example, for single vehicle accidents only the "pedestrian" and "single vehicle" categories are relevant in the "direction analysis" variable, while for multiple vehicle accidents only the other five categories are relevant.

But perhaps most importantly, single and multiple vehicle accidents represent two distinct types of accidents. This is true in terms of what actually happens; i.e. a single vehicle accident can be accomplished by one vehicle; it takes at least two to have a multiple vehicle accident. It is also true in terms of relationships between sex and other variables. The reader will be able to note cases in which the relationship between sex and other variables is not the same for both types of accidents throughout the results to be reported in this study.

The data from driver one and driver two of the same year are actually not completely independent since a pair

of drivers is involved in each accident. However, credence is added to any conclusion drawn for multiple vehicle accidents by considering the data from both driver one and driver two. The dependency within years merely makes comparisons of the results of both years relatively more important and consistency between drivers of the same year somewhat less convincing than if they were independently sampled.

A significant chi square value gives no information about the direction of the relationship. Once a statistically significant relationship has been determined, the data must be further examined to discover the nature of the relationship. In this study, this was done by comparing proportions for those variables with significant chi square values. Within each sex the number of accidents in each category was divided by the total number of accidents in which a member of that sex was the driver. By comparing these proportions for the six (or fewer) separate analyses, conclusions were drawn as to the nature of the relationship between sex of the driver and the variable in question.

For some variables, further analyses were accomplished by looking at the relation of sex and the variable of interest within urban and rural accidents separately in some cases, and within day and night separately in other cases. The reason for doing this was simply to assess the effect of either the location of accidents or the time of

the accident upon the relation between sex and the variable of interest. Some differences were expected to diminish while others were expected to accentuate by these further analyses.

CHAPTER IV

THE RESULTS

The results of the chi square analyses are found in table 1.

Time Variables

All of the analyses with the "light condition" variable were significant. The relative proportions are presented in table 2. In every case female drivers have proportionately more accidents in the daytime, while male drivers are relatively higher at night and at dusk and dawn. The light – dark difference is much more pronounced for single than for multiple vehicle accidents. Considering the consistency of these results it can be concluded that the differences found between the sexes on the "light condition" variable are statistically reliable. When light condition was broken down into rural and urban locations, the proportions of accidents for each sex were very similar to the proportions in the entire sample. Thus, location did not appear to influence the relationship between sex and light condition. These results are found in table 3.

The highly related "time of day" variable exhibited a similar consistency. The results are presented in table 4. For single vehicle accidents in both years, male driv-

TABLE 1

CHI SQUARE VALUES AND SIGNIFICANCE LEVELS FOR SEX CROSSED WITH ALL OTHER VARIABLES

VARIABLE	Single		Multiple			
	1966	1971	1966		1971	
			Dr 1	Dr 2	Dr 1	Dr 2
Time Variables						
Light condition	102.42[d]	81.22[d]	9.60[c]	10.12[c]	19.68[d]	22.34[d]
Time of day	110.29[d]	117.76[d]	18.35[b]	40.04[d]	20.84[c]	42.89[d]
Day (7 categories)	21.73[c]	16.05[b]	13.25[a]	15.43[b]	13.50[a]	16.19[b]
Day (2 categories)	15.35[d]	9.51[c]	2.74	14.76[d]	7.62[c]	5.23[a]
Road Characteristics						
Highway classification	4.85	12.18[c]	11.82[c]	15.19[c]	15.12[c]	21.24[d]
Road geometry	37.91[d]	13.01[c]	3.23	.63	10.25[b]	5.28
Road surface	.29	.04	.01	4.52[a]	.01	.11
Road defects	.11	14.98[d]	4.75[a]	3.75	.72	.00
Location						
Intersection	1.36	.02	3.51	3.40	11.17[d]	6.07[b]
Locality	.07	1.66	7.36[c]	1.94	13.61[d]	5.20[a]

TABLE 1 (continued)

CHI SQUARE VALUES AND SIGNIFICANCE LEVELS FOR SEX CROSSED WITH ALL OTHER VARIABLES

VARIABLE	Single		Multiple			
	1966	1971	1966		1971	
			Dr 1	Dr 2	Dr 1	Dr 2
Collision Characteristics						
Directional analysis	.19	1.90	17.10[c]	20.73[d]	26.40[d]	11.33[a]
Fatal	2.07	2.52	.92	1.01	2.39	.80
Vehicle Characteristics						
Vehicle type	35.19[d]	60.92[d]	38.87[d]	37.84[d]	80.97[d]	50.51[d]
Vehicle defects	2.50	.49	1.28	.18	.20	.65
Vision obscured	6.06[b]	1.04	.08	.06	.13	.13
Driver Characteristics						
Age	27.27[d]	17.23[c]	4.91	4.93	7.62	21.88[d]
Experience	16.81[d]	----	36.14[d]	39.26[d]	----	----
Registration	10.52[c]	.17	2.71	3.72	1.16	1.92
Driver Behavior						
Speed violation	17.00[d]	26.49[d]	13.01[d]	4.49[a]	21.21[d]	16.02[d]
Right-of-way violation	.01	.09	4.12[a]	12.61[d]	6.30[b]	1.51

TABLE 1 (continued)

CHI SQUARE VALUES AND SIGNIFICANCE LEVELS FOR SEX CROSSED WITH ALL OTHER VARIABLES

VARIABLE	Single		Multiple			
	1966	1971	1966		1971	
			Dr 1	Dr 2	Dr 1	Dr 2
Following-too-close	.05	1.74	.10	.16	.04	.67
Passing violation	3.17	3.71	.04	1.14	1.18	.26
Turning violation	.45	.94	.17	.10	.48	.11
Traffic control violation	.04	.02	.03	.06	2.94	2.87
Violation other than speeding or drinking	14.52[d]	1.73	.29	5.14[a]	4.37[a]	6.48[b]
Alcohol	123.47[d]	159.02[d]	37.36[d]	32.25[d]	47.63[d]	41.05[d]
Sleep	12.03[d]	22.15[d]	2.78	4.90[a]	10.96[d]	5.23[a]
Speed	77.36[d]	52.02[d]	35.06[d]	29.43[d]	42.20[d]	26.81[d]
Weather Variables						
Weather	29.47[d]	17.81[d]	1.87	4.81	.81	15.19[c]
Surface condition	34.37[d]	20.63[d]	10.46[c]	1.69	2.96	12.85[c]

a = $p < .05$ b = $p < .02$ c = $p < .01$ d = $p < .001$

TABLE 2

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF LIGHT CONDITION

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Light	69.6	43.5	63.5	42.7
Dark	25.0	50.8	33.0	53.5
Dusk-dawn	5.4	5.7	3.5	3.9
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Light	69.9	61.6	70.0	60.1
Dark	25.3	32.8	26.5	34.1
Dusk-dawn	4.8	5.6	3.5	5.8
Driver 2				
Light	67.1	58.1	71.7	58.9
Dark	29.5	37.7	25.2	37.0
Dusk-dawn	3.4	4.2	3.1	4.1

TABLE 3

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF LIGHT CONDITION WITHIN LOCATIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Light	74.5	65.7	49.7	39.9	65.2	62.4	47.5	39.1
Dark	20.2	29.1	44.8	54.4	31.5	33.7	48.0	57.2
Dusk-dawn	5.3	5.2	5.5	5.7	3.3	3.9	4.5	3.7
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
Light	64.8	72.0	57.2	64.2	66.4	70.8	55.9	64.7
Dark	30.1	23.1	37.8	29.9	30.6	24.2	39.3	32.2
Dusk-dawn	5.1	4.9	5.0	5.9	3.0	5.0	4.8	3.1
Driver 2								
Light	70.9	81.1	55.9	62.3	70.5	76.8	56.2	64.1
Dark	27.1	13.9	38.4	31.8	26.9	18.3	39.2	32.6
Dusk-dawn	2.0	5.0	5.7	5.9	2.6	4.9	4.6	3.3

TABLE 4

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF TIME OF DAY

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
12 PM - 3 AM	8.4	17.8	8.5	16.2
3 AM - 7 AM	6.2	10.5	6.7	12.3
7 AM - 9 AM	9.3	4.7	10.0	4.4
9 AM - 11 AM	9.3	4.4	8.2	4.5
11 AM - 1 PM	7.6	5.3	10.2	5.6
1 PM - 4 PM	22.6	12.6	19.7	11.2
4 PM - 6 PM	15.7	11.5	11.0	11.6
6 PM - 9 PM	13.1	16.3	14.7	16.6
9 PM - 12 PM	7.8	16.9	11.0	17.6
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
12 PM - 3 AM	4.2	7.3	5.5	8.2
3 AM - 7 AM	3.3	4.7	2.2	5.1
7 AM - 9 AM	9.9	7.4	6.9	7.0
9 AM - 11 AM	7.2	7.5	9.3	7.6
11 AM - 1 PM	11.7	7.7	12.9	10.8
1 PM - 4 PM	21.2	17.5	19.3	17.3
4 PM - 6 PM	15.6	15.5	16.4	14.0
6 PM - 9 PM	15.9	20.0	18.0	18.0
9 PM - 12 PM	11.1	12.4	9.5	11.9
Driver 2				
12 PM - 3 AM	3.5	7.4	3.5	8.4
3 AM - 7 AM	1.8	5.1	2.8	5.7
7 AM - 9 AM	10.0	7.4	10.7	6.3
9 AM - 11 AM	10.0	6.9	12.6	7.1
11 AM - 1 PM	11.5	8.2	13.8	10.3
1 PM - 4 PM	21.6	17.2	16.7	17.7
4 PM - 6 PM	17.4	15.2	14.5	14.5
6 PM - 9 PM	19.0	19.7	17.3	18.1
9 PM - 12 PM	6.2	12.9	8.2	11.9

ers clearly had proportionately more accidents between the hours of six P.M. and seven A.M. Female drivers were proportionately higher from seven A.M. until four P.M., with the remaining two hours being somewhat uncertain. The proportions for multiple vehicle accidents were similar, but not as much difference was shown between the sexes. Very similar conclusions can be drawn as were in the case of the data from single vehicle accidents, although there are singular exceptions. There does appear to be sufficient consistency to conclude a reliable difference between the sexes of the nature reported does, in fact, exist.

The proportions of rush hour (7 - 9 A.M., and 4 - 6 P.M.) accidents to total daytime (7 A.M. to 6 P.M.) accidents are found in table 5. In all conditions except 1966 driver two, male drivers had a higher proportion of rush hour accidents than female drivers.

All of the analysis proved to be significant when considering each of the seven days of the week as a separate category. With the data dichotomously grouped into the categories "weekend" (Saturday and Sunday) and "weekday" (Monday through Friday), all of the analyses were significant except driver one in 1966 multiple vehicle accidents. Although there are some weekdays in which males had proportionately more accidents than females, the general trend was definitely for males to have a greater proportion of their accidents on weekends than female drivers. Table 6 presents the proportions of accidents for each sex on the

TABLE 5

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN RUSH HOUR (7-9 AM & 4-6 PM) AND OTHER DAYLIGHT HOURS (9 AM - 4 PM)

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Rush hour	38.8	42.1	35.7	42.9
Other daylight hours	61.2	57.9	64.3	57.1
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Rush hour	38.9	40.9	36.1	37.1
Other daylight hours	61.1	59.1	63.9	62.9
Driver 2				
Rush hour	40.0	37.7	36.9	37.9
Other daylight hours	60.0	62.3	63.1	62.1

TABLE 6

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF DAY OF THE WEEK

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Sunday	13.5	20.3	15.1	17.3
Monday	10.6	11.4	12.2	12.4
Tuesday	11.8	10.0	16.5	11.6
Wednesday	10.9	10.4	13.5	11.7
Thursday	15.8	10.8	11.7	10.5
Friday	18.1	14.5	13.0	14.2
Saturday	19.3	22.6	18.0	22.3
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Sunday	16.6	19.8	12.9	16.9
Monday	13.1	12.0	15.2	12.5
Tuesday	11.6	9.0	9.3	11.2
Wednesday	11.6	8.9	13.5	11.4
Thursday	14.6	11.6	12.9	12.3
Friday	11.6	16.2	18.0	15.0
Saturday	20.9	22.6	18.2	20.6
Driver 2				
Sunday	14.1	20.3	13.5	16.6
Monday	13.9	11.9	14.5	12.9
Tuesday	11.2	9.0	10.0	10.8
Wednesday	11.3	9.1	13.2	11.7
Thursday	13.3	11.9	17.5	11.5
Friday	18.0	14.9	14.1	16.0
Saturday	18.2	22.9	17.2	20.5

different days. Table 7 presents the relative proportion of each sex for the weekday and weekend categories.

TABLE 7

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF WEEKDAY - WEEKEND

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Weekday	67.2	57.1	66.9	60.4
Weekend	32.8	42.9	33.1	39.6
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Weekday	62.5	57.6	68.9	62.5
Weekend	37.5	42.4	31.1	37.5
Driver 2				
Weekday	67.7	56.8	69.3	62.9
Weekend	32.3	43.2	30.7	37.1

Road Characteristics

The "highway classification" variable crossed with sex yielded significant chi square values for all of the analysis except single vehicle accidents in 1966. The differentiating factor for the multiple vehicle accidents was the tendency for male drivers to have relatively more acci-

dents on U. S. highways and, to a lesser extent, state highways, while female drivers tended toward relatively more accidents on city streets and, to a lesser extent, on county roads. These results can be seen in table 8. Although the chi square value for 1971 single vehicle accidents was significant, the 1966 single vehicle data contra-

TABLE 8

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF HIGHWAY CLASSIFICATION

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
U. S.	16.7	16.4	17.9	18.6
State	15.7	20.3	16.7	14.7
County	60.7	57.2	45.1	51.5
City	6.9	6.1	20.3	15.2
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
U. S.	24.1	32.4	24.2	28.3
State	21.8	22.3	24.8	25.4
County	48.7	40.8	29.9	31.7
City	5.4	4.5	21.1	14.6
Driver 2				
U. S.	26.2	32.0	20.0	28.5
State	18.6	22.9	22.3	25.9
County	48.1	40.9	36.4	30.3
City	7.1	4.2	21.3	15.3

dict this result. Therefore, no inference can be made concerning the single vehicle data on this variable.

It should be noted, however, that the "highway classification" variable is not as relevant to this study as it is to administrative considerations. The highway classification is often not indicative of the type of roadway in question, e.g., a U. S. highway is often a city street.

The relative proportions of each sex for each category of the "road geometry" variable are found in table 9. Both of the chi square values for single vehicle accidents were significant. However, for multiple vehicle accidents only one analysis was significant. The large chi square value for single vehicle accidents in 1966 came mainly from the contribution of the "curve" category, where females were far below the expected value. Female drivers were also below the expected value for the 1971 data but not as much. The results of the two analyses were also consistent for the other categories, with male drivers having relatively more accidents in the "grade-curve" category and female drivers having relatively more in the "straight" and "grade" categories. Because only one of the multiple vehicle analyses proved significant, no relationship for this type of accident can be inferred.

When the data were analyzed separately for rural and urban accidents, the tendency for males to have more single vehicle accidents on curves was accentuated in rural

TABLE 9

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF ROAD GEOMETRY

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Straight	67.4	56.3	64.0	62.7
Grade	17.0	14.6	16.7	12.7
Curve	8.3	20.0	10.7	15.2
Grade-curve	7.3	9.1	8.6	9.4
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Straight	74.6	75.5	80.9	74.8
Grade	18.8	16.3	14.5	18.1
Curve	4.9	5.3	3.0	4.2
Grade-curve	1.7	2.9	1.6	2.9
Driver 2				
Straight	75.9	75.2	78.9	75.9
Grade	15.4	16.9	15.8	17.4
Curve	6.0	5.1	4.2	3.8
Grade-curve	2.7	2.8	1.1	2.9

locations. A similar rise in sex differences on curves was exhibited in accidents happening during the night-time. The sex differences remained in evidence within urban locations and during the daylight; however, with reduced magnitude. No new information was in evidence from these further analyses for multiple vehicle accidents. These results are found in tables 10 and 11.

TABLE 10

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF ROAD GEOMETRY WITHIN LOCATIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Straight	81.0	61.9	68.9	50.9	73.0	55.6	72.8	55.5
Grade	10.1	18.6	9.3	16.6	11.3	21.9	11.4	13.4
Curve	7.6	9.2	15.9	22.0	8.8	11.8	9.7	19.2
Grade-curve	1.3	10.3	5.9	10.5	6.9	10.7	6.1	11.9
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
Straight	85.2	65.3	82.8	70.5	85.4	68.8	81.2	62.7
Grade	10.4	26.0	11.2	19.8	11.8	21.7	14.0	25.8
Curve	3.0	6.7	4.3	6.0	2.2	5.2	3.0	6.3
Grade-curve	1.4	2.0	1.7	3.7	.6	4.3	1.8	5.2
Driver 2								
Straight	85.7	67.9	82.8	70.0	84.6	64.2	81.8	64.2
Grade	8.3	21.2	11.6	20.7	11.4	24.7	13.9	24.3
Curve	4.5	7.3	3.9	5.9	4.0	6.1	2.6	6.2
Grade-curve	1.5	3.6	1.7	3.4	.0	5.0	1.7	5.3

TABLE 11

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF ROAD GEOMETRY WITHIN LIGHT CONDITIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Straight	69.4	68.7	62.4	50.8	64.8	60.9	69.0	57.8
Grade	18.8	8.0	19.3	10.8	16.2	19.1	13.8	11.6
Curve	7.5	12.0	12.0	27.2	10.2	11.8	9.4	19.4
Grade-curve	4.3	11.3	6.3	11.2	8.8	8.2	7.8	11.2
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Driver 1								
Straight	73.3	82.1	74.9	76.0	81.7	80.3	74.1	76.1
Grade	20.5	12.8	15.5	17.9	13.0	15.9	17.9	18.6
Curve	4.1	3.8	6.1	4.2	3.5	2.3	4.7	3.0
Grade-curve	2.1	1.3	3.5	1.9	1.8	1.5	3.3	2.3
Driver 2								
Straight	74.5	80.6	74.7	76.4	82.3	70.0	74.6	78.1
Grade	16.7	11.3	16.3	17.9	12.3	25.7	17.7	16.8
Curve	5.3	8.1	5.8	3.7	4.4	4.3	4.4	2.7
Grade-curve	3.5	.0	3.2	2.0	1.0	.0	3.3	2.4

One single vehicle and one multiple vehicle analysis was significant for the "road defect" variable. In the absence of replication, these results are suspect. The relative proportions can be seen in table 12. A small tendency for females to have more accidents in the presence of road defects is in evidence. In conjunction with the small number of accidents which fell into the "road defect" category, thus attenuating the chi square value, this leads to a suspicion that a relation may exist. This conclusion can, however, only be held very tenuously.

TABLE 12

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF ROAD DEFECT

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Road defect	11.5	11.0	12.0	7.0
No road defect	88.5	89.0	88.0	93.0
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Road defect	8.4	5.5	6.1	5.1
No road defect	91.6	94.5	93.9	94.9
Driver 2				
Road defect	3.8	6.4	5.3	5.3
No road defect	96.2	93.6	94.7	94.7

Location

Neither the analyses for single vehicle accidents nor the analyses for 1966 multiple vehicle accidents were significant for the variable "intersection". Both analyses of 1971 multiple vehicle data were. The proportions of multiple vehicle accidents are presented in table 13. Although the 1966 data were not significant, all of the proportions show similar direction. Female drivers show a higher proportion of accidents at intersections. It seems reasonable to assume a small but reliable difference between the sexes on this variable for multiple vehicle accidents.

When multiple vehicle accidents were further analyzed within rural and urban accidents, females still had consistently more intersection accidents, relatively

TABLE 13

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF INTERSECTION

	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Intersection	49.3	43.9	54.0	46.0
Nonintersection	50.7	56.1	46.0	54.0
Driver 2				
Intersection	49.3	43.9	54.5	47.5
Nonintersection	50.7	56.1	45.5	52.5

speaking, for rural accidents. For urban accidents, female and male drivers were much more similar. Males actually had a slightly higher proportion of their accidents for 1966 driver one, while females were slightly higher in the other three multiple vehicle conditions. It appears that for urban accidents, no consistent sex difference was in evidence, while in rural accidents, females were proportionately more often found in intersection accidents. These results are found in table 14.

All but three of the analyses of the variable "location" were significant. Table 15 presents the relative proportions for each sex of the data from all six conditions in the "location" category. The direction of the relationship is the same for all conditions; namely, female drivers tend to have relatively more accidents in non-rural areas, while males, conversely, have more rural accidents. The conclusion must be that a weak but reliable relationship exists between sex and location. The proportions of each sex and the two location categories within day and night-time accidents are found in table 16. In general, the sex and location relationship is the same in the two light conditions.

Collision Characteristics

The variable "direction analysis" must be interpreted somewhat differently for single as opposed to multiple vehicle accidents. For single vehicle accidents, only

TABLE 14

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF INTERSECTION WITHIN LOCATIONS

	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
Intersection	53.8	44.5	56.4	35.6	58.3	40.8	53.3	33.0
Nonintersection	46.2	55.5	43.6	64.4	41.7	59.2	46.7	67.0
Driver 2								
Intersection	56.3	42.8	55.8	35.8	58.1	43.9	54.1	33.0
Nonintersection	43.7	57.2	44.2	64.2	41.9	56.1	45.9	67.0

TABLE 15

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF LOCATION

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Urban	30.2	29.6	47.9	44.8
Rural	69.8	70.4	52.1	55.2
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Urban	48.7	40.7	75.3	67.1
Rural	51.3	59.3	24.7	32.9
Driver 2				
Urban	45.5	41.3	73.8	68.1
Rural	54.5	58.7	26.2	31.9

TABLE 16

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF LOCATION WITHIN LIGHT CONDITIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Urban	33.3	23.5	34.4	25.8	48.0	45.2	49.3	40.2
Rural	66.7	76.5	65.6	74.2	52.0	54.8	50.7	59.8
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Driver 1								
Urban	46.1	55.3	37.8	46.4	74.2	79.6	63.8	71.4
Rural	53.9	44.7	62.2	53.6	25.8	20.4	36.2	28.6
Driver 2								
Urban	42.3	62.1	38.6	45.9	72.4	80.8	65.3	72.0
Rural	57.7	37.9	61.4	54.1	27.6	19.2	34.7	28.0

the "pedestrian" and "single vehicle" categories are relevant. The chi square analyses for the variable "direction analysis" on single vehicle accidents were non-significant for both years. The multiple vehicle proportions are presented in table 17. All of the analyses for this category were significant. Thus, a relationship between the sex of the driver and the direction analysis variable can be inferred only for multiple vehicle accidents. Females have proportionately more accidents with the vehicles entering from an angle and proportionately less with the vehicles going in the same direction. There is a small tendency for females to be relatively higher in the "opposite direction"

TABLE 17

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF DIRECTION ANALYSIS

	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Entering from angle	30.6	27.2	36.2	26.7
Same direction	27.9	32.0	21.0	28.5
Opposite direction	31.6	30.8	21.8	21.8
Stopped	6.6	9.0	20.3	21.1
Parked	3.3	1.0	.7	1.9
Driver 2				
Entering from angle	35.1	26.2	34.7	27.9
Same direction	23.2	33.0	21.5	27.6
Opposite direction	32.5	30.6	23.4	21.5
Stopped	7.9	7.7	18.9	21.3
Parked	1.3	2.5	1.5	1.7

category also. The other two categories show little consistency. The results of this variable within locations for multiple vehicle accidents is found in table 18. It can be seen that the relationships described above are found within the two locations also.

The chi square analyses for the variable "fatal" crossed with sex were all non-significant; therefore, as far as these analyses go, no conclusion can be drawn.

Vehicle Characteristics

All analyses demonstrated that the "vehicle type" variable and sex were highly related. Inspection of the proportions of each sex for each category, which are found in table 19, makes the direction of this relationship obvious. In all cases male drivers were relatively less likely to be driving passenger cars than female drivers, and relatively more likely to be driving pickups and trucks. These results were highly reliable.

The chi square values for the variable "vehicle defect" crossed with sex were all non-significant. The chi square values for the variable "vision obscured" and sex were all non-significant except that from the analysis of 1966 single vehicle accidents. Because there were no significant analyses for the "vehicle defect" variable, and because there was no evidence for replication for the one significant result for the variable "vision obscured", no relation between either variable and sex can be inferred.

TABLE 18

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF DIRECTION ANALYSIS WITHIN LOCATIONS

	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
Entering from angle	31.7	27.8	29.9	24.4	37.5	32.0	28.9	22.0
Same direction	28.1	28.5	32.5	31.3	18.7	28.0	24.4	36.9
Opposite direction	27.3	36.5	26.0	34.2	20.4	26.0	18.5	28.1
Stopped	8.6	4.6	9.7	8.0	22.7	12.0	26.6	10.4
Parked	4.3	2.6	1.9	2.1	.7	2.0	1.6	2.6
Driver 2								
Entering from angle	40.2	30.7	28.1	24.1	36.3	30.5	30.3	22.7
Same direction	19.7	25.8	35.5	32.7	18.9	27.8	24.2	36.2
Opposite direction	28.0	36.8	24.8	34.0	22.1	27.8	18.0	27.6
Stopped	9.8	6.1	9.2	6.7	21.1	12.5	26.5	10.4
Parked	2.3	.6	2.4	2.5	1.6	1.4	1.0	3.1

TABLE 19

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF VEHICLE TYPE

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Car	97.8	89.0	97.2	86.0
Pickup	1.4	4.7	1.5	5.8
Truck	.0	3.5	.5	4.4
Other	.8	2.8	.8	3.8

	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Car	97.4	86.0	99.0	85.5
Pickup	.9	4.1	.6	5.9
Truck	.3	7.6	.0	7.0
Other	1.4	2.3	.4	1.6
Driver 2				
Car	97.0	85.6	98.8	86.1
Pickup	2.1	4.3	.3	4.5
Truck	.6	6.8	.0	6.1
Other	.3	3.3	.9	3.3

Driver Characteristics

The analysis of single vehicle accidents for both years were highly significant when the variable "age" was crossed with sex of the driver. The proportions for each sex in each category are presented in table 20. It can be seen that the differences between the two sexes were in a similar direction for the two years. Female drivers had proportionately more accidents between the ages of 25 and 64, while male drivers took relative precedence for 24 and under and very slightly for 65 and older. Since only one of the multiple vehicle analyses demonstrated a significant relationship, no conclusion can be inferred from the multiple vehicle data.

When age was analyzed within locations, and within light conditions nothing with any consistency was exhibited for multiple vehicle accidents. For single vehicle accidents, males between the ages of 20 and 24 consistently had proportionately more accidents than females of the same age. These results are found in table 21 and 22.

Unfortunately the accident records from 1971 did not contain data on the driving experience of the drivers. However, such data were collected as a part of the 1966 records and were analyzed as a part of this study. All three analyses showed a significant relationship between experience and sex. The results in terms of relative proportions are found in table 23. All three tables show a

TABLE 20

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF AGE

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
- 19	15.3	18.4	18.0	18.2
20 - 24	15.6	23.2	16.0	21.6
25 - 44	44.2	40.7	40.2	39.2
45 - 64	21.6	13.7	22.8	16.8
65 -	3.3	4.0	3.0	4.2
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
- 19	8.8	11.4	10.7	12.6
20 - 24	15.7	15.1	18.6	15.4
25 - 44	51.5	46.7	40.4	41.1
45 - 64	19.2	20.2	25.4	23.9
65 -	4.8	6.6	4.9	7.0
Driver 2				
- 19	10.9	11.5	10.8	15.8
20 - 24	14.2	15.1	15.2	14.3
25 - 44	50.1	45.2	48.8	40.2
45 - 64	20.4	21.3	23.3	23.8
65 -	4.4	6.9	1.9	5.9

TABLE 21

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF AGE WITHIN LOCATIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
- 19	13.8	16.5	16.7	19.0	20.5	15.6	19.3	18.0
20 - 24	11.7	15.5	21.8	23.7	15.6	17.6	19.3	23.5
25 - 44	43.7	42.7	43.4	39.9	33.9	45.9	39.6	39.2
45 - 64	25.5	22.5	13.8	13.8	25.6	18.5	16.7	16.2
65 -	5.3	2.8	4.3	3.6	4.4	2.4	5.1	3.1
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
- 19	9.6	8.6	11.4	11.0	11.4	9.1	13.8	10.5
20 - 24	15.4	16.6	14.8	15.7	19.3	14.2	14.3	17.4
25 - 44	57.1	46.0	49.9	44.7	38.9	45.0	41.1	41.0
45 - 64	14.1	23.3	18.6	21.2	26.4	24.2	23.7	24.1
65 -	3.8	5.5	5.3	7.4	4.0	7.5	7.1	7.0
Driver 2								
- 19	11.3	11.1	13.2	9.7	15.5	19.5	15.9	15.6
20 - 24	13.9	14.4	16.7	13.7	14.6	17.1	14.0	13.7
25 - 44	54.3	46.2	45.4	46.0	45.9	35.4	41.2	38.2
44 - 64	17.9	22.2	20.1	22.1	22.3	25.6	23.2	26.4
65 -	2.6	6.1	4.6	8.5	1.7	2.4	5.7	6.1

TABLE 22

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF AGE WITHIN LIGHT CONDITIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
- 19	14.5	17.8	16.3	20.0	19.0	18.8	18.4	19.9
20 - 24	12.2	20.2	17.5	27.8	14.6	20.5	17.0	25.1
25 - 44	45.7	41.7	41.2	41.0	40.9	39.4	35.8	41.7
45 - 64	23.5	17.9	18.4	10.0	21.9	18.9	22.2	11.2
65 -	4.1	2.4	6.6	1.2	3.6	2.4	6.6	2.1
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Driver 1								
- 19	8.1	9.4	10.3	12.8	9.9	13.1	11.7	15.0
20 - 24	15.9	14.1	14.3	16.3	16.9	21.4	14.2	17.8
25 - 44	48.9	60.0	44.1	51.7	38.3	44.1	38.8	44.0
45 - 64	20.2	16.5	23.2	15.3	28.0	21.4	26.3	19.4
65 -	6.9	.0	8.1	3.9	6.9	.0	9.0	3.8
Driver 2								
- 19	10.8	13.6	11.3	12.4	14.5	24.1	12.6	20.8
20 - 24	12.3	19.8	13.2	18.5	12.7	22.8	13.5	15.8
25 - 44	51.5	42.4	44.5	46.3	46.1	34.0	40.0	40.9
45 - 64	20.0	22.7	21.8	19.7	24.1	19.0	26.2	19.9
65 -	5.4	1.5	9.2	3.1	2.6	.1	7.7	2.6

strong consistency, with female drivers of less than five years experience having a disproportionately large number of accidents compared to male drivers with the same amount of experience. It is unfortunate that the relation could not be tested by replication. However, in the face of the consistency of the 1966 data the inference that a true relationship as described above does exist seems reasonable.

TABLE 23

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF EXPERIENCE

	Single Vehicle 1966	
	Female	Male
Less than one year	8.0	5.0
One to five years	35.9	28.8
More than five years	56.1	66.2
	Multiple Vehicle 1966	
	Female	Male
Driver 1		
Less than one year	3.8	2.4
One to five years	32.6	19.0
More than five years	63.6	78.6
Driver 2		
Less than one year	6.0	2.7
One to five years	29.1	17.6
More than five years	64.9	79.7

For the 1966 sample of single vehicle accidents, a tendency was shown for inexperienced females to differ from inexperienced males more extensively in urban settings than rural settings. This was not the case in multiple vehicle accidents. These results are found in table 24. Likewise the same sex difference is more pronounced in the daytime

TABLE 24

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF EXPERIENCE WITHIN LOCATIONS

	Single Vehicle 1966			
	Female		Male	
	Urban	Rural	Urban	Rural
Less than one year	8.1	7.8	4.1	5.3
One to five years	36.4	33.4	25.6	30.0
More than five years	55.5	58.8	70.3	64.7

	Multiple Vehicle 1966			
	Female		Male	
	Urban	Rural	Urban	Rural
Driver 1				
Less than one year	2.8	5.1	2.5	1.9
One to five years	31.2	32.6	19.3	19.2
More than five years	66.0	62.3	78.2	78.9
Driver 2				
Less than one year	6.4	5.8	3.3	2.3
One to five years	33.6	24.7	20.6	17.4
More than five years	60.0	69.5	76.1	80.3

than at night for single vehicle accidents. The difference between day and night is much less pronounced in multiple vehicle accidents. These results are presented in table 25.

To help clarify the age and experience relationship, proportions of each sex and age level within levels of experiences are found in table 26. It can be seen that mid-

TABLE 25

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF EXPERIENCE WITHIN LIGHT CONDITIONS

	Single Vehicle 1966			
	Female		Male	
	Light	Dark	Light	Dark
Less than one year	9.1	4.6	6.1	4.3
One to five years	33.9	40.0	21.9	34.3
More than five years	57.0	55.4	72.0	61.4

	Multiple Vehicle 1966			
	Female		Male	
	Light	Dark	Light	Dark
Driver 1				
Less than one year	1.9	8.3	2.3	2.3
One to five years	33.0	26.4	18.1	20.1
More than five years	65.1	65.3	79.6	77.7
Driver 2				
Less than one year	6.2	6.3	2.7	3.1
One to five years	27.9	35.9	17.1	21.5
More than five years	65.9	57.8	80.2	75.4

TABLE 26

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF AGE WITHIN EXPERIENCE

	Single Vehicle 1966					
	Female			Male		
	- 1	1 - 5	5 -	- 1	1 - 5	5 -
- 19	57.1	29.0	.6	78.5	49.8	.7
20 - 24	4.8	34.4	4.5	12.3	44.5	14.6
25 - 44	9.5	31.2	59.2	6.2	4.4	59.2
45 - 64	19.1	5.4	31.8	1.5	1.0	20.1
65 -	9.5	.0	3.9	1.5	.3	5.4
	Multiple Vehicle 1966					
	Female			Male		
	- 1	1 - 5	5 -	- 1	1 - 5	5 -
Driver 1						
- 19	72.7	19.8	.0	75.0	49.1	.3
20 - 24	9.1	35.4	5.9	6.3	42.5	9.3
25 - 44	18.2	36.5	62.7	9.3	7.7	55.5
45 - 64	.0	8.3	25.0	9.4	.7	26.7
65 -	.0	.0	6.4	.0	.0	8.2
Driver 2						
- 19	38.8	31.0	.5	82.5	46.2	.5
20 - 24	11.1	32.2	5.7	5.0	41.5	9.1
25 - 44	38.9	33.3	61.3	2.5	9.3	55.6
45 - 64	5.6	3.4	26.3	7.5	2.6	26.5
65 -	5.6	.1	6.2	2.5	.4	8.3

dle-aged females have relatively more accidents than middle-aged males within the inexperienced category. This difference is quite large. This is true for both single and multiple vehicle accidents.

The only significant analysis of the variable "registration" crossed with sex was of the data from 1966 single vehicle accidents. Table 27 presents the proportions of accidents for each year.

TABLE 27

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF REGISTRATION

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Instate	98.6	95.2	94.3	94.7
Outstate	1.4	4.8	5.7	5.3

The relationship in the 1966 single vehicle data shows females to be associated with "instate". However, the 1971 single vehicle data contradict this result; hence, no conclusion can be drawn. This likewise is true for the multiple vehicle data, since none of the analyses were significant.

Driver Behavior

The variable "speed violation" crossed with sex yielded significant chi square values for all six analyses. The results in terms of proportions are presented in table 28. In all cases male drivers have relatively more accidents involving a speed violation than female drivers. The relation is not as strong for multiple as for single vehicle accidents, nonetheless it can be assumed to be reliable for both types of accidents.

TABLE 28

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF SPEED VIOLATION

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Speed violation	41.8	52.5	37.4	49.4
No speed violation	58.2	47.5	62.6	50.6

	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Speed violation	11.6	19.9	7.3	14.6
No speed violation	88.4	80.1	92.7	85.4
Driver 2				
Speed violation	8.6	12.7	7.5	15.2
No speed violation	91.4	87.3	92.5	84.8

The breakdown of the speed violation proportions within the sexes for urban and rural accidents is found in table 29. It can be seen that the relationship between the two variables is unaltered by this analysis. The analysis within light conditions for single vehicle accidents did have the effect of reducing the sex difference, though not eliminating it. The relationships for multiple vehicle accidents were not altered to any degree. These results may be found in table 30.

Table 31 contains the proportions of the variable "right-of-way violation" crossed with sex of the driver for multiple vehicle accidents. No significant relationship was found between these two variables in the single vehicle data, while all data except driver two for 1971 yielded significant chi squares in multiple vehicle accidents. On all multiple vehicle analyses there were proportionately more accidents involving a female driver and a right-of-way violation than accidents involving a male driver and the same violation. Thus, a reliable relationship can be inferred for multiple vehicle accidents. When multiple vehicle accidents were examined for urban and rural accidents separately, the relationship between the two variables remained very similar. These results can be seen in table 32.

The analyses of sex crossed with the following violations all yielded non-significant chi square values both for single and multiple vehicle accidents for both years:

TABLE 29

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF SPEED VIOLATION WITHIN LOCATIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Speed violation	25.5	47.9	33.9	61.5	28.7	45.9	36.3	61.5
No speed violation	74.5	52.1	66.1	38.5	71.3	54.1	63.7	38.5
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
Speed violation	10.9	12.8	15.3	23.4	5.4	13.3	13.0	18.2
No speed violation	89.1	87.2	84.7	76.6	94.6	86.7	87.0	81.8
Driver 2								
Speed violation	4.6	11.7	9.9	14.8	6.4	11.0	10.0	15.6
No speed violation	95.4	88.3	90.1	85.2	93.6	89.0	90.0	84.4

TABLE 30

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF SPEED VIOLATION WITHIN LIGHT CONDITIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Speed violation	33.3	58.3	40.9	61.7	33.3	45.7	35.7	62.3
No speed violation	66.7	41.7	59.1	38.3	66.7	54.3	64.3	37.7
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Driver 1								
Speed violation	10.3	14.1	19.5	20.6	7.5	6.9	12.5	18.3
No speed violation	89.7	85.1	80.5	79.4	92.5	93.1	87.5	81.7
Driver 2								
Speed violation	8.4	7.6	11.2	15.2	7.0	7.5	10.3	14.4
No speed violation	91.6	92.4	88.8	84.8	93.0	92.5	89.7	85.6

TABLE 31

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF RIGHT-OF-WAY VIOLATION

	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Violation	20.3	16.0	23.6	18.8
No violation	79.7	84.0	76.4	81.2
Driver 2				
Violation	23.0	15.4	22.2	19.6
No violation	77.0	84.6	77.8	80.4

TABLE 32

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF RIGHT-OF-WAY VIOLATION WITHIN LOCATIONS

	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
Right-of-way violation	24.4	15.2	17.5	15.0	25.2	19.2	19.9	16.2
No violation	75.6	84.8	82.5	85.0	74.8	80.8	80.1	83.8
Driver 2								
Right-of-way violation	21.6	20.6	17.3	14.0	22.6	22.0	21.1	15.9
No violation	78.4	79.4	82.7	86.0	77.4	78.0	78.9	84.1

Following-too-close

Passing violation

Turning violation

Traffic control violation

Because of the non-significant chi square values, no relation between sex and any of these variables can be inferred. However, it may be faulty to assume that no relationship actually exists since all of the violations were small in number compared to the total number of accidents.

Analyses were done by putting all violations other than speeding or drinking into one category, making the other category the absence of any non-alcohol or non-speeding violation associated with the accident. Table 33 contains the proportions of each sex for each category. The analyses for single vehicle accidents were indefinate. The analysis of 1966 data proved significant, but in a direction opposite that of the non-significant 1971 data. For multiple vehicle accidents, the differences between the sexes were all in the same direction, with female drivers having a relatively greater proportion of accidents involving a violation other than speeding or drinking than male drivers. Even though only three of the four analyses were significant, in the face of this consistency it seems safe to conclude a reliable difference between the sexes of this nature for multiple vehicle accidents does exist.

All analyses of the variable "alcohol" crossed with sex were highly significant. The proportions presented in

TABLE 33

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF VIOLATION OTHER THAN SPEEDING OR DRINKING

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Violation	15.2	9.0	16.0	18.4
No violation	84.8	91.0	84.0	81.6
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Violation	76.1	74.6	83.0	79.0
No violation	23.9	25.7	17.0	21.0
Driver 2				
Violation	80.1	74.6	83.0	77.0
No violation	19.9	25.4	17.0	23.0

table 34 make it very evident that in all cases male drivers were found relatively more frequently in both the "drunk" and "drinking" categories than female drivers. The inference can be made that this is a reliable relationship.

TABLE 34

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF ALCOHOL

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Not drinking	89.9	63.2	87.1	60.5
Drinking	9.2	27.7	12.4	29.5
Drunk	.9	9.1	.5	10.0
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Not drinking	96.2	84.3	94.4	83.2
Drinking	3.5	11.1	5.2	13.5
Drunk	.3	4.6	.4	3.3
Driver 2				
Not drinking	95.7	84.5	96.1	83.8
Drinking	3.6	11.0	3.4	13.7
Drunk	.7	4.5	.5	2.5

The relationship remained consistent and strong when accidents were further separated into urban and rural locations, and proportions calculated separately. These

results can be seen in table 35. When accidents are divided by light condition, males continue to be found more often in the drinking and drunk categories than females; however, the sex difference is considerably stronger in accidents happening at night. These results are found in table 36.

The "sleep" variable crossed with sex yielded significant chi squares for both analyses of the single vehicle data and three of the four analyses of multiple vehicle data. The data in terms of proportions are presented in table 37. The data from all six conditions are consistent in showing male drivers to be guilty of having relatively more accidents involving sleep than female drivers. It appears safe to conclude that this is a reliable difference between the sexes. The chi square analyses indicate a stronger relationship in the single vehicle data than in the multiple vehicle data. Analyses were not done within light conditions because very few accidents involved sleep in the daytime.

All of the analyses of the variable "speed" crossed with sex were significant. The proportions of all six sets of data are presented in table 38. For all data, females have proportionately more accidents at lower speeds, while males take precidence at higher speeds. The significant chi square values, coupled with the strong consistency of the proportions, leaves little doubt as to the validity of the conclusion that male drivers had a greater propor-

TABLE 35

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF ALCOHOL WITHIN LOCATIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Not drinking	91.3	88.4	70.4	59.4	87.3	88.0	66.0	59.9
Drinking	6.2	11.1	18.7	32.3	12.7	10.9	27.3	36.4
Drunk	2.5	.5	10.9	8.3	.0	1.1	6.7	3.7
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
Not drinking	94.9	97.2	84.3	84.7	94.1	94.6	82.0	86.8
Drinking	4.4	2.8	10.4	11.2	5.3	5.4	14.9	11.2
Drunk	.7	.0	5.3	4.1	.6	.0	3.1	2.0
Driver 2								
Not drinking	96.3	95.7	87.8	89.0	100.0	96.0	83.8	84.6
Drinking	3.0	3.7	7.2	8.5	.0	3.5	13.5	11.3
Drunk	.7	.6	5.0	2.5	.0	.5	2.7	4.1

TABLE 36

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF ALCOHOL WITHIN LIGHT CONDITIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Not drinking	96.0	65.2	84.6	43.2	95.5	75.0	83.8	44.8
Drinking	3.5	31.8	11.3	43.1	4.1	24.1	13.3	48.4
Drunk	.5	3.0	4.1	13.7	.4	.9	2.9	6.8
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Driver 1								
Not drinking	98.6	87.7	90.4	72.8	97.7	85.9	92.7	68.1
Drinking	1.4	10.8	6.7	19.5	2.0	13.4	5.8	26.8
Drunk	.0	1.5	2.9	7.7	.3	.7	1.5	5.1
Driver 2								
Not drinking	96.2	92.6	93.9	78.0	100.0	96.0	92.8	69.9
Drinking	3.0	7.4	4.6	14.9	.0	3.5	6.4	24.7
Drunk	.8	.0	1.5	7.1	.0	.5	.8	5.4

TABLE 37

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF SLEEP

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Sleep	1.7	5.5	2.0	7.1
No sleep	98.3	94.5	98.0	92.9
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Sleep	.3	1.2	.6	2.8
No sleep	99.7	98.8	99.4	97.2
Driver 2				
Sleep	.0	1.3	.4	2.2
No sleep	100.0	98.7	99.6	97.8

TABLE 38

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF SPEED

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
0 - 10	5.9	5.1	16.4	12.0
11 - 20	12.8	7.8	16.7	12.5
21 - 30	27.2	16.0	22.8	16.4
31 - 40	25.5	23.5	17.0	21.0
41 - 50	20.7	25.8	15.8	19.0
51 - 60	6.0	14.9	8.8	12.0
61 - 70	1.7	5.6	1.4	5.4
71 -	.2	1.3	1.1	1.7
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
0 - 10	12.0	9.4	17.6	14.5
11 - 20	16.8	13.7	29.5	24.0
21 - 30	15.5	11.9	19.6	15.0
31 - 40	21.8	17.8	16.1	17.6
41 - 50	22.4	22.1	10.7	15.2
51 - 60	7.2	16.5	4.5	8.6
61 - 70	4.0	6.8	1.8	3.7
71 -	.3	1.8	.2	1.4
Driver 2				
0 - 10	14.2	13.2	16.0	14.3
11 - 20	19.9	14.1	28.1	21.8
21 - 30	14.5	11.1	21.0	16.8
31 - 40	23.6	19.0	16.4	17.8
41 - 50	14.9	21.6	10.7	15.6
51 - 60	8.1	14.4	5.3	8.7
61 - 70	4.1	5.5	2.5	3.6
71 -	.7	1.1	.0	1.4

tion of their accidents at higher speeds than female drivers.

The speed and sex relationship was further examined within locations and within light conditions. For these analyses, speed was subdivided into three larger categories. The relationship remained of similar magnitude within locations. Within light conditions, however, the difference between the sexes tended to be reduced. Males nonetheless remained more frequently involved in accidents at higher speeds than females in all conditions. These results are found in tables 39 and 40.

Weather Variables

Both analyses of the single vehicle accidents were significant for the variable "weather". Only one of the multiple vehicle analyses was significant. The results in terms of proportions are presented in table 41. In single vehicle accidents for both years, females demonstrated a relatively greater number of accidents in rainy and snowy weather, while male drivers were relatively higher in the "clear" and "foggy" categories. The inference can be made that a reliable difference exists between the sexes of this nature for single vehicle accidents. No conclusion can be made for the multiple vehicle data.

The proportions of both sexes for the various weather conditions within locations are found in table 42. Snow is definately shown to be more prevalent for females

TABLE 39

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF SPEED WITHIN LOCATIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
0 - 30	79.2	35.0	57.2	16.7	75.8	41.4	62.1	24.0
30 - 50	19.5	55.6	33.7	56.0	19.6	33.5	26.9	39.9
50 -	1.3	9.4	9.1	27.3	4.6	25.1	11.0	36.1
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
0 - 30	79.6	52.1	66.8	43.5	91.5	60.0	80.5	52.1
30 - 50	19.0	40.3	30.8	43.8	7.6	28.7	16.1	33.0
50 -	1.4	7.6	2.4	12.7	.9	11.3	3.4	14.9
Driver 2								
0 - 30	81.5	64.1	70.6	47.4	88.0	62.0	79.6	52.9
30 - 50	17.8	27.6	26.9	42.7	10.1	32.4	17.3	30.6
50 -	.7	8.3	2.5	9.9	1.9	5.6	3.1	16.5

TABLE 40

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF SPEED WITHIN LIGHT CONDITIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
0 - 30	57.0	20.0	40.6	17.9	59.5	55.1	53.2	29.7
30 - 50	36.8	65.0	42.2	55.8	25.3	27.1	27.3	40.6
50 -	6.2	15.0	17.2	26.3	15.2	17.8	19.5	29.7
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Driver 1								
0 - 30	68.9	62.8	54.8	50.9	83.1	85.2	72.2	68.2
30 - 50	25.9	34.6	36.7	40.7	12.2	13.3	20.1	25.2
50 -	5.2	2.6	8.5	8.4	4.7	1.5	7.7	6.6
Driver 2								
0 - 30	70.5	79.0	59.2	54.2	82.7	78.5	73.1	66.8
30 - 50	23.7	19.4	33.6	39.1	14.3	18.6	18.9	26.1
50 -	5.8	1.6	7.2	6.7	3.0	2.9	8.0	7.1

TABLE 41

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF WEATHER

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Clear	72.3	81.4	78.3	84.1
Rain	14.5	8.9	10.0	8.2
Snow	11.1	6.0	9.7	5.2
Fog	2.1	3.7	2.0	2.5
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Clear	75.2	76.9	79.6	79.4
Rain	10.4	11.0	12.1	12.2
Snow	11.6	9.4	7.3	6.9
Fog	2.8	2.7	1.0	1.5
Driver 2				
Clear	77.9	76.4	87.7	83.9
Rain	9.5	11.2	3.1	7.5
Snow	11.1	9.5	8.6	6.7
Fog	1.5	2.9	.6	1.9

TABLE 42

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF WEATHER WITHIN LOCATIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Clear	80.6	66.8	84.4	79.8	86.7	71.3	86.1	82.4
Rain	8.6	16.8	7.8	9.6	8.8	10.7	7.8	8.8
Snow	9.7	13.4	5.4	6.4	3.9	14.6	3.9	6.1
Fog	1.1	3.0	2.4	4.2	.6	3.4	2.2	2.7
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
Clear	78.7	71.7	81.7	73.6	82.7	70.8	79.4	78.9
Rain	9.0	10.7	11.4	10.5	12.2	11.7	14.3	8.2
Snow	11.0	13.2	5.4	12.4	4.6	15.8	5.5	9.8
Fog	1.3	4.4	1.5	3.5	.5	1.7	.8	3.1
Driver 2								
Clear	78.9	76.9	81.5	72.6	84.5	80.4	79.3	76.9
Rain	13.5	5.8	10.4	11.5	9.0	3.7	14.8	9.7
Snow	7.4	14.4	6.3	12.2	5.6	15.9	5.2	10.2
Fog	.2	2.9	1.8	3.7	.9	.0	.7	3.2

in rural accidents than in urban accidents, relative to the male proportions in the two settings. This is also somewhat true for the rain category. In the multiple vehicle accidents, snow again appears to be more prevalent for females in rural locations.

The proportions for the relationship within light conditions are found in table 43. It can be seen that for single vehicle accidents, light condition made little difference. For multiple vehicle accidents, females were more often involved in accidents in snow in the darkness than males in all four analyses. There was very little difference between the sexes in the daylight within the snow category. None of the other categories showed much consistency.

Both chi square analyses of the variable "surface condition" crossed with sex for single vehicle accidents were highly significant. Two of the four multiple vehicle analyses were significant. The results are presented in terms of proportions in table 44. For the single vehicle accidents, female drivers tended to have proportionately more accidents in the presence of snowy road conditions for both years. This is likewise true of the two multiple vehicle conditions which exhibited significant relationships. The two sets of data which were not significant show little difference on snow. Since, however, they do not contradict the relation between female drivers and snow, it seems reasonable to conclude, though cautiously, that a relationship

TABLE 43

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF WEATHER WITHIN LIGHT CONDITIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Clear	73.6	71.6	84.6	84.0	83.2	72.5	87.3	81.5
Rain	13.2	13.6	9.8	7.3	6.8	15.0	7.8	8.6
Snow	12.7	8.6	5.0	6.6	8.8	9.4	4.2	6.0
Fog	.5	6.2	.6	2.1	1.2	3.1	.7	3.9

	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Driver 1								
Clear	76.7	71.4	78.1	76.0	81.1	75.1	79.7	79.0
Rain	10.1	9.5	9.6	12.5	11.1	15.2	12.6	11.4
Snow	10.1	16.7	10.2	7.8	6.6	9.7	6.5	7.4
Fog	3.1	2.4	2.1	3.7	1.2	.0	1.2	2.2
Driver 2								
Clear	82.0	61.9	76.6	76.9	86.4	78.7	78.4	78.2
Rain	6.4	23.8	10.6	10.8	7.0	6.3	13.5	12.9
Snow	10.1	14.3	10.3	8.4	6.6	12.5	6.6	7.3
Fog	1.5	.0	2.5	3.9	.0	2.5	1.5	1.6

TABLE 44

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF SURFACE CONDITION

	Single Vehicle			
	1966		1971	
	Female	Male	Female	Male
Dry	52.3	64.3	58.5	67.5
Wet	19.0	18.9	19.5	17.8
Snow	28.7	16.8	22.0	14.7
	Multiple Vehicle			
	1966		1971	
	Female	Male	Female	Male
Driver 1				
Dry	55.2	61.5	60.8	57.8
Wet	23.0	23.5	23.3	26.9
Snow	21.8	15.0	15.9	15.3
Driver 2				
Dry	59.6	60.6	55.8	59.9
Wet	22.1	23.6	23.1	25.9
Snow	18.3	15.8	21.1	14.2

between sex and road condition does exist, with female drivers having relatively more accidents on snowy road surfaces and males having relatively more accidents under dry conditions. More confidence can be held in this conclusion for single vehicle accidents.

The analyses done within locations and within light conditions showed snowy roads more strongly related to fe-

males in rural than urban settings in single vehicle accidents. This was not consistently true for multiple vehicle accidents. Snow was likewise more pronounced for the multiple vehicle accidents of females after dark, while the results of the single vehicle accidents were mostly unaffected. These results can be found in tables 45 and 46.

TABLE 45

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF SURFACE CONDITION WITHIN LOCATIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Dry	68.1	44.1	65.9	62.7	65.2	55.1	68.1	68.2
Wet	11.7	22.1	19.0	19.7	21.0	17.1	19.7	16.2
Snow	20.2	33.8	15.1	17.6	13.8	27.8	12.2	15.6
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Driver 1								
Dry	54.5	56.1	62.1	60.2	63.4	54.1	56.2	62.1
Wet	26.9	18.3	27.4	21.3	24.4	19.2	30.8	16.8
Snow	18.6	25.6	10.5	18.5	12.2	26.7	13.0	21.1
Driver 2								
Dry	51.7	65.0	62.6	58.5	54.3	59.7	59.0	60.5
Wet	33.1	13.3	26.1	22.3	28.2	9.8	29.2	18.4
Snow	15.2	21.7	11.3	19.2	17.5	30.5	11.8	21.1

TABLE 46

THE PERCENTAGE OF ACCIDENTS FOR EACH SEX WITHIN EACH CATEGORY OF SURFACE CONDITION WITHIN LIGHT CONDITIONS

	Single Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Dry	54.5	51.1	67.5	62.7	63.1	55.9	71.6	64.9
Wet	18.5	17.9	17.4	20.1	17.7	21.3	16.7	18.7
Snow	27.0	31.0	15.1	17.2	19.2	22.8	11.7	16.4
	Multiple Vehicle							
	1966				1971			
	Female		Male		Female		Male	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
Driver 1								
Dry	56.9	50.6	62.3	61.7	65.1	54.5	61.1	55.9
Wet	25.2	16.5	22.3	24.0	21.7	26.2	24.6	26.9
Snow	17.9	32.9	15.4	14.3	13.2	19.3	14.3	17.2
Driver 2								
Dry	64.0	42.4	60.5	62.2	60.1	48.8	61.7	56.5
Wet	19.2	36.4	23.8	21.5	21.5	25.0	25.2	26.9
Snow	16.8	21.2	15.7	16.3	18.4	26.2	13.1	16.6

CHAPTER V

DISCUSSION

Time Variables

A very strong relationship between sex and both light condition and time of day for both types of accidents was exhibited by the data. These two variables are, of course, highly related; for time of day in large part determines the light conditions, although the correspondence is less than perfect due to seasonal variations and weather changes. The direction of the relationship, males having more accidents in the night-time and females having more during the day, is fully predictable from consideration of exposure differences. These variables differentiated the sexes more in the case of single vehicle accidents. This can be due to the fact that males drive relatively more at night, and single vehicle accidents are associated with night-time driving conditions. Further analysis of the light condition variable within urban and rural accidents showed that the sex difference was not an artifact of location differences, but rather held up within both types of location. Since the exposure hypothesis predicted real day - night driving differences, location was not expected to alter the relationship.

Exposure predicted that males would have more daytime accidents during the rush hours (7 - 9 AM and 4 - 6 PM) than female drivers, relative to all the daytime accidents. The data were consistently in line with this prediction.

The relationship between sex and day of the week proved to be stable and strong. Likewise, the inference that females have relatively more accidents on weekdays and men on weekends is fully in line with what is expected from exposure considerations.

Road Characteristics

The results of the variables classified as road characteristics are neither strong nor unambiguous. Nonetheless, certain interesting relationships do appear. The classification of the highway upon which the accident took place was unrelated to sex in the single vehicle accident data, with no evidence of any consistent pattern emerging. The same variable showed a significant relationship with sex on all multiple vehicle analyses. The pattern was fairly consistent for male drivers to have relatively more accidents on U. S. and state highways, while female drivers had relatively more accidents on county roads and city streets. The results of the multiple vehicle analyses are consistent with what would be expected by considering exposure alone. This researcher cannot see any reason why single vehicle data does not follow a similar pattern.

However, U. S. and state highways which go through and often are the main streets of communities are coded as U. S. or state highways when, in fact, they are city streets. Furthermore, county roads in the suburbs are quite different in characteristics from county roads in rural areas. This makes the interpretation of the highway classification variable highly ambiguous. In the presence of this ambiguity and in the absence of any reasonable alternative hypothesis at the present, no real case can be made for rejecting exposure as inadequate in the case of single vehicle accidents. But neither is the absence of a relationship of the type exhibited by the multiple vehicle data totally understandable. There is a definite need for further research or further analysis to explain these results.

Analyses of road geometry were nonsignificant for multiple vehicle accidents, however, there was a strong significance for single vehicle accidents. The difference between the sexes was largest in the curve category, with males taking precedence. Males were also relatively higher in the grade-curve category, with female drivers being relatively higher in the grade and straight categories. These results could indicate that males leave the roadway on curves, thereby becoming victims of single vehicle mishaps relatively more frequently than females. The exposure hypothesis predicts this insofar as male drivers are expected to be found on highways where there are more likely to be

curves than female drivers. However, the data on the "highway classification" variable do not seem to show this to be true in single vehicle accidents although again the variable is quite ambiguous. It could be argued that the difference in the curve category is explainable by the fact that males drive more in rural areas where there are more curves, but when accidents were analyzed only within rural locations the sex difference increased rather than decreased. The same situation was true for accidents happening at night. A reasonable explanation then becomes that males tend to drive at higher speeds and more often after drinking than females. Both high speeds and alcohol are more prevalent in rural and night-time single vehicle accidents, thus leading to the actual sex difference in the curve category. The sex differences are smaller in urban and daytime single vehicle accidents and absent altogether in multiple vehicle accidents because alcohol and high speeds are not as prevalent in these situations.

The alternative explanation is that under the same circumstances, males are less able to successfully negotiate a curve than females. In the face of other research cited in this study, namely that in unusual circumstances female drivers display less skill, this explanation seems untenable. Under normal circumstances, drivers do not usually leave the road on a curve unless they are attempting to take the curve at an excessive speed or unless their ability is impaired such as with alcohol. Since males are

more often found at high speeds and with alcohol, it would appear reasonable to suggest that the sex difference on curves was caused by these other two variables.

No conclusion can be drawn from the data on road surface. There could be a weak relationship there with the small number of accidents on non-paved roads serving to obscure it. Exposure does not seem to predict any relationship between sex and this variable.

There were also a small number of accidents in the presence of a road defect. Despite this fact there is some evidence, though not strong, that female drivers do relatively more poorly in the presence of a road defect for both single and multiple vehicle accidents. A relationship of this sort is important because it is not predicted by exposure. There does not seem to be any reason to expect females to be driving in the presence of a road defect any more often than male drivers. This result suggests that female drivers are slightly less able to cope as adequately as male drivers in situations requiring greater than usual driving skill.

Location

That females have relatively more multiple vehicle accidents at intersections than males is predictable from exposure in terms of the locations in which the two sexes tend to drive. This implies that within locations, the sexes should have a very similar proportion of accidents at

intersections. Such was the case for urban accidents, but female drivers were involved more often in intersection accidents within rural areas also. The fact that in urban accidents the sexes were very similar seems to preclude any explanation in terms of driving ability at intersections. It is quite frankly difficult to understand the rural difference. The most reasonable explanation seems to be differential driving habits of the two sexes. Females may have tended to drive in rural areas containing more intersections than male drivers. It does not seem reasonable to reject the exposure hypothesis.

Intersections did not differentiate the sexes in single vehicle accidents. This is reasonable since when only one vehicle is involved an intersection is not much more likely to contain an accident than any other comparably length stretch of road. Single vehicle accidents are not as dependent upon high traffic volume.

Men were shown to have relatively more rural accidents than female drivers at a significant level. This result held up for daylight and night-time accidents. The small but apparently reliable difference is in the direction predicted by exposure.

Collision Characteristics

For the variable "direction analysis" only the four multiple vehicle analyses were significant. The categories "same direction" and "entering fron an angle" exhibited a

strong consistency, with males being relatively higher in the former, and females in the latter. Since females are more likely to be involved in an accident at an intersection, they would be expected to be relatively higher in the "entering from an angle" category within rural accidents. However, this result was also exhibited in urban accidents. Since most same direction accidents must be rear end accidents, males must be more likely to have rear-end collisions than females. The reason for this is not clear. It could be a resultant of the tendency for males to drive at higher speeds; and, hence, be less able to stop in time. It could also be caused by poorer visibility at night, since the data show that same direction accidents are more likely to happen at night than entering from an angle accidents. Since male drivers are also associated with night, this would lead to the relationship which has been found. The male proportion being higher in this category naturally forces the female proportion to be higher elsewhere. This is perhaps why females were higher in entering from an angle for urban as well as rural accidents. Also the data have shown females to be proportionately more often guilty of a right-of-way violation in multiple vehicle accidents than males in urban as well as rural accidents. This could be the cause of the higher female proportion of entering from an angle accidents, or the result of it, since a high correlation between right-of-way violations and entering from an angle accidents is to be expected.

The validity of these explanations is less than obvious. However, the competing explanation is that males are less adroit at stopping their vehicles than are females under similar conditions and / or females are more likely to ignore a traffic signal at an intersection than males. This explanation seems perhaps less valid than the one put forth above, which is in line with the exposure hypothesis. The least which can be said is that the evidence is not great enough to reject the hypothesis at this point.

There is very little which can be said concerning the "fatal" variable. It is predicted that males would be relatively more likely to be involved in fatal accidents than females. Male drivers were involved in proportionately more fatal accidents than females, however, the number of fatal accidents was too small for any analysis to reach significance. Hence, no conclusion can be made.

Vehicle Characteristics

There seems to be little which needs to be said concerning this class of variables. The high significance of "vehicle type" is, of course, easily explainable in terms of exposure. Females just do not typically drive anything but passenger cars. Both "vehicle defect" and "vision obscured" were rare in occurrence, and furthermore there is little theoretical reason to expect the sexes to differ on either of these two variables.

Driver Characteristics

Sex and age were unrelated for multiple vehicle accidents, but inexperienced females and experienced male drivers had a disproportionate number of accidents. The same relationship on the experience variable held for single vehicle accidents, but age exhibited a consistent relationship with sex, with young male drivers (under 25) and middle-aged female drivers (25 to 64) having relatively more accidents. The differences in the over 65 category were very slight.

This inconsistency between the age and experience variables is easily explainable by the fact that females in the sample were much more likely to begin driving at a more advanced age than males. This can be seen very plainly in the analyses of sex and age within levels of experience. The tendency for more and more females to begin driving at all probably at least partially explains the sex difference and experience. There were probably a greater proportion of inexperienced females relative to all female drivers in the driving population than the same ratio for males.

It is also possible that part of the sex difference on the experience variable is because females drive less than males. If it is assumed that safe driving ability increases as a function of the amount of actual driving time, rather than the elapsed time since obtaining a li-

cense to drive, one year of experience for an average male means more actual driving experience than one year of experience for an average female. This would result in the expectation that inexperienced females (in terms of years driving) would have a higher accident rate than inexperienced males.

The analyses for the age variable leave two unanswerable questions. First, why are females in the 20 to 24 year age group involved in proportionately more accidents than males in multiple vehicle accidents? Such was not the case for single vehicle accidents. Exposure predicts the opposite since it was thought that young males drive disproportionately more than young females. This also contradicts the research findings of Lauer[42] and Swanson, et al.,[43] although as was mentioned, the methods by which these studies controlled for mileage are highly questionable. Secondly, what causes the sex difference in single vehicle accidents and not in multiple vehicle accidents? The evidence points away from a third variable being responsible. Sex differences were manifested over both levels of location and both levels of light condition for single vehicle accidents. This would not be the case if either of these variables were responsible for the dif-

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[42]Lauer, op. cit.

[43]Swanson, et al., op. cit.

ference. Furthermore, since both the presence of alcohol and high speeds are related to rural locations and nighttime, if either of these variables were responsible, larger sex differences would be expected at night and in rural locations. Thus, this variable is in need of further research. At this point all that can be said is that past research was only replicated in part and the exposure theory was only validated in part. No alternative explanation appears readily evident.

The small and questionable relationship between sex and registration is easily explainable by exposure considerations. The reason for the weakness of the results probably lies in the fact that there were relatively few outstate drivers in the sample. It can only be concluded that these results did not contradict the exposure hypothesis.

Driver Behavior

The strong tendency for males to be more often guilty of a speeding violation than females is not predictable from exposure differences. If the relationship were explainable either because males drive more at night or more in rural areas, the analyses done within locations and within light conditions would be expected to show little or no sex differences. Such was not the case. The sex differences were respectably large in each analysis. Thus, it appears that the tendency for males to be more

often guilty of a speeding violation is not explainable by exposure. On the other hand, it does not seem reasonable that this difference is explainable by differences in driving ability, i.e., that males drive more poorly when they are violating the legal limit than females when they are violating the legal limit. It seems much more likely that cultural roles, expectations, etc., lead men to do more speeding than women. In many segments of society speeding is considered acceptable and even sometimes desirable masculine behavior, while accepted feminine behavior does not include driving an automobile at excessive speeds.

The previous discussion of intersections and direction analysis is quite relevant to the right-of-way violation variable. If exposure were the explanation for the small relationship of females and right-of-way violations, analyses of these two variables within locations should show little or no sex differences. However, the sex difference did hold up within each location. As with the intersection and direction analysis variables, no explanation for these results is readily available.

As for the other violations, it is unfortunate, but apparently true that the frequency of such violations was in all cases too small to find any relationships, if indeed any exist.

When all the non-alcohol and non-speeding violations were grouped together into one category, with the absence of any such violation in the other, data from sin-

gle vehicle accidents were inconclusive, while the multiple vehicle data exhibited a small but reliable tendency for females to have more non-speeding or drinking violations. This is in line with what is predicted from exposure differences. The reason that the single vehicle results were ambiguous is probably because these violations are rarer in single vehicle accidents and less relevant.

The sex differences on the alcohol, speed, and sleep variables were all large and consistent. The sex difference on sleep is easily explainable in terms of the tendency for males to drive more during the late-night hours. The exposure theory predicted males to have a disproportionate number of accidents with alcohol. That this difference holds up within locations and light conditions gives strength to the conclusion that the sexes are differentiated by alcohol and the results are not an artifact of another variable. The added strength of the sex difference on alcohol within night-time accidents is no doubt a result of the pronounced tendency for alcohol to be more often present in night-time driving.

The tendency for male drivers to have accidents at higher speeds than female drivers also held up within locations and light conditions. Part of the apparent sex difference on speed was shown to be a result of the mutual relation each of these variables had with the light condition variable. However, a sex difference was still in evidence within light conditions. As with the case of the

related speed violation variable, this consistent difference is not explainable by exposure, but rather males do apparently drive faster than females other things being equal. Again, cultural role differences between the sexes seems most adequate to explain this driving difference.

Weather Variables

Both the "weather" variable and the highly related "surface condition" variable showed females to be involved in a higher than expected number of accidents in snow conditions for single vehicle accidents and to a lesser extent for multiple vehicle accidents. The results of the analysis within locations and light conditions for these two variables generally gave indication of a larger sex difference on snowy roads and in snowy weather at night and in rural locations, with females having a higher proportion in each case.

These results do not seem predictable by exposure, for by and large snow is evenly distributed over all times and areas. In fact exposure leads to the opposite prediction, since females may be less likely to drive during bad weather conditions. The relationship between female drivers and snow add credence to the previously stated hypothesis that female drivers tend to be more vulnerable to situations requiring more than a usual amount of driving skill. Although snow is not infrequent in Michigan, it seems reasonable to consider driving during falling snow or snowy road

conditions as presenting an especially stressful situation. This would seem to be especially true of night-time driving and the higher speeds and oftentimes poorer roads of rural areas. It is hard to see any reason for suspecting females drive more in snowy weather in these conditions than males. It is more reasonable to suggest safe driving ability difference. The high demands for skill which a snow-covered road often makes on a driver, particularly at night and in rural locations, were apparently more frequently met by male drivers than female drivers.

CHAPTER VI

CONCLUSION

Many statistically significant and replicated differences between male and female automobile drivers both for single and multiple vehicle accidents have been found and reported in this study. The overall model or hypothesis adopted at the outset was that all of these differences were potentially explainable in terms of driving exposure differences between the sexes. Many of the differences were indeed explainable in this manner. There were some exceptions, however.

Females were found to be positively related to road defects and snowy weather. Either of these results standing alone would not be sufficient to cast much doubt on the exposure hypothesis. However, in combination with results of previous studies they indicate that there may very well be something else going on.

In Pennsylvania Turnpike accidents, Blotzer, et al., found females were relatively more often in the categories they named "deficiencies in routine driving skills" and "failure to cope with road conditions".[44] Penn found females to be guilty of "faulty driving" more frequently than

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[44] Blotzer, et al., op. cit., p. 37.

male drivers.[45] In the presence of an unexpected motor scooter, Uhr found female drivers to be markedly more likely to make a dangerous and inappropriate response than males.[46] Baker found females less able to successfully cope with flat tires while driving.[47]

There seems to be a definite common thread running through these results. All indicate that female drivers tend to have more accidents in the presence of stressful conditions, in other words, all indicate that female drivers are more likely to make an inappropriate response when driving in a situation requiring added skill. Blotzer, et. al., explained his results in terms of the way drivers learn to cope with stressful situations. They suggested that since this knowledge is not really taught and not required to obtain an operator's license, drivers must learn from experience. Since females tend to drive less frequently under stressful conditions they learn more slowly.[48]

There may be other reasons for this sex difference. Two areas, the psychological and the physiological, seem most promising. Physically, men are of course, generally stronger, but this probably makes little difference with

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[45]Penn, op. cit., p. 3.

[46]Uhr, op. cit., p. 69.

[47]Baker, op. cit., pp. 8-9.

[48]Blotzer, et al., op. cit.

the ease of operation of modern day vehicles. Because of athletics and physical labor, men are probably better coordinated than females which may make a difference in quick manipulation of a vehicle.

From a psychological point of view, men are probably more accustomed to needing to make a quick rational decision and then acting upon it than females. Females, furthermore, are expected to react to situations in a more emotional manner than are males in this culture. Under stress it is the male rather than the female who is usually looked to for calm rational decision making.

This is not to say that females can not be trained to make appropriate responses. It does, in fact, appear that females do need more training than males. The suggestion can be made to devise some sort of training device for training all potential drivers to cope with snow and ice, heavy traffic, road defects, etc. Special emphasis should be placed then upon the training of female potential drivers. A device of this sort could have an appreciable effect in the prevention of accidents.

/There was also some indication that male drivers tended to exceed the speed limit and generally be traveling faster more frequently than female drivers when involved in an accident./ The interpretation given to this result was in terms of cultural roles and driving confidence rather than in terms of differences between the sexes in driving abilities when exceeding the speed limit.

The practical implications of an interpretation stressing ability would be in terms of increased training for males in driving at speeds exceeding the legal limit. This does not seem at all relevant to the problem.

Rather, what appears to be needed is increased education focused on the hazards of excessive speed, particularly aimed at male drivers. Also, attempts should be made to alter the association between excessive speed and masculinity which has developed in some segments of this culture.

The fact does remain that males were found significantly more often having consumed alcohol before accidents and consistently were driving at higher rates of speed directly preceding accidents. Both of these factors are conducive to serious accidents. The data of this study contained only two categories of severity, fatal and nonfatal, and only a few of the entire sample of accidents contained a fatality. Despite this lack, a reasonable assumption to make is that males tended to have more severe accidents than females. In this way females were safer drivers. Without trying to minimize the need for improved driving on the part of women, if a choice had to be made as to which of the two sexes was in greater need of being the target of a safety campaign, male drivers would undoubtedly get the nod.

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APPENDIX

APPENDIX A

CATEGORIES WITHIN EACH VARIABLE

Time Variables

Light Condition

Light
Dark
Dusk-dawn

Time of Day

12 PM - 3 AM
3 AM - 7 AM
7 AM - 9 AM
9 AM - 11 AM
11 AM - 1 PM
1 PM - 4 PM
4 PM - 6 PM
6 PM - 9 PM
9 PM - 12 PM

Day of Week

Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

Road Characteristics

Highway Classification

U. S.
State
County
City

Road Geometry

Straight
Grade

Curve
Grade-curve

Road Surface

Paved
Not Paved

Road Defects

Road Defect
No Road Defect

Location

Intersection

Intersection
Nonintersection

Locality

Urban
Rural

Collision Characteristics

Directional Analysis

Entering From Angle
Same Direction
Opposite Direction
Stopped
Parked
Pedestrian
Single Vehicle

Fatal

Fatal
Non-fatal

Vehicle Characteristics

Vehicle Type

Car
Pickup
Truck
Other

Vehicle Defects

One or More Vehicle Defects
No Vehicle Defects

Vision Obscured

Vision Obscured
Vision Not Obscured

Driver Characteristics

Sex

Female
Male

Age

19 and Under
20 to 24
25 to 44
45 to 64
65 and Over

Experience

Less Than One Year
One To Five Years
More Than Five Years

Registration

Instate
Outstate

Driver Behavior

Speed Violation

Speed Violation
No Speed Violation

Right-of-way Violation

Right-of-way Violation
No Right-of-way Violation

Following-too-close

Violation
No Violation

Passing Violation

Passing Violation
No Passing Violation

Turning Violation

Turning Violation
No Turning Violation

Traffic Control Violation

Traffic Control Violation
No Traffic Control Violation

Violations Other Than Speeding or Drinking

Any Violation Other Than Speeding or Drinking
No Violations Other Than Speeding or Drinking

Alcohol

Not Drinking
Drinking
Drunk

Sleep

Sleep
No Sleep

Speed

0 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 and Over

<u>Weather Variables</u>

Weather

Clear
Rain
Snow
Fog

Surface Condition

Dry
Wet
Snow