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AN INTRODUCTORY STUDY TO SHOW THE RELATIONSHIPS
BETWEEN MICHIGAN DRIVERS BY AGE, SEX AND
EXPOSURE IN MILES OF MOTOR VEHICLE OPERATION

By

Frederick E. Vanosdall

AN ABSTRACT OF A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

School of Police Administration and Public Safety

1966

APPROVED:

Raymond T. Galvin, Chairman

Bernard J. Kuhn

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ABSTRACT

AN INTRODUCTORY STUDY TO SHOW THE RELATIONSHIPS BETWEEN MICHIGAN DRIVERS BY AGE, SEX AND EXPOSURE IN MILES OF MOTOR VEHICLE OPERATION

by Frederick E. Vanosdall

This study purports to determine the number of miles driven for an average week during the daytime, nighttime, and in the country and city by Michigan drivers according to age.

Exposure information, the number of miles driven, was collected from 6358 Michigan drivers at the time they were renewing their operator and chauffeur licenses. Twenty-six state authorized driver license examination stations, located in the metropolitan, urban, suburban and rural areas of Michigan were selected to participate in the study. Drivers completed questionnaires requesting their name, date of birth, sex and an estimate of the number of miles they drove during an average week, in the daytime, nighttime, country and city.

Exposure data was transferred to IBM cards and grouped by sex and then into seventeen age groups; drivers seventeen to twenty years of age were separated year by year, all drivers twenty years of age and older were grouped into

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fourteen groups in five year intervals, with average weekly, daytime, nighttime, country and city mileage.

Mean and Standard deviations were calculated for each age of driver, by age, sex and the five areas of exposure to determine the central tendency and dispersion of the exposure data. The results of these calculations clearly indicated that exposure data does not fall in a normal distribution and that there was a large degree of dispersion.

Tables and graphs were prepared to show the changes in the amounts and types of exposure for each age group and sex.

The study concludes that there are some relationships between age and exposure. These relationships are not absolute, but provide a basis for comparison and analysis of other data from drivers' records, accident statistics, and evaluation of drivers who have completed driver education programs.

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ACKNOWLEDGMENTS

The writer wishes to express his sincere appreciation to Mr. Raymond T. Galvin and Dr. Bernard J. Kuhn, under whose guidance this study was completed.

The writer also desires to extend his appreciation to Gordon H. Sheehe, Director of the Highway Traffic Safety Center, for his support and interest that contributed to the value of this work.

In the initial steps of this study, Congressman Billie S. Farnum, then Deputy Secretary of State, and Lee C. Richardson, Director of the Division of Driver and Vehicle Services, supported plans to conduct a part of the study in state authorized driver license examination stations, for which the writer is indebted to them.

Special recognition is deserved by the Automotive Safety Foundation for the fellowship which made possible the course of study in Highway Traffic Administration and this thesis.

Many persons in the Michigan Department of State, Police and Sheriff's departments rendered technical assistance, for which the writer extends his sincere thanks.

From his example and contributions to this and other studies concerning basic information about drivers and other

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aspects of traffic accident prevention, Glenn M. Schultz has encouraged this writer to continue in the manner he initiated, to encourage others to examine the need for basic information upon which to base future progress in safety programs.

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CHAPTER I

INTRODUCTION

As annual traffic accidents and deaths have increased, more and more attention and financial support has been given to studies on the elements of traffic accidents; the driver, his vehicle and the roadway. The wealth of information produced by these studies has contributed to an increased level and scope of understanding of the traffic accident problem.

In 1958 the United States Congress' interest in this problem prompted the appointment of a special congressional sub-committee on traffic safety. State officials and representatives of private enterprise were invited to appear before this committee to report on the efforts being made to reduce the death toll on the nation's highways. State officials were questioned about the progress being made on specific improvements in traffic safety efforts. Some inquiries concerned the existence and use of information which would show if there were any relationships between drivers' age, exposure, and accident involvement. At that

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time, the officials were unable to give answers that would clarify these relationships because they did not have data on driver exposure.

It soon became evident from the special sub-committee hearings that "If accidents are to be related to highway, vehicle, and human factors in a meaningful fashion it is essential that relative exposure of people and vehicles to accidents be measured."¹

Several measures of accident exposure have been developed, but no single measure is the best under all circumstances.²

Progress in safety research has shown the usefulness of " . . . the widely accepted measures of exposure . . . vehicle-miles of travel i.e., the number of vehicles using the highway multiplied by the length of the highway in miles."³

Existing research has also shown that exposure information is making an important contribution in the analysis of traffic accidents; for comparison of various highways, vehicles and drivers; for economic analysis of highway

¹Special Sub-committee for Traffic Safety, The Federal Role in Highway Safety, A Report to the 80th Congress, 1st Session, Document No. 93., United States Printing Office, Washington, D.C. (1959), p. 25.

²Ibid., p. 25.

³Ibid., p. 25.

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improvements and others uses.⁴ Exposure has been identified as a factor to consider in determining the types of actions in programs of driver improvement administered by state driver license agencies. However, to date there have been few studies which have shown the relationships between drivers' ages, sex, and exposure in the number of miles driven during the daytime, nighttime, in the country or in the city. Studies completed through 1965, have considered various aspects of exposure, but none has treated these five aspects of exposure simultaneously.

I. STATEMENT OF THE PROBLEM

Statement of the Problem. Significant information on the number of miles people drive is very limited. The lack of this information is partially due to the limited methods for collecting it. Direct interviews with drivers is one of the best methods, however it may not assure reliable information because drivers must estimate the number of miles they drive.

Authorities in the trucking industry, responsible for the study and analysis of traffic accidents involving their equipment, maintain detailed records on drivers and their exposure.

⁴Ibid., p. 25.

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Studies primarily concerned with determining the relationships between drivers records of traffic violations, traffic accidents and miles driven have provided limited exposure information by different age groups of drivers.

One of the most recent studies of drivers, reexamined because they had a poor driving record, reported that on the average, both male and female reexamined drivers drove significantly more miles [$P < .001$] than their counterparts in the general driving population.⁵ And also "For the re-examined male drivers, comparison with the average male driver showed that significantly fewer drove an average of 10,000 miles per year, while considerably more reexamined males drove 22,500 or more miles per year."⁶

The findings of this study indicated that further research is needed on annual mileage and also by type of exposure.⁷

II. PURPOSE OF THE STUDY

The principal objective of this study is to describe as accurately as possible the number of miles of operation of motor vehicles by Michigan drivers.

⁵R. S. Coppin and G. Van Oldenbeek, The Fatal Accident Re-Examination Program in California, Report No. 23, California Department of Motor Vehicles, Sacramento, California (January, 1966), p. 16.

⁶Ibid., p. 16.

⁷Ibid., p. 16.

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Emphasis is given to five variables, arbitrarily selected as impinging upon the hazards to be encountered in the operation of a motor vehicle and isolated according to the following conditions and circumstances:

1. The age of the driver.
2. The sex of the driver.
3. The number of miles of operation of a motor vehicle in a typical or average week.
4. The number of miles of operation of a motor vehicle in a typical or average week in reference to the presence of, or degree of light, called the daytime or nighttime.
5. The number of miles of operation of a motor vehicle in a typical or average week with reference to the site of that operation being in the country (rural) or in the city (urban) area.

III. LIMITATIONS OF THE STUDY

There were believed to be other important variables which affect the occurrence of motor vehicle difficulties (accidents and/or traffic violations, warnings or arrests), such as the driver's socio-economic status, occupation, education, residence, and other factors which have either direct or indirect influence upon driver behavior. No attempt was made to consider, or in any other way use these variables.

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These factors were considered beyond the scope of the study which gives its principle attention to exposure and the driver in terms of the universal constants of age and sex.

IV. NEED FOR THE STUDY

Several studies, presented in Chapter II, have referred to the relationship between exposure and traffic accident involvement and/or traffic law violations. While these studies have identified the need for exposure data, their most important contribution to this study has been to focus attention on the value of exposure data as a basic factor necessary for analyzing the effectiveness of driver education, driver licensing, and traffic law enforcement programs.

This study was undertaken for the purpose of fulfilling the following needs:

1. To establish, as accurately as the methods followed permit, typical or average numbers of miles that may be expected of licensed drivers according to their age.
2. To provide driver license administrators, or comparable officials, responsible for decisions affecting drivers' privileges to drive, a new instrument with which to more effectively evaluate the seriousness of drivers' records of traffic violations and/or accidents.

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3. To provide an additional basis for study and analysis of traffic accident data.

The literature indicates that "exposure" has taken on many meanings and connotations. Texts in driver education refer to exposure as the hazards and conditions affecting driving at night, in the city and country.⁸ Researchers have found it necessary to define exposure wherever it has been a factor in research and analysis.⁹ Businesses and industries have concepts of exposure based upon their respective interests. For example, the insurance industry has several types of exposure classified according to area, occupation, age, sex, density of vehicles where insureds live or drive and the purpose of his driving. The traffic engineer has qualified his comparisons between

⁸ Leon Brody and Herbert J. Stack, Highway Safety and Driver Education (Englewood Cliffs, New Jersey: Prentice Hall Inc., 1956), p. 29. 3rd Printing; Center for Safety Education, Man and the Motor Car (New York: Prentice Hall Inc., 1956), pp. 267-8 & 123; Maxwell Halsey and Leslie Silvernale, Let's Drive Right (Chicago: Scott Foresman and Company, 1954), pp. 268, 200-1 & 371; American Automobile Association, Sportsmanlike Driving (Washington, D.C.: Kingsport Press Inc., 1955), pp. 32, 264 & 312.

⁹ Ross A. McFarland, Roland C. Moore, and A. Bertrand Warren, Human Variables in Motor Vehicle Accidents, A Review of the Literature, Harvard School of Public Health (Boston: 1955), pp. 12-40. Academy of Science - National Research Council, "Health, Medical and Drug Factors in Highway Safety," Proceedings of the Second Highway Research Correlation Conference, Publication No. 328 (Washington, D.C.: 1954), p. 39; Harold E. Elliott (ed.), Medical Aspects of Traffic Accidents, Proceedings of the Montreal Conference, 1955 (Toronto: Sun Life Assurance Company), p. 310.

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accidents and exposure by stating that "To compare hazard, accident comparisons must be based on exposure."¹⁰

Generally, three rates of exposure have been recognized by safety people. They are based on population, vehicle registrations and mileage, with "exposure to accidents" defined as the mileage rate or vehicle miles.¹¹ These are the present standards used nationally in the assessment of traffic safety activities conducted by state agencies having responsibility for accident prevention programs.

This study attempts to provide more specific information on exposure and where that exposure occurred. There is already some acceptance that there are different types of exposure; this study also attempts to show relationships between different types of exposure and driver age and sex.

V. DEFINITION OF TERMS USED

It has been shown that "exposure" does not have a precise definition to which there has been universal acceptance by persons engaged in traffic safety activities. Therefore in this study exposure will be defined as follows:

¹⁰Henry K. Evans (ed.), Traffic Engineering Handbook, Institute of Traffic Engineers (New York: Peter F. Mallon Inc., 1950), p. 120.

¹¹Ibid., pp. 120-121.

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Exposure. In this report, "exposure" will mean the amount of operation of a motor vehicle in miles during a typical or average week by a licensed operator or chauffeur. This broad meaning of "exposure" will then be divided into four areas or categories which will be defined as follows:

Daytime. In this report "daytime" will mean "the time between sunrise and sunset."¹²

Nighttime. In this report "nighttime" will mean "any other hour than daytime."¹³ Various conditions can cause a darkness similar to the early hours of the "nighttime," such as severe thunderstorms, extreme fog, or smoke moving across a highway. Instructions were included in this study explaining that "nighttime" would be considered anytime headlights on a motor vehicle were necessary.

Country. In this report "country" will mean any area other than city. The extension of urbanization and suburban developments into rural areas make it difficult for drivers to know where "country" begins or ends. Therefore any suburban area outside the city limits will be considered "country."

¹²J. Stannard Baker and William R. Stebbins, Jr., Dictionary of Highway Traffic (Evanston, Illinois: Traffic Institute, Northwestern University, 1960), p. 44.

¹³Ibid., p. 140.

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City. For the purpose of this investigation "city" will mean the area within the boundaries of the city limits.

VI. ORGANIZATION OF THE REMAINDER OF THE THESIS

Progress in developing measurements of accident experience and driver behavior through surveys and research projects, reviewed in Chapter II, call attention to exposure as an influential factor in the interpretation of study results.

Plans for and problems associated with the collection of exposure data are presented in Chapter III. An explanation of the study's limitations and the stability of the exposure data collected in 1959 have been prepared for the reader here.

Data in this study was organized to facilitate the use of graphs and tables to emphasize the differences between each area of exposure by the sex and ages of drivers. To further describe the relationships and differences between the data, two summarizing constants, the mean and standard deviation were employed. The results of these analyses, with graphs and tables are reported in Chapter IV.

The final chapter, contains the Findings, Conclusions and Recommendations, supported by the Conclusions and Findings.

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CHAPTER II

A REVIEW OF THE LITERATURE

Interest in informal surveys about driver behavior developed in motor vehicle departments and law enforcement organizations soon after the popular movement to build better highways.

Following World War II, traffic accidents increased rapidly and resulted in more and highly developed approaches for the study of characteristics which contribute to the accident. Formal scientific research projects were conducted by universities, federal agencies concerned with public health, and professional researchers. All have been interested in studying driver behavior and the related factors which influence driver performance.

Several studies have called attention to the importance of exposure information and some have mileage data incorporated into a formula for evaluating driver performance.

Books for driver education in high schools have referred to various types of exposure, briefly. Generally it has been used as a factor to control the matching of drivers being studied. In some studies, the amount and where the motorist drive has become valuable information for evaluating

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the relationships between factors such as levels of traffic density and driver fatigue; identifying the change in driver behavior under various degrees of stress as volume increases; or driver response during various types of distractions while driving. The following chapter contains a comprehensive review of studies which show the increasing importance placed on exposure by researchers concerned with driver behavior and traffic accidents.

I. HISTORICAL REVIEW OF THE STUDIES

Scientific research in the area of traffic safety has been evaluated in this way:

A great many major studies involving the human element have been made. Generally they have attempted to (1) determine a unique human characteristic that is associated with accidents, (2) determine the effect of countless influences or conditions upon subject's action or reaction, (3) determine the behavior of humans as a group in the actual driving scene, and (4) suggest, propose, attempt or take action based upon such determinations.¹⁴

The first studies of driver behavior were products of private business and government agencies interested in each of the basic elements of the traffic accident picture; the driver, the vehicle, and the highway. These studies aroused motor vehicle administrators to the need for research

¹⁴United States Congress, House Committee on Interstate and Foreign Commerce, Investigation of Highway Traffic Accidents, The Federal Role in Traffic Safety (Washington, D.C.: 1959), p. 30.

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which could be used to help control the rapidly rising deaths caused by traffic accidents.

During the 1930's, numerous studies and surveys were conducted in the interest of accident prevention. Their findings focused attention on vehicle mileage, occupational use of cars, drivers' annual mileage, and mileage for owners residing in unincorporated or incorporated areas. The results brought about improvements in the quality of government services to the public.^{15,16,17,18}

Recent research on the human factors in traffic accidents has indicated the value of studying social and psychological pressures and their influence upon driver behavior. Some of the studies in these areas have selected driver exposure, in terms of miles driven annually, as a basis for measuring driver performance. Tests to measure psychological abilities, mechanical aptitudes, intelligence, attitudes and emotional stability have been used in attempts to predict drivers' chances of being involved in traffic

¹⁵McFarland, op. cit., p. 38.

¹⁶Ibid., p. 40.

¹⁷"Average Annual Mileage and Number of Trips per year by Occupational Groups," Automobile Facts and Figures (New York: Automobile Manufacturers Association, 1941), p. 58.

¹⁸Harry R. DeSilva, Why We Have Automobile Accidents, (New York: John Wiley and Sons, 1942), pp. 12-14.

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accidents.^{19,20,21} However, these studies were not designed to show whether there was any relationships between the ages of drivers, their rates of exposure and their performance on the tests. Where exposure had been considered most useful, it was used to control the selection of drivers and to match them with others having similar degrees of exposure.

Twenty years ago Harry DeSilva wrote, "a driver's annual mileage provides a rough indication of the number of dangers he encounters . . . " and " . . . a knowledge of exposure is basic to any study of relative accident susceptibility."²² His interest in driver exposure is shown in his thorough examination of various types of exposure in his book, Why We Have Automobile Accidents.

The Connecticut survey. In 1938 the Connecticut Motor Vehicle Department mailed 15,000 questionnaires to

¹⁹M. A. Kraft and T. W. Forbes, "Evaluating the Influence of Personal Characteristics of the Traffic Accident Experience of Transit Operators," Highway Research Board Proceedings of the 24th Annual Meeting (Washington, D.C.: National Academy of Science - National Research Council, 1944), pp. 278-291.

²⁰D. J. Moffie, et al., "Relations Between Psychological Tests and Driver Performance," Highway Research Board Bulletin Number 60 (Washington, D.C.: National Academy of Science - National Research Council, 1952), pp. 17-24.

²¹Earl David Heath, "The Relationship Between Drivers Records, Selected Personality Characteristics and Biographical Data of Traffic Offenders and Non-offenders" (Unpublished Doctoral Dissertation, New York University Center for Safety Education, 1958), p. 6.

²²Harry R. DeSilva, Why We Have Automobile Accidents (New York: John Wiley and Sons, 1942), pp. 7-11.

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drivers requesting information concerning their age, sex, accident experience, annual mileage and occupation. This information was used to show relationships between drivers, their number of accidents and annual mileage.

Results of this survey reported by DeSilva showed that:

1. Driving was less pleasurable for drivers of advanced age,
2. Drivers between the ages of 25 and 29 drove more than any other age group,
3. Women drove less than men, and
4. Younger drivers with less experience had more accidents.²³

These findings may have been influenced by the " . . . larger than normal proportion of well-to-do urban drivers who answered the questionnaire . . . , "²⁴ and indicated a typical weakness of the questionnaire method of collecting data. Opinion poll authorities point out there " . . . is no assurance the respondents (returning questionnaires) will be representative of the whole population."²⁵

²³Ibid., p. 27.

²⁴Ibid., p. 27.

²⁵Scott M. Cutlip and Allen H. Center, Effective Public Relations (Englewood Cliffs: Prentice Hall, Inc., 1958), p. 106.

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The Connecticut survey did show interesting trends of exposure for male and female drivers. Figure 1 indicates the unusually high annual mileage for the 25 - 29 year old age group males, as a contrast to the females. Women made a gradual increase, after a rapid growth during the teenage years, that continued until they reached 40 - 44 years of age. Their mileage became more erratic, declining sharply at times, while men, declined very slowly beginning at age group 35 - 39 years of age.

In 1948, an Eno Foundation sponsored study provided results which agreed with DeSilva's concept about the relationships between exposure and accidents. It concluded that "There is a wide range in the driving exposure (M.V.M.), the accident experience and the violation record of the accident repeater(s). The best indication of the seriousness of the repeater's record is his accidents and violations per 100,000,000 M.V.M."²⁶ (M.V.M. meaning Motor Vehicle Miles.)

Efforts have been made to improve and clarify misunderstandings that arise when exposure and motor vehicle traffic accident rates are compared. Sidney J. Williams and Alan D. Beatty " . . . pointed out that vehicle mileage does not adequately measure the exposure to motor vehicle

²⁶Herbert J. Stack, Personal Characteristics of Traffic Accident Repeaters (Saugatuck, Connecticut, The Eno Foundation for Highway Traffic Control, 1948), p. 50.

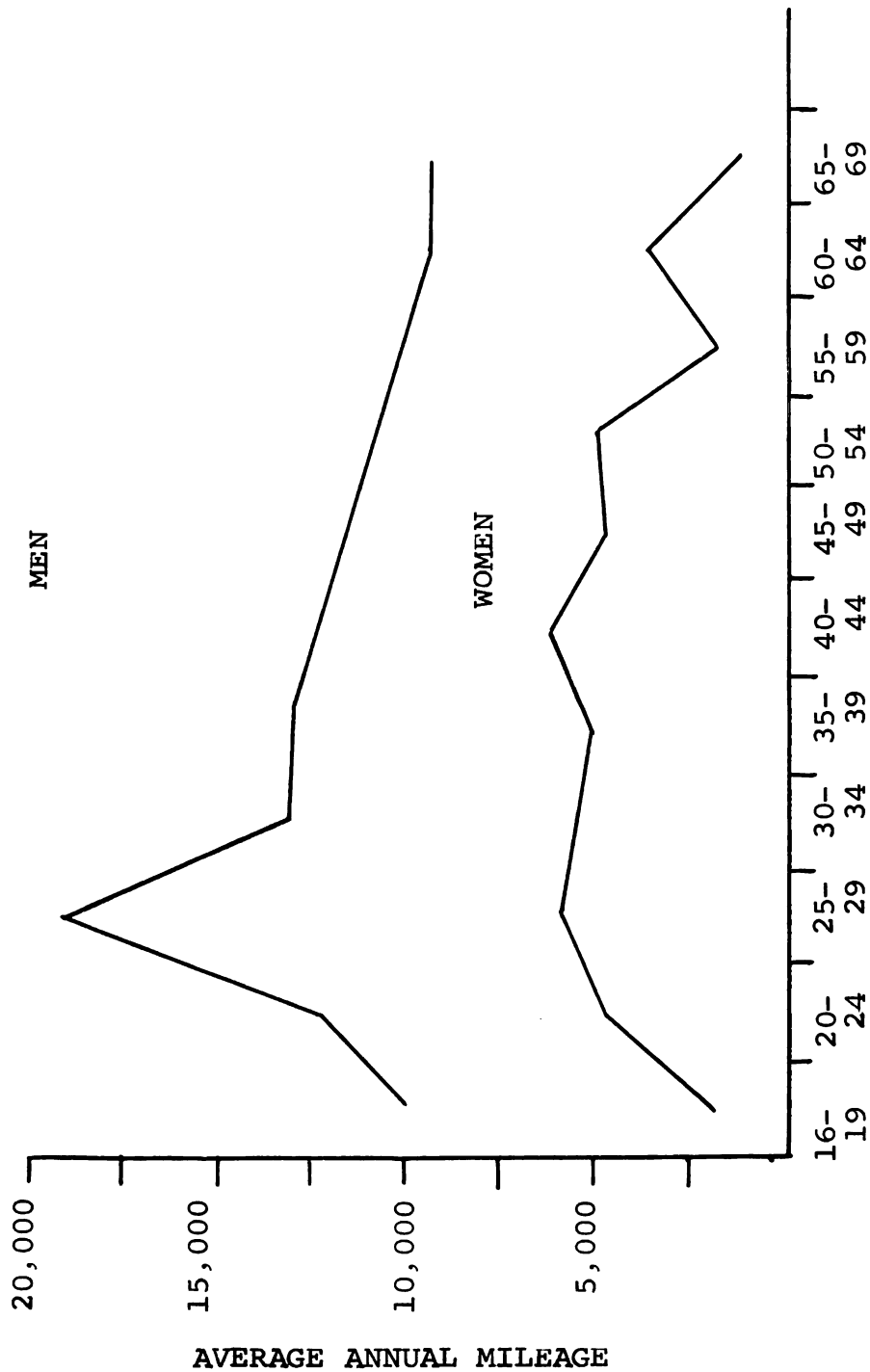


Figure 1

ANNUAL MILEAGE OF MEN AND WOMEN IN DIFFERENT AGE GROUPS
(Connecticut, 1938)

Harry R. DeSilva, Why We Have Automobile Accidents
(New York: John Wiley and Sons, 1942), p. 25.

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accidents in situations involving more than one vehicle."²⁷

They set forth four principle classes of motor vehicle accidents:

1. Collisions with pedestrians.
2. Collisions between motor vehicles.
3. Noncollision accidents and fixed object collisions.²⁸
4. All other types.

Beatty's discussion of these accidents was directed towards providing a method or plan by which to combine various factors of exposure, primarily people and vehicles, or vehicle miles, as a better way to measure accident experience.²⁹

Other researchers have defined exposure in various ways. Dunlap referred to exposure as the " . . . frequency of the existence of a situation which may or may not result in an accident."³⁰ McFarland observed that drivers "differ widely in their exposure, even though they have equal records one may have driven many more miles than the other or under vastly different circumstances."³¹

²⁷ Alan D. Beatty, "The Measurement of Exposure to Motor Vehicle Accidents," Traffic Engineering, XXIX (March, 1959), p. 19.

²⁸ Ibid.

²⁹ Ibid.

³⁰ Jack L. Dunlap, An Analysis of Risk and Exposure in Automobile Accidents, A Report Prepared for the Commission on Accidental Trauma, Armed Forces Epidemiological Board, Office of the Surgeon General (Stamford, Connecticut: Dunlap and Associates Inc., 1953), p. 2.

³¹ McFarland, op. cit., p. 12.

DeSilva emphasized the importance of exposure when considering " . . . the number as well as the comparative danger of the external hazards encountered when driving."³² He also noted that " . . . the high exposure driver should not be allowed to use the highways unless he can drive not merely as well as the average driver but better."³³

The Pennsylvania study. Pennsylvania Motor Vehicle authorities conducted a survey program in 1954, using approximately the same procedure followed in the Connecticut Survey. Their questionnaire was expanded to include personal opinions of drivers.

The purpose of the study was to determine the relative incidence of accidents among Pennsylvania's drivers. It was intended to provide data concerning the number of miles driven by residents, according to age group and sex.

A representative sample of 1976 drivers was selected using a system of 105,000 Random Digits. Questionnaires were mailed that requested information about each driver's age, sex, driving experience, accident involvement, annual mileage, driving habits and opinions of traffic laws.

Analysis of the data from 1019 completed questionnaires, showed that:

³²DeSilva, op. cit., p. 32.

³³Ibid.

1. Men were involved in 580 accidents per 100,000,000 miles while
2. Women were involved in 450 accidents per 100,000,000 miles of travel.

These differences were partially accounted for by the author's statement that "It is possible . . . men drive for longer hours than women . . . becoming more fatigued . . . and that men do most of the driving when road and traffic conditions are relatively hazardous."³⁴ This kind of information, with the breakdown of mileage driven by age groups and sex, offered the Pennsylvania authorities more thorough understanding of what was happening to their drivers, and their response to the traffic laws.

Lauer's study in Iowa. Dr. A. R. Lauer designed and conducted one of the first studies in driver behavior and driver exposure using statistical techniques to control and analyze data.

Lauer had noticed that many people had arrived at "faulty conclusions concerning young drivers, women drivers and older drivers and their roles in the accident

³⁴Pennsylvania Motor Vehicle Operator Study, "The Characteristics of Pennsylvania Drivers, Including sex, age, driving experience, miles driven, traffic accident involvement, habits and opinions" (Harrisburg: Department of Revenue, 1954), p. 2. (Mimeographed.)

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picture."³⁵ He believed a study of accidents in Iowa could untangle some of these conclusions. On this basis a five year study of Iowa drivers was undertaken. The goal of his study was to disprove these erroneous beliefs.

Two hypotheses were presented in his study:

Reported accidents are distributed evenly throughout the driving population according to the density of the population, age and the number of licensees and

Accidents are distributed evenly throughout the driving population on the basis of miles driven by each age group.³⁶

The methodology used for selecting drivers to participate in this study involved the use of 1,300,000 drivers' records in the Iowa Department of Public Safety. One driver out of every 200 was selected and sent a questionnaire requesting information about his annual mileage, numbers of miles driven during the daytime and nighttime. Personal data such as age, sex, residence and driving record was taken from the official record. Questionnaires were mailed to 7692 drivers. Results from 1419 questionnaires were used in the study.

Returned questionnaires were divided into two equal groups and analyzed. Charts were prepared showing the

³⁵A. R. Lauer, et al., "Age and Sex in Relation to Accidents," Highway Research Board Bulletin Number 60, Road-User Characteristics, Presented at the Thirty-First Annual Meeting, January, 1952 (Washington: 1952), p. 25.

³⁶Ibid.

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relationships between these groups. Data on each driver was organized into age groups showing the percentages of drivers with the highest mileages, annually, for daytime, nighttime and according to sex.

Lauer's study showed that there were some significant relationships between the ages of drivers and the frequency of accidents. This was found, however, in only three age groups:

1. Male drivers between 18 - 23 showed an age-accident relationship, significant at the five per cent level.
2. Male drivers between 33 - 35 showed a relationship between age and accidents, at the one per cent level of significance.
3. Male drivers between 54 - 56 had the same level of statistical significance as those 33 - 35.³⁷

Lauer found he could not prove his hypotheses. It was however, one of the first studies to establish statistically significant relationships between driver age and accident involvement, equated for mileage.

As a result of his study, Lauer suggested that the techniques he used in the study might have application in spotting "areas of poor enforcement, low accident reporting indices, or other conditions affecting highway safety."³⁸

³⁷ Ibid., p. 31.

³⁸ Ibid., p. 32.

Interest in traffic safety research at the university level appeared to increase following Lauer's work. The next decade was to see a more intense interest and action exerted by professional researchers, university organizations, personnel and government agencies at the state and federal level.

Congressional interest in traffic safety and exposure data. Traffic safety officials in government and industry began appearing before a Sub-committee on Traffic Safety, designated by the House of Representatives Committee on Interstate and Foreign Commerce. It was to be concerned with traffic safety and the progress of safety in highway transportation. Hearings started in 1956 were directed by the Sub-committee Chairman, Representative K. A. Roberts,³⁹ who established an agenda including (1) vehicle construction and design, (2) the human factors in highway accidents, (3) legislation, (4) law enforcement and (5) highways.⁴⁰

Officials of state government and representatives of private industry were asked about the safety of the highways, vehicles and drivers, the accident rates and the availability of information regarding exposure of drivers according to their ages.

³⁹The New York Times, June 5, 1956, p. 28:2.

⁴⁰Ibid., August 4, 1956, p. 17:2.

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Representative Beamer, sponsor of the legislation providing states with authority to enter into traffic safety compacts, such as the Vehicle Equipment Safety Compact and the Driver License Compact, asked James E. Nicholas, General Manager of the Indiana Motor Truck Association, " . . . whether or not you have any information indicating the percentage of accidents of any type that truck drivers have as contrast to the drivers of other vehicles per thousand miles or million miles, whatever the basis might be . . . ?"⁴¹ Mr. Nicholas did not have any data or an answer for the question.

Later in the hearings, Harold Kaiser, Chief, Accident Records Section for the Ohio Department of Highway Safety, was asked:

Do you find that certain age groups are more prone to have accidents? . . . Mr. Kaiser (in reply) . . . the mere breakdown of the driver population of Ohio by age groups is not the complete answer. You must know, for example how many miles they drive whether more teenagers or one specific age group drives more miles in rural areas than they do in cities; do young drivers drive more of their mileage at night . . . ⁴²

Mr. Kaiser knew of the need for exposure information and statistics according to age, but it had not been studied adequately and the answers were not available.

⁴¹United States Congress, House Committee on Interstate and Foreign Commerce, Investigation of Highway Traffic Accidents, Hearings before Sub-committee, 84th Congress, 2nd Session (Washington: Government Printing Office, 1957), p. 869.

⁴²Ibid., p. 636.

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The early hearings in 1956, were accurate indicators of the interest to be shown in the field of traffic safety in later years.

Heath's Study in New Jersey. In researching the relationships of drivers with and without poor driving records, Heath used exposure in annual mileage, to match drivers in each of the good and bad driver groups.

In preparation for the selection of drivers for his study, Heath collected exposure information from drivers in various occupations. The average mileage of these drivers was prepared into a guide showing the average mileage for each occupation, along with a description of the type and amounts of driving for each occupation. This guide was used by drivers participating in his study, to more accurately estimate their exposure.

Exposure data was important as a measure and basis for determining whether more experienced drivers acquired more violations or were involved in more accidents than less experienced drivers. The process of matching drivers, according to their rates of exposure and experience was one of Heath's most difficult tasks and he echoed Stewart's comment that " . . . any attempt to control these variables beyond a point is reduced to a hopeless state of absurdity."⁴³

⁴³Robert C. Stewart, "An Evaluation of the Driver Education Program in the State of Delaware in Terms of Performance Records of Participants of this Program" (Dover, Delaware: State Department of Public Instruction, 1956), p. 7.

However, Heath's study enabled him to determine that " . . . annual mileage has little effect on accident experience but . . . violation experience seems to increase with driving exposure."⁴⁴

Billion's Study in Schenectady, New York. C. E.

Billion designed and directed a study of 810 drivers for the United States Bureau of Roads and the New York Department of Public Works. The purpose of this project as set forth in two hypotheses was:

- (1) "To determine those attributes that may be casually associated with driver behavior; and
- (2) To prove that drivers responsible for motor vehicle accidents have different personal, social and driver characteristics than drivers who have not had accidents."⁴⁵

One of the basis for evaluating driver performance was driver exposure.

Drivers participating in this study were selected by a random sampling of city blocks, residences, families, and drivers within families.

⁴⁴Earl David Heath, "The Relationship Between Driving Records, Selected Personality Characteristics, and Biographical Data on Traffic Offenders and Non-offenders" (Doctoral Dissertation at the Center for Safety Education, New York City University, 1958), p. 6.

⁴⁵C. E. Billion, "Community Study of the Characteristics of Drivers and Driver Behavior Related to Accident Exposure," Highway Research Board Bulletin Number 172 (Washington, D.C.: National Academy of Science - National Research Council, 1958), p. 36.

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Trained interviewers conducted in depth interviews with drivers, recording personal, social, and driving history. Data concerning the number of miles driven was requested of each driver and diaries provided to record future mileage more accurately.

This study was unique. Trained observers scored the performance of 571 drivers as to their obedience to traffic laws, reactions to traffic situations and demonstration of safe driving practices as they drove to work.

Drivers were grouped together by annual mileage as shown in Table I. This shows three levels of annual mileage, the numbers and percentages of drivers involved in accidents and determinations as to their responsibility for these accidents. To determine the responsibility for accidents, a group of judges were selected who were qualified to examine accident information and the driver's role in it and then determine who was responsible for the accident.

Among the positive aspects of this study was the use of the Thurstone Temperament Schedule for the selection of such personality traits as " . . . impulsiveness and sociability . . . in combination with the biographical items of age, marital status, education, occupation, number of positions held during the 5-year period preceeding examination, reasons for terminating previous employment, and annual salary."⁴⁶ The results of Billion's work did not prove

⁴⁶Ibid., p. 18.

TABLE I

"DRIVERS COMPARED BY EXPOSURE AND ACCIDENT STATUS"*

Exposure Category	No Accidents		Accident Responsibility		Accident Non-Responsibility		Total	
	Number	%	Number	%	Number	%	Number	%
Low 0-7600	243	90	21	8	6	2	270	100
Medium 7601-18,100	231	86	24	9	15	6	270	100
High 18,101-161,000	217	80	37	14	16	6	270	100
	691	85	82	10	37	5	810	100

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either of his hypotheses. His findings, however resembled Heath's, showing a relationship between exposure and drivers records. From his work, Billion concluded:

From a comparison of the driving records of traffic offenders whose driving experience was less than 50,000 miles per year with those whose driving experience was in excess of this amount, it appears that annual mileage has little effect on accident experience, but that violation experience seems to increase with exposure.⁴⁷

This study followed a well planned design for collecting and analyzing data, with later follow-up techniques. The technique of establishing three major ranges of exposure may have, however, detracted from the sensitivity of the analysis relating exposure to accident involvement and responsibility.

The Bureau of Public Roads Study. This study was initiated as an operational study of traffic accidents to be conducted in areas selected geographically, so the conditions affecting driving and other data required for the study, would be representative of all the regions of the United States.

The objective was " . . . to determine the relationships among drivers and vehicle characteristics and traffic accident frequency."⁴⁸ To accomplish this objective a new research technique was devised.

⁴⁷ Ibid., p. 18.

⁴⁸ Special Sub-committee on Traffic Safety, op. cit., p. 71.

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Particular care was taken to devise a methodology that would include miles of driving as a measure of accident occurrence. This is one of the first comprehensive approaches to a study of the driver, vehicle, and highway characteristics as a system that has taken account of travel mileage for exposure.⁴⁹

Information was recorded from 290,000 drivers who traveled more than 317 billion miles over thirty-five sections of typical roadways, 600 miles in length and under every conceivable condition.

Traffic accident records accumulated for three to four years on the sections of highway included in the study were reviewed and classified into areas of driver and vehicle characteristics. This information was then matched with comparable data collected from drivers who traveled the same portions of highways being studied, but had no accidents.

As one method of evaluating this research, a unit of measurement was developed and called "the accident involvement rate" it represents the number of involvements that occur for every 100 million miles of highway travel.⁵⁰

One of the principal findings of this study was the amounts of exposure of drivers by sex, age and general information about driving at night and in the daytime.

⁴⁹Ibid., p. 71.

⁵⁰Ibid., p. 72.

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Sex and age of drivers affected the proportionate distribution of travel on main rural highways. Female drivers performed only 13 per cent of the day travel and only 7 percent of night travel. Male drivers between 20 and 55 years of age performed the greatest amount of travel per registered driver - older drivers reduced their travel even more at night.⁵¹

From this intensive study of travel and accidents on rural highways, there is much evidence to show the value of the driving characteristics of drivers in other traffic environments.

The California Negligent Operator Study. As one phase of a continued research program, this study was designed " . . . to determine to what extent if any, the driving records of negligent drivers improved following an interview with a driver improvement analyst and the resultant action . . . " ⁵²

Approximately 5,000 driver improvement cases were reviewed of which 4081 cases were selected for the study group. Data was tallied identifying each driver, his record before a corrective interview, annual mileage, the action taken, and his subsequent record.

⁵¹Accidents on Main Rural Highways Related to Speed, Driver, and Vehicle, A Report by the U.S. Department of Commerce, Bureau of Public Roads (Washington: Government Printing Office, July, 1964), p. 2.

⁵²R. S. Coppin and Ira Samuels, "Characteristics of Negligent Drivers," Control of the Negligent Driver, Part I. A Report for the Division of Driver Licenses, California Department of Motor Vehicles (Sacramento: 1961), p. 3. (Mimeographed.)

The negligent operator mileage data was used to calculate mean mileages for each age group of drivers. This analysis showed that negligent drivers drove more than a random sample of applicants renewing their licenses.⁵³

Graphically the California data on mean mileage, shown in Figure 2 closely resembles the comparable profile in Figure 3 showing Michigan drivers' mean weekly mileage.

The findings of this study enabled California driver licensing authorities to make numerous comparisons between negligent operators and average drivers,⁵⁴ as to age, occupation, sex, annual mileage, driving records before and records after the actions taken in the driver improvement interview. These comparisons provided California Licensing Authorities with necessary information to evaluate the effectiveness of their driver improvement personnel and the driver improvement program.

II. LIMITATIONS OF PREVIOUS STUDIES

The early studies were conducted to learn more about drivers' habits, their uses of vehicles, destinations and numbers of miles driven and did not attempt to establish controls or analyze the data collected by statistical

⁵³Vision Research Project, Department of Motor Vehicles, State of California, Research Report No. 2, October, 1959.

⁵⁴Coppin, op. cit., p. 4.

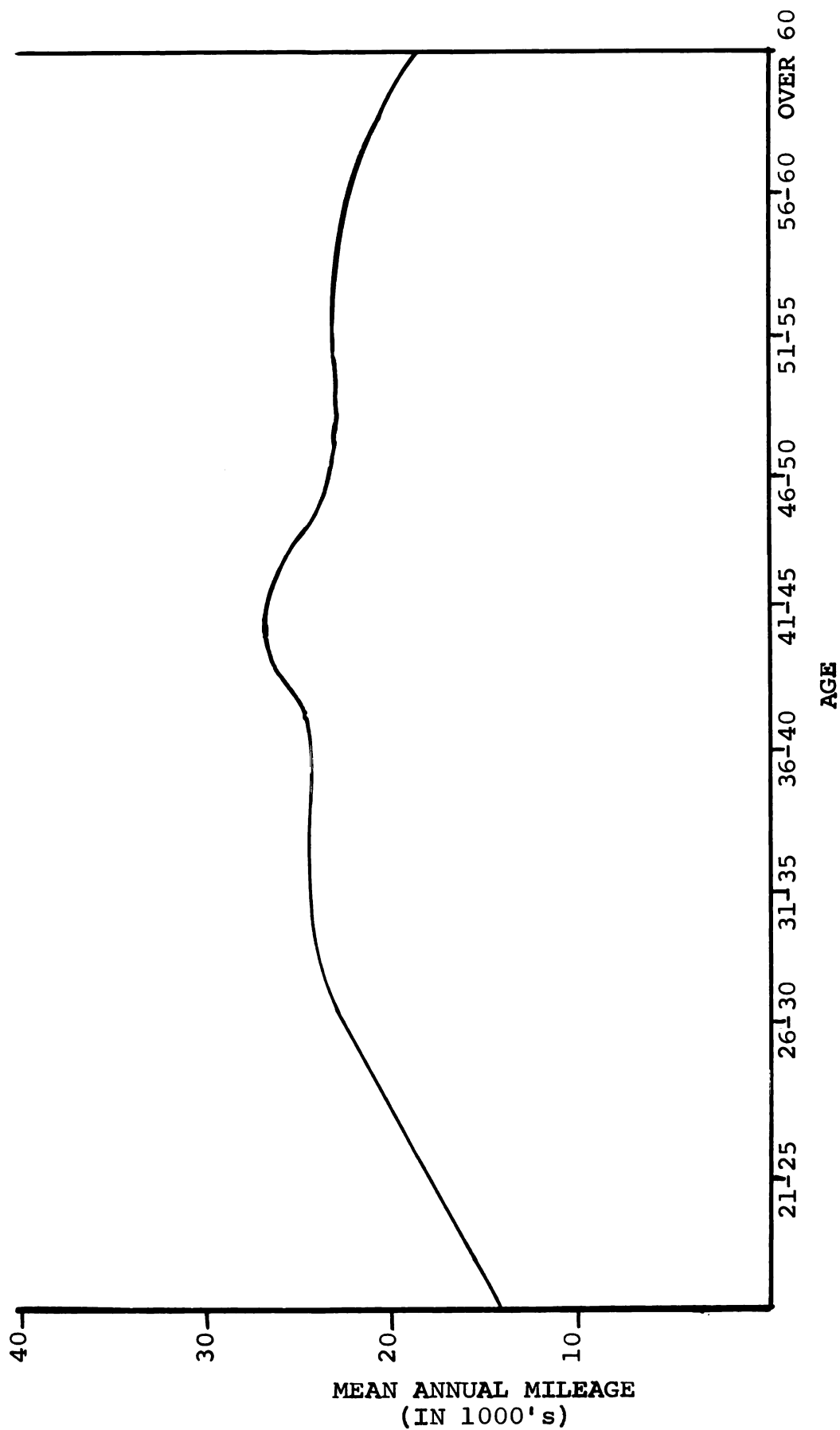


Figure 2

CALIFORNIA'S DEPARTMENT OF MOTOR VEHICLE STUDY OF NEGLIGENT OPERATORS
MEAN ANNUAL MILEAGE OF NEGLIGENT OPERATORS BY AGE GROUP

methods.⁵⁵ They were limited in scope and designed to provide information that could be applied to solve immediate problems.

Questionnaires mailed to drivers were frequently used to collect data because they were economical and could be developed to gather specific information quickly. However, there was a need for more knowledge and skill in constructing questions and designing questionnaires that would encourage drivers to return unbiased information about themselves and their driving.

These studies using mail questionnaires may have been handicapped by the lack of public information concerning the value of surveys and research in providing an improved public service and the importance of public cooperation to accomplish these improvements. The result was shown by the public's response to questionnaires. In both Pennsylvania and Iowa the per cent of questionnaires returned was less than half the total mailed.

III. SUCCESS OF EARLIER STUDIES

Information learned from the Pennsylvania and Iowa studies indicated areas in which law enforcement and accident prevention activities could have been improved, in some

⁵⁵Automobile Manufacturers Association, Automobile Facts and Figures (New York: 1939), pp. 40-41.

manner. Pennsylvania's drivers opinions and accident data, by age and annual mileage was considered of special interest in highway safety planning. "Available information from the study indicates that successful educational and promotional programs directed to drivers under 30 years of age would result in substantial reductions in the number of highway accidents."⁵⁶ This statement was based on accident findings showing 16 - 19 year old drivers had 6.9 times the accident rate of the safest age group, the 50 - 59 year old group.

Later, more scientific studies followed the more traditional research concepts, developing a research study design, establishing hypotheses, and making statistical analyses of data. From some of these studies there was evidence that the techniques for collecting large quantities of accurate data were inadequate. This limitation was also overcome by the use of interviewers trained to collect data and record it on questionnaires. Information such as exposure, in the studies by Heath, Billion and Coppin, was obtained from interviews conducted for several purposes. The costs of this stage in research has resulted in the development of qualified researchers or funds for contracts with consultants, university organizations or private research firms.

⁵⁶ Pennsylvania, op. cit., p. 1.

The literature reveals that exposure has been used in research studies as the basis for selecting or matching study subjects and for evaluating their driving records.

However, there has not been a study involving a large sample of the driving population in order to provide exposure information for basic reference purposes.

In this study an effort is made to obtain a comprehensive sampling from the driving population of Michigan, to supply the need for a basic reference of driver exposure and various types of exposure.

CHAPTER III

THE RESEARCH METHODOLOGY

Methods for collecting reliable information on driver exposure have been expensive and justifiable only when combined with multi-purpose studies on driver behavior. Requests for estimated annual mileage usually exceeds the average driver's ability to recall how many miles he drives. His estimate consequently becomes the same or approximates the number of miles he has heard others use. Therefore questionnaires, used in most studies economized on the collection of large quantities of data, but could not assure researchers that the data on driver exposure was realistic or accurate.

The need for controls has been met with some success by the interview questionnaire.

Questionnaire design, testing and distribution in twenty-six driver license stations was completed and almost 6700 drivers had reported their exposure on a questionnaire before August, 1959.

The collection of data from drivers was simplified in this study by making it convenient for motorists to answer questions when they applied for the renewal of their driver license.

Direct contact with and supervision of drivers completing questionnaires was encouraged to assure more reliable information. Personnel responsible for the collection of data expressed interest in the project. Their interest probably encouraged drivers to complete questionnaires. Also, personnel in some examination stations reported that they solicited the mileage information from applicants.

I. DETERMINING THE STUDY SAMPLE

Foundation of the study sample. The procedure for determining the number of drivers to be included in the study group was based upon a study to establish an age distribution for Michigan drivers, and personal discussions with the author and researcher responsible for it, Dr. Gerald F. King. King's study involved the selection of 11,792 driver records, from which dates of birth were recorded and used to construct an age distribution of drivers.⁵⁷

It was believed a study sample of 10,000 drivers, would provide an approximate age distribution similar to that King had selected. Exposure data from this number of drivers could then be typical of Michigan drivers.

⁵⁷Gerald F. King, The Age Characteristics of Michigan Drivers (East Lansing, Michigan: Michigan State University, Highway Traffic Safety Center, 1959), p. 9. (Mimeographed.)

Development of a plan for conducting the study was discussed with driver license officials in the Michigan Department of State.

Michigan Driver License Law requires the renewal of licenses annually for chauffers and every three years for operators of regular passenger vehicles. Therefore, state authorized driver license examination stations could provide an opportune place for collecting data from drivers about the number of miles they drive.

This study would involve only those drivers who appeared at a driver license examination station to renew their license to drive. The objectivity of this selection process was assured by two factors, (1) drivers' licenses expire on their date of birth, which occurs in some degree of randomness and (2) drivers choose the time to renew their license, based upon their awareness of the law and that their license has expired.

Based on these conditions, it is possible this sample of drivers and information about their exposure would be comparable to and complement the control data age distribution established by King.

Permission (A proposal) requesting authority to solicit assistance from state authorized driver license examination stations in various geographical areas, typical of metropolitan, urban, suburban and rural traffic environments, was presented to the Michigan Department of State and

approved. In addition to this Department's complete support for this project, all official correspondence concerning the study was prepared on letterhead paper, under the auspices and approval of the Director of the Division of Driver and Vehicle Services, the late Lee C. Richardson and former Deputy Secretary of State, now Congressman, Billie S. Farnum.

II. SELECTION OF PARTICIPATING STATIONS

Stations selected for participation in the collection of data were required to meet specific conditions:

1. To be interested in the value of research, agree to perform the added duties connected with supervising the collection of data, and to control or limit access to the questionnaires.
2. To have proven reliability in performing their licensing duties.
3. To be near the center of study operations in Lansing, Michigan.
4. To be located in an area typical or representative of a metropolitan, urban, suburban or rural traffic environment.

These conditions were determined (1) by personal interviews with the Chief of Police or Sheriff of each department selected to participate in this activity; (2) by reviewing each department's record of performance in the Department of State's records; and (3) by an examination of

station locations and an estimate of the types of traffic environments surrounding each station.

III. QUESTIONNAIRE DESIGN

The nature of this study involved sampling a large number of drivers located in an eleven county area. Without full time field study personnel to collect data, a questionnaire was developed that could be completed by drivers, with supervision by driver license examiners.

Guided by suggestions from Dr. King, a questionnaire was developed, minimizing ambiguous and leading statements, explaining words that would prevent the average driver from having a clear understanding of the information being requested of him.

The questionnaire was designed in three parts:

1. A title, "How Many Miles Do You Drive?" intended to arouse interest, curiosity and encourage drivers to cooperate and read on to
2. an explanation of the study's purpose, with
3. a request that each reader (driver) cooperate by supplying information to the questions asked concerning his name, date of birth, occupation, sex, marital status, and how many miles he drove in a typical or average week, during the daytime, nighttime, in the country and city.

Average weekly mileage was requested rather than annual mileage, because the writer believed drivers could estimate the number of miles they drove during a week more realistically and accurately.

Space for each type of information was carefully labeled and ample space provided for writing in answers, except for information on marital status and sex, which were followed by boxes in which a check or an "X" could be marked.

Pilot testing the questionnaire. Pilot testing the questionnaire was completed by the Lansing Police Department Driver License Station, Lansing, Michigan. Twenty-five questionnaires were assigned to the examination station, to be completed by applicants for renewal licenses, with a minimum of assistance.

Evaluating the questionnaire. An examination of pilot test questionnaire forms revealed several problems. Some drivers had not completed their mileage data. Others put the date of their application down for their date of birth, or estimated amounts of mileage for complementary areas of exposure that did not equal the average weekly mileage. Most of the errors indicated careless or hurried efforts to complete the questionnaire without reading what was requested of them. There were no obvious types of errors, other than the frequent error in completing the exposure information with percentage figures, miles that were

probably annual mileages, or appeared to be unreasonable or excessive estimates of exposure.

Study of the pilot questionnaires, and plans for revising the form to make it more descriptive resulted in an enlarged and more detailed form. These efforts were discontinued because it was very possible the public would be discouraged by the appearance of a long and involved questionnaire. The original questionnaire as shown in Appendix A was adopted and a decision made to give the driver license examiners more specific information for assisting in the study through an official letter requesting cooperation in the study, Appendix B. With a better understanding of the study, they would be encouraged to supervise completion of questionnaires, assist persons having problems and clarify what the purpose of the study is.

IV. DISTRIBUTION OF THE QUESTIONNAIRE

Questionnaires were distributed to twenty-six driver examination stations, participating in the study in proportion to the number of license renewal applications processed by these stations during the year, 1958. For example: If Station "X" had eight per cent of all applications processed by the twenty-six participating stations, it was given eight per cent of the total sample of 10,000 questionnaires.

The complete distribution plan was prepared according to official Department of State records, as shown in Table II.

TABLE II
DISTRIBUTION PLAN FOR QUESTIONNAIRES IN
TWENTY-SIX DRIVER LICENSE STATIONS

Jurisdiction City or County ^a	License Applications 1958	Questionnaires Given Stations
Barry County (SO)	4,442	86
Hastings PD	1,180	23
Calhoun County (SO)	12,993	250
Albion PD	2,166	42
Battle Creek PD	8,477	163
Marshall PD	1,221	23
Gratiot County (SO)	5,011	96
Alma PD	1,822	35
Ingham County (SO)	13,856	266
East Lansing PD	4,222	81
Lansing PD	18,502	356
Kalamazoo County (SO)	14,975	288
Kalamazoo PD	13,070	251
Kent County (SO)	26,770	511
East Grand Rapids PD	2,011	39
Grandville PD	2,623	51
Grand Rapids PD	29,085	559
Rockford PD	760	13
Sparta PD	953	18
Livingston County (SO)	7,193	138
Montcalm County (SO)	7,128	137
Shiawassee County (SO)	6,878	132
Owosso PD	3,060	59
Wayne County (SO)	46,658	896
Detroit PD	278,687	5,353
Highland Park PD	<u>6,911</u>	<u>133</u>
	520,654	10,000

^aCity jurisdictions, are Police Departments and can be identified by the letters PD.

County jurisdictions, are Sheriff Departments and can be identified by the letters SO.

Each Sheriff, Chief of Police or their representative, who was assigned the responsibility for driver licensing duties, was contacted personally, when the questionnaires were distributed. This provided an opportunity to discuss details of the study with officials of the cooperating departments, and review the value of the study and their role in collecting the data.

V. COLLECTING THE EXPOSURE DATA

Instructions were given to driver examiners requesting them to encourage all drivers appearing to renew expiring licenses between May 1, 1959 and August 1, 1959 to complete a questionnaire. Whenever possible, examiners were asked to supervise or complete questionnaires by interviewing the driver license applicant. Persons refusing to cooperate were to be excused, since information obtained under duress would probably be unreliable.

Arrangements were made with each department, to pick up all questionnaires after August 1, 1959. All questionnaires, completed, incomplete or blank were to be retained and returned on that date.

VI. LIMITATIONS OF THE STUDY

Collecting data from Michigan's driving population involved two unforeseen problems, that influenced the number and quality of questionnaires during the period selected for this function.

During the month of June, shortly after the study began, thousands of youths eligible for drivers licenses completed the high school driver education programs. These students, mostly in their junior and senior years, could apply for a driver license. These applicants required more of the examiners time, than was required for a driver license renewal applicant. Consequently, the amount of time available for the collection of data on the questionnaires was reduced.

In some stations, summer vacations of police officers and examiners caused shortages of personnel acquainted with the data collection procedures.

The degree to which these two factors affected the data could not be determined. They were not discovered until after the questionnaires were collected.

Absolute controls for the collection of data in this study could not be realistically planned, because of the large geographical area in which the data was to be collected simultaneously. Such a plan would have required extensive financial support and a study team in each of the locations where questionnaires were to be used, to assure the completeness and accuracy of the data.

Although Michigan law requires the renewal of chauffers licenses annually, and operators licenses on their birthdays every third year, drivers may appear in person up to 90 days before the law requires their license be renewed.

Therefore, even the random effect of birthdates could not be assured and provide a representative sample of Michigan's driving population.

Driver license examiners and the public were both able to influence the study, positively and negatively depending upon their cooperation and diligence in making accurate estimates of their exposure and recording it on the questionnaires.

Finally, there was no assurance that every applicant for a renewal of his license was given a questionnaire or an opportunity to complete one. However, frequent incidents were mentioned by examiners, that showed their interest and sincerity in the study had prompted positive response from the public.

Quantitatively, the study was limited by the fact that only 63.5 per cent of the questionnaires were acceptable for use in the study.

VII. PRESENTATION OF THE DATA

In preparation for presenting the findings of this study, exposure data was organized according to driver's age, sex and area of exposure. So that this information may be more easily assimilated, the findings are presented in tables and graphs in Chapter IV, Collection and Analysis of Data.

VIII. STABILITY OF THE EXPOSURE DATA

Annually, for many years, the Bureau of Public Roads has estimated the number of miles driven by the average automobile in the United States. These estimates have been based upon the fuel consumption for all passenger automobiles. In 1959 the estimated passenger vehicle mileage per vehicle was 9,529 miles;⁵⁸ in 1961, 9,492 miles and in 1963, 9,378 miles.⁵⁹ These estimates indicate that the average passenger vehicle mileage has changed little.

In addition to the Bureau's information, [the State of California's Department of Motor Vehicles found that the mean annual mileage for California's male drivers was 12,749 and female drivers was 6,711.⁶⁰] It is interesting to note that the average of these two classes of drivers, results in an average annual mileage of 9,730 miles.

Though 1959 data on exposure was used in this study, the stability of past and recent exposure information would indicate that it is still relevant.

⁵⁸Automobile Manufacturers Association, Automobile Facts and Figures, Automotive Manufacturers Association (Detroit, Michigan: 1965), p. 45.

⁵⁹Bureau of Public Roads, Highway Statistics, 1963, United States Department of Commerce (Washington: Government Printing Office, March, 1965), p. 13.

⁶⁰R. S. Coppin and R. S. Peck, The Totally Deaf Driver in California, Part II, State of California Department of Motor Vehicles, Report #16 (Sacramento: December, 1964), p. 7.

CHAPTER IV

COLLECTION AND ANALYSIS OF DATA

Following August 1, 1959 questionnaires were collected from the twenty-six selected driver license examination stations. They were screened and the data was transferred to IBM cards.

All data was first grouped according to drivers' characteristics, then by types of exposure. Analysis of the grouped data was made to determine the degree of central tendency and dispersion. Tables and graphs were prepared to illustrate how each type of exposure varies with age. To emphasize these changes that occur in exposure and age, one demonstration project was developed using a diazo-process for preparing exposure profiles on acetate sheets.

I. SCREENING QUESTIONNAIRES

During the scheduled study period, from May 1, 1959 to August 1, 1959, 6684 questionnaires were completed. Each one was counted and reviewed before it was selected for use in the study, to determine the value of the information presented. Questionnaires were accepted if they included the driver's personal history information and average weekly

mileage and one or more areas of exposure. In the reviewing process, 309 questionnaires were discarded because of erroneous or fictitious personal data, incomplete or exaggerated exposure information. The remaining 6375 questionnaires were grouped according to drivers' ages (from 17 to 87 years of age) and given an identification number. Each station cooperating in the study was given an alphabetical letter which was entered on each questionnaire. The questionnaires completed at each station were numbered when they were being reviewed for errors. After all questionnaires were screened and grouped by age, an identification number was assigned and used as a control number in transferring the data to IBM cards.

II. TRANSFERRING DATA FOR MACHINE PROCESSING

IBM cards were prepared showing all the data from each questionnaire except the driver's name, address and occupation. In this phase, seventeen more questionnaires were discarded because of incorrect information. This final screening process yielded 6358 acceptable driver exposure cards.

The following information was punched into the IBM cards, in sequence: Questionnaire identification number; the driver's year of birth (showing the last two digits); sex and marital status were coded, with number "1" representing male and "2" representing female; with number "3" representing

married drivers and "4" for single and other status; and the average weekly mileage, daytime mileage, nighttime mileage, country mileage and city mileage.

III. GROUPING THE DATA FOR STUDY

Drivers were considered in three major groups:

- (1) Class I All drivers
- (2) Class II Male drivers
- (3) Class III Female drivers

Within each class, exposure data was separated into:

- (a) Average weekly mileage
- (b) Daytime mileage
- (c) Nighttime mileage
- (d) Country mileage
- (e) City mileage.

The IBM cards were arranged according to driver's age, from the youngest to the oldest driver. Drivers of the same age were placed in the order of the code numbers assigned for sex and marital status and then by the number of miles reported, in ascending order. All drivers were grouped by age into five year intervals, except drivers under twenty years of age, which were placed in classes of one year.

Five data reports were printed in this format, one for each area of exposure. These data reports were the sources for all other information presented graphically, in

tables, charts and narrative text in an attempt to describe the exposure characteristics of Michigan drivers.

So that the data may be more easily understood, it is presented in the following tables and graphs.

Tables III through VII show the grouped data for the total number of drivers, the numbers of male and female drivers, the sums of miles driven per week and the mean mileage for each age group.

It will be noted that there are different N's for each area of exposure. This was due to the inclusion of some questionnaires which reported average weekly miles, without dividing the miles into the four basic areas of exposure. This also will account for the inconsistencies that are evident when the summarized data for complementary areas of exposure will not equal the total or average weekly mileage. However, each questionnaire balanced between average weekly mileage and the sum of the complementary areas.

In order to more clearly show the relationships between age groups and sex in each area of exposure and compare the areas of exposure within a single age group, the following line graphs were prepared.

These graphs show exposure characteristics of male and female drivers for each of the five areas of exposure; the average weekly mileage, daytime, nighttime, country and

TABLE III

**TOTAL AND MEAN WEEKLY MILEAGE FOR MICHIGAN DRIVERS
ACCORDING TO SEX AND AGE GROUP**

Age Group	All Drivers			Male Drivers			Female Drivers		
	N	Total Weekly Mileage	M	N	Total Weekly Mileage	M	N	Total Weekly Mileage	M
17	7	430	61.43	3	325	108.33	4	105	26.25
18	18	3,890	216.11	15	3,655	243.67	3	235	78.33
19	200	27,780	138.90	135	23,925	177.22	65	3,855	59.31
20-24	639	119,660	187.26	418	105,051	251.32	221	14,609	66.10
25-29	733	165,944	226.39	525	152,865	291.17	208	13,079	62.88
30-34	925	208,190	225.07	637	188,908	296.56	288	19,201	66.67
35-39	864	202,252	234.09	610	181,013	296.74	254	21,239	83.62
40-44	770	174,005	225.98	506	148,230	292.94	264	25,775	97.63
45-49	558	138,166	247.61	381	122,020	320.26	177	16,146	91.22
50-54	507	115,955	228.71	350	99,674	284.78	157	16,281	103.70
55-59	434	101,041	232.81	324	89,625	276.62	110	11,416	103.78
60-64	314	70,135	223.36	244	62,330	255.45	70	7,805	111.50
65-69	214	35,859	167.56	170	31,324	184.26	44	4,535	103.07
70-74	107	18,821	175.90	94	17,701	188.31	13	1,120	86.15
75-79	51	6,305	123.63	46	5,920	128.69	5	385	77.00
80-84	13	1,780	136.92	11	1,720	156.36	2	60	30.00
85-89	4	380	95.00	4	380	95.00			
T	6,358	1,390,512	218.32	4,473	1,234,666	278.26	1,885	155,846	82.67
%	100	100		70.35	88.79		29.65	11.20	

TABLE IV

DAYTIME AND MEAN WEEKLY MILEAGE FOR MICHIGAN DRIVERS
ACCORDING TO SEX AND AGE GROUP

Age Group	All Drivers			Male Drivers			Female Drivers		
	N	Daytime Weekly Mileage	M	N	Daytime Weekly Mileage	M	N	Daytime Weekly Mileage	M
17	7	186	26.57	3	110	36.67	4	76	19.00
18	14	2,230	159.29	11	2,100	190.91	3	130	43.33
19	184	15,146	82.32	124	12,934	104.31	60	2,212	36.87
20-24	597	78,720	131.86	390	68,922	176.72	207	9,798	47.33
25-29	693	116,506	168.12	500	107,341	214.68	193	9,165	47.49
30-34	814	146,118	179.51	586	132,533	226.17	269	13,585	50.50
35-39	794	136,252	171.60	562	121,258	215.76	232	14,994	64.63
40-44	705	117,056	166.04	461	98,858	214.44	244	18,198	74.58
45-49	515	91,479	177.63	350	79,986	228.53	165	11,493	69.65
50-54	449	74,513	165.95	305	63,130	206.98	144	11,383	79.05
55-59	387	67,365	174.07	286	58,894	205.92	101	8,471	83.87
60-64	286	47,920	167.55	225	42,010	186.71	61	5,910	96.89
65-69	203	26,518	130.63	161	23,036	143.08	42	3,482	82.90
70-74	95	12,432	130.86	82	11,497	140.21	13	935	71.92
75-79	45	4,565	101.44	41	4,345	105.98	4	220	55.00
80-84	12	1,154	96.17	10	1,104	110.40	2	50	25.00
85-89	4	345	86.25	4	345	86.25			
T	5,845	938,505	160.56	4,101	828,403	202.00	1,744	110,102	63.13
	100	100		70.16	88.27		29.84	11.73	
				68% of all mileage			76% of all mileage		

TABLE V

**NIGHTTIME AND MEAN WEEKLY MILEAGE FOR MICHIGAN DRIVERS
ACCORDING TO SEX AND AGE GROUP**

Age Group	All Drivers			Male Drivers			Female Drivers		
	N	Nighttime Weekly Mileage	M	N	Nighttime Weekly Mileage	M	N	Nighttime Weekly Mileage	M
17	6	244	40.67	2	215	107.50	4	29	7.25
18	13	1,410	108.46	11	1,305	118.64	2	105	52.50
19	167	11,324	67.81	117	9,951	85.05	50	1,373	27.46
20-24	496	34,937	70.44	327	30,881	94.44	169	4,056	24.00
25-29	573	46,617	81.36	436	43,901	100.69	137	2,716	19.82
30-34	717	53,388	74.46	522	48,482	92.88	195	4,906	25.16
35-39	662	54,837	82.84	489	49,922	102.09	173	4,915	28.14
40-44	585	43,190	73.83	407	37,271	91.57	178	5,919	33.25
45-49	399	39,193	98.29	277	35,344	127.59	122	3,849	31.55
50-54	347	25,209	72.65	247	21,937	88.81	100	3,272	32.72
55-59	312	26,067	83.55	244	23,952	98.16	68	2,115	31.10
60-64	217	16,710	77.00	182	15,595	85.69	35	1,115	31.86
65-69	151	7,461	49.41	129	6,708	52.00	22	753	34.23
70-74	67	3,394	50.66	63	3,234	51.33	4	160	40.00
75-79	27	1,005	37.22	25	990	39.60	2	15	7.50
80-84	6	626	104.33	5	616	123.20	1	10	10.00
85-89	2	35	17.50	2	35	17.50			
T	4,747	365,647	77.02	3,485	330,339	94.78	1,262	35,308	27.98
%	100	100		73.41	90.34		26.59	9.66	
				32% of all mileage	32% of all mileage		24% of all mileage		

TABLE VI

COUNTRY AND MEAN WEEKLY MILEAGE FOR MICHIGAN DRIVERS
ACCORDING TO SEX AND AGE GROUP

Age Group	All Drivers			Male Drivers			Female Drivers		
	N	Country Weekly Mileage	M	N	Country Weekly Mileage	M	N	Country Weekly Mileage	M
17	3	225	75.00	2	220	110.00	1	5	5.00
18	10	1,235	123.50	9	1,185	131.67	1	50	50.00
19	120	11,758	98.98	89	10,402	116.88	31	1,356	43.74
20-24	387	47,056	121.59	280	41,859	149.50	107	5,197	48.58
25-29	452	71,190	157.50	350	67,512	192.89	102	3,678	36.06
30-34	553	89,530	161.90	432	84,608	195.85	121	4,922	40.68
35-39	523	83,583	159.81	410	77,907	190.02	113	5,676	50.23
40-44	465	73,203	157.43	336	66,171	196.94	129	7,032	54.51
45-49	342	57,514	168.17	253	52,558	207.74	89	4,956	55.69
50-54	296	39,527	133.54	218	34,755	159.43	78	4,772	61.18
55-59	278	36,352	130.76	208	31,917	153.45	70	4,435	63.36
60-64	200	31,296	156.48	161	28,651	177.96	39	2,645	67.82
65-69	147	14,705	100.03	118	12,890	109.24	29	1,815	62.59
70-74	69	7,453	108.01	60	6,952	115.87	9	501	55.67
75-79	29	2,399	82.72	25	2,259	90.36	4	140	35.00
80-84	6	430	71.67	6	430	71.67			
85-89	2	190	95.00	2	190	95.00			
T	3,882	567,646	146.22	2,959	520,466	175.89	923	47,180	52.19
%				76.22	91.69		23.78	8.31	

TABLE VII

CITY AND MEAN WEEKLY MILEAGE FOR MICHIGAN DRIVERS
ACCORDING TO SEX AND AGE GROUP

Age Group	All Drivers			Male Drivers			Female Drivers		
	N	City Weekly Mileage	M	N	City Weekly Mileage	M	N	City Weekly Mileage	M
17	7	205	29.29	3	105	35.00	4	100	25.00
18	14	2,405	171.79	11	2,220	201.82	3	185	61.67
19	189	15,225	80.56	128	12,781	99.85	61	2,444	40.07
20-24	591	64,804	109.65	383	55,927	146.02	208	8,877	42.68
25-29	686	89,149	129.95	495	80,978	163.59	191	8,171	42.78
30-34	848	109,002	128.54	579	95,414	164.79	269	13,588	50.51
35-39	782	105,634	135.08	557	91,459	164.20	225	14,175	63.00
40-44	688	89,438	130.00	453	73,542	162.34	235	15,896	67.64
45-49	498	66,288	133.11	335	56,782	169.50	163	9,506	58.32
50-54	442	64,637	146.24	306	55,022	179.81	136	9,615	70.69
55-59	382	56,654	148.31	286	50,274	175.78	96	6,380	66.46
60-64	274	34,869	127.26	218	30,649	140.59	56	4,220	75.36
65-69	191	19,269	100.88	156	16,889	108.26	35	2,380	68.00
70-74	93	9,238	99.33	80	8,619	107.74	13	619	47.62
75-79	39	2,846	72.97	35	2,751	78.60	4	95	23.75
80-84	11	1,350	122.73	9	1,290	143.33	2	60	30.00
85-89	4	190	47.50	4	190	47.50			
T	5,739	731,203	127.40	4,038	634,892	157.22	1,701	96,311	56.62
%				70.36	86.83		29.64	13.17	

TABLE VIII
SUMMARY OF EXPOSURE DATA PER WEEK DURING THE
DAYTIME, NIGHTTIME, IN THE
COUNTRY AND CITY

Class Drivers		Weekly	Daytime	Night- time	Country	City
	N	6,358	5,845	4,747	3,882	5,739
I	Miles	1,390,512	938,505	365,647	567,646	731,203
	M	218.32	160.56	77.02	146.22	127.40
	N	4,474	4,101	3,484	2,959	4,038
II	Miles	1,234,666	828,403	330,339	520,466	634,892
	M	278.26	202.00	94.78	175.89	157.22
	N	1,885	1,744	1,262	923	1,701
III	Miles	155,846	110,102	35,308	47,180	96,311
	M	82.67	63.13	27.98	52.19	56.42

city mileages. A color code was selected to help identify each of the types of exposure, as shown here:

Black	Average Weekly Mileage
Red	Daytime Weekly Mileage
Blue	Nighttime Weekly Mileage
Green	Country Weekly Mileage
Brown	City Weekly Mileage

Figure 3 indicates the characteristic trends of exposure according to age groups and for the different types or areas of exposure for each age group.

Figures 4 and 5 show the contrasts in the amounts of driving reported by male and female drivers. Basically, there are two major differences between the male and female driver: (1) one in the gross difference in the numbers of miles being driven and (2) in the amounts, or proportions, of driving occurring in each of the exposure areas.

When Figures 4 and 5 are compared, the difference in rate of exposure is clearly defined, but also equally well defined is the female's far more stable pattern of exposure, with its gradual incline until age group 65 - 69, when all areas except nighttime (blue) decline. Later, a sharp drop occurs for nighttime mileage at age 70-74.

Further comparisons between the male and female drivers will be presented as part of the Findings in Chapter V.

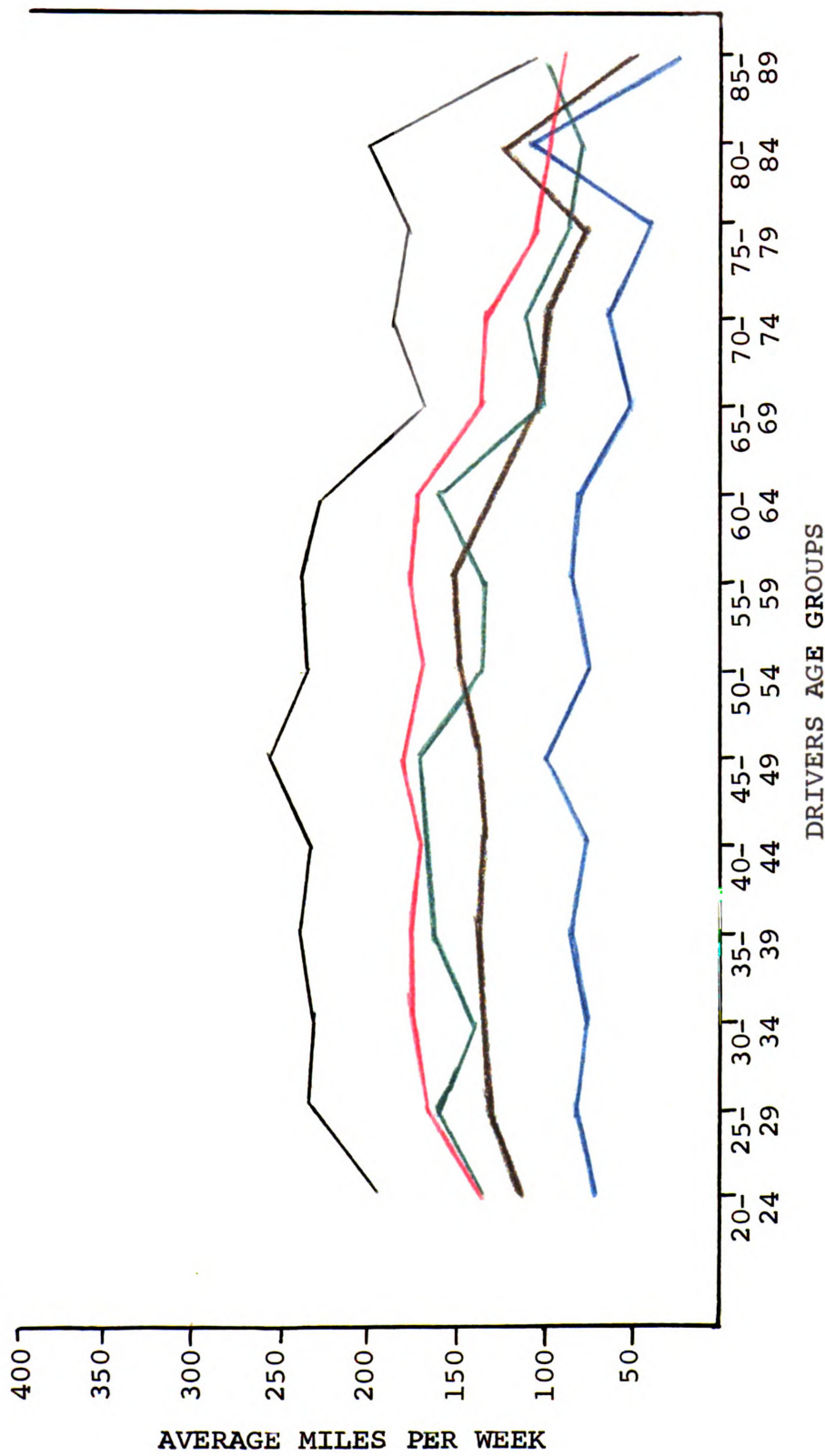


FIGURE 3
MICHIGAN DRIVERS DISTRIBUTION OF AVERAGE WEEKLY MILEAGE INTO
DAYTIME, NIGHTTIME, COUNTRY AND CITY
ACCORDING TO AGE GROUP

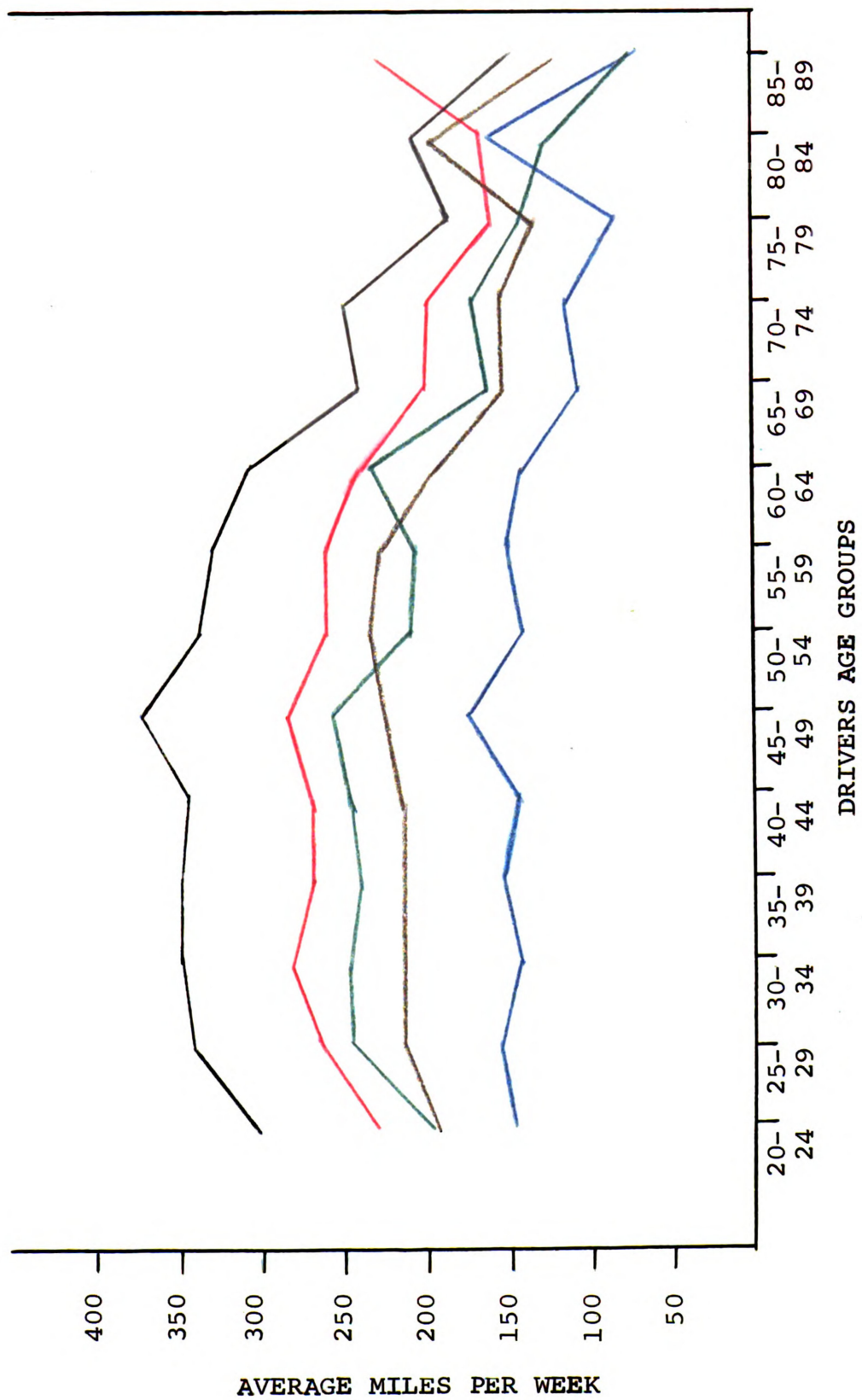
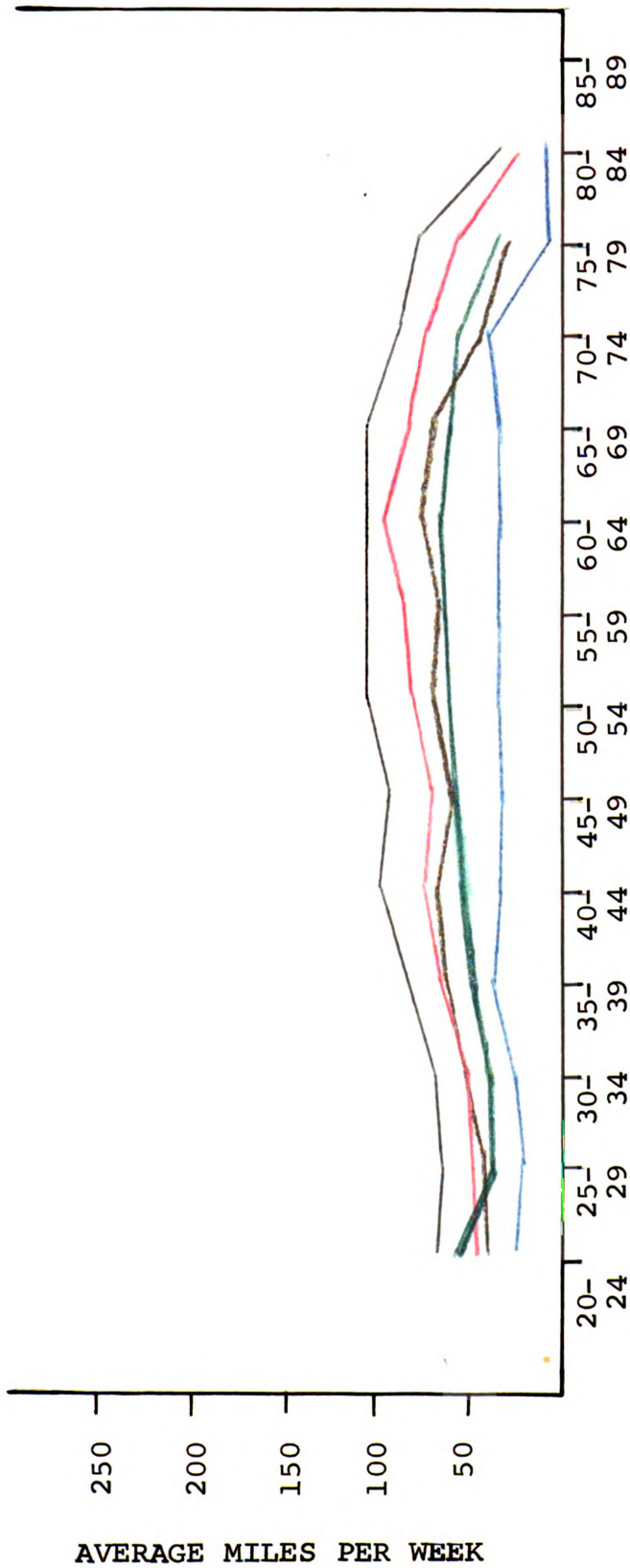


FIGURE 4

MICHIGAN MALE DRIVERS DISTRIBUTION OF AVERAGE WEEKLY MILEAGE INTO DAYTIME, NIGHTTIME, COUNTRY AND CITY ACCORDING TO AGE GROUP



DRIVERS AGE GROUPS

FIGURE 5

MICHIGAN FEMALE DRIVERS DISTRIBUTION OF AVERAGE WEEKLY MILEAGE INTO DAYTIME, NIGHTTIME, COUNTRY AND CITY ACCORDING TO AGE GROUP

IV. ANALYSIS OF GROUPED DATA

In order to compare the same types of data from two sources and distinguish differences between them, a brief and fairly complete numerical description was needed to show the degree of central tendency and dispersion of the data. Two constants afford this type of description, the mean and standard deviation.⁶¹ The mean and standard deviation were selected for use in this study because they are accurate measures of central tendency and dispersion. The formulae used are shown here:⁶²

$$M = \frac{\sum Nf(x)}{N}$$

$$S.D. = \sqrt{\frac{\sum N^2 - \frac{(\sum N)^2}{N}}{N}}$$

Calculations for the mean and standard deviation were completed for each age, up to age 70* for both male and female, for the average weekly mileage, and daytime, nighttime, country and city mileage. The results of these calculations were prepared in tables and are contained in Appendix C.

⁶¹C. R. Richardson, An Introduction to Statistical Analysis (New York: Harcourt, Brace and Company, 1944), p. 142.

⁶²Albert E. Waugh, Elements of Statistical Method (New York: McGraw Hill Book Company, Inc., 1945), p. 145.

* for drivers over age 70 were not computed when $N > 15$.

Two observations can be made from these tables in Appendix C concerning (1) the many age groups that have a consistantly large value for the mean and , and (2) the frequency with which age groups showed a mean and in various exposure areas, that were nearly equal in magnitude. These observations indicate that there was a high degree of dispersion in the data. The characteristics of dispersion can be seen in the histograms prepared to show the exposure characteristics of three ages of drivers.

V. COMPARING EXPOSURE DATA FOR DRIVERS 24, 34, AND 53 YEARS OF AGE

Actual driving experience or exposure has long been presumed to change with age, increasing as drivers become older. By observing the study data, such changes seemed to exist. To show these changes more precisely, exposure for drivers 24, 34, and 53 years of age were selected. These ages tend to be typical of youthful drivers, the young family drivers, and the older drivers, respectively. Each of these ages probably has a more clearly defined and different need from the others.

Profiles of exposure for these age groups were prepared from Tables IX, X, and XI. These profiles are found in a special supplement in the pocket section of this thesis. In this supplement, graphs showing exposure in each area were prepared on separate acetate sheets, color coded to

designate the area of exposure. These materials enable the reader to compare exposure profiles of each age, identified by a distinctive line, and note the similarities and differences among them. For example: these profiles show that more younger drivers drove less than older drivers, as shown by the percentage of younger drivers that drove less than 100 miles per week. A higher percentage of older drivers drove more miles than younger drivers. As shown by the percentage of older drivers that drove more than 100 miles per week.

When using these materials, the reader should note the legend on the grid, over which the transparent graphs are placed. Using the code, to select the age of driver and type of exposure for examination, place the transparent acetate graph over the grid in such a manner that the vertical and horizontal scales match. Additional graphs may be used as overlays to compare other exposure characteristics.

Tables IX, X, and XI follow.

TABLE IX

THE PERCENTAGE OF MICHIGAN DRIVERS 24 YEARS OF AGE
AND THEIR EXPOSURE IN MILES PER WEEK

Exposure in Miles Per Week	Weekly Mileage		Daytime Miles		Nighttime Miles		Country Miles		City Miles	
	N	%	N	%	N	%	N	%	N	%
50	39	30.7	47	37.6	68	72.3	31	45.6	57	43.5
100	23	18.2	30	24.0	14	14.9	8	11.8	37	28.3
150	20	15.7	18	14.4	5	5.3	9	13.2	11	8.4
200	14	11.0	8	6.4	6	6.4	8	11.8	12	9.2
250	5	3.9	4	3.2	1	1.1	2	3.0	4	3.0
300	6	4.7	9	7.2			5	7.3	4	3.0
350	1	.8	1	.8			4	5.9	3	2.3
400	6	4.7	2	1.6			1	1.4	3	2.3
450	2	1.6	2	1.6						
500	11	8.7	4	3.2						
TOTALS	127	100.0	125	100.0	94	100.0	68	100.0	131	100.0

TABLE X

THE PERCENTAGE OF MICHIGAN DRIVERS 34 YEARS OF AGE
AND THEIR EXPOSURE IN MILES PER WEEK

Exposure in Miles Per Week	Weekly Mileage		Daytime Miles		Nighttime Miles		Country Miles		City Miles	
	N	%	N	%	N	%	N	%	N	%
50	53	31.4	58	36.2	98	75.3	47	43.1	79	47.8
100	36	21.1	36	22.5	22	16.9	26	23.9	36	21.8
150	17	10.1	17	10.6	4	3.1	8	7.3	15	9.1
200	28	16.6	18	11.3	4	3.1	8	7.3	14	8.5
250	12	7.1	12	7.5			6	5.5	6	3.7
300	8	4.7	6	3.8			3	2.8	6	3.7
350	3	1.8	1	.6			1	.9	1	.6
400	6	3.6	6	3.8	2	1.6	4	3.7	5	3.0
450	1	.6	1	.6			2	1.8	1	.6
500	5	3.0	5	3.1			4	3.7	2	1.2
TOTALS	169	100.0	160	100.0	130	100.0	109	100.0	165	100.0

TABLE XI

THE PERCENTAGE OF MICHIGAN DRIVERS 53 YEARS OF AGE
AND THEIR EXPOSURE IN MILES PER WEEK

Exposure in Miles Per Week	Weekly Mileage		Daytime Miles		Nighttime Miles		Country Miles		City Miles	
	N	%	N	%	N	%	N	%	N	%
50	10	12.4	16	21.6	42	65.6	19	35.8	21	29.6
100	15	18.5	18	24.3	14	21.8	16	30.2	19	26.8
150	9	11.1	10	13.5	4	6.3	5	9.4	9	12.7
200	18	22.2	13	17.6	4	6.3	4	7.6	11	15.5
250	7	8.6	6	8.1			1	1.9	4	5.6
300	9	11.1	4	5.4			4	7.6	1	1.4
350	5	6.2	4	5.4			1	1.9	2	2.8
400	4	5.0	1	1.4			3	5.6	3	4.2
450	1	1.2	2	2.7					1	1.4
500	3	3.7								
TOTALS	81	100.0	74	100.0	64	100.0	53	100.0	71	100.0

CHAPTER V

SUMMARY AND CONCLUSIONS

I. SUMMARY

This study provides the first descriptive data on driver exposure for Michigan drivers. Average rates of exposure for each area in the daytime, nighttime, country and city are prepared by driver age and sex.

Michigan [male drivers represented 70.35 per cent of the drivers in the study sample and female drivers 29.65 per cent. These drivers reported average weekly mileage which indicated that male drivers drove 88.8 per cent of the total miles and female drivers drove 11.2 per cent.]

The typical Michigan driver averages about 218 miles per week, which if projected to an annual estimate is 11,336 miles. Approximately 67 per cent of this amount was driven during the daytime and 33 per cent at night.

[Male drivers averaged 278 miles per week, or 14,456 miles per year. Of this amount, approximately 68 per cent was driven in the daytime and 32 per cent at night.]

Female drivers averaged 83 miles per week, or 4,316 miles per year. Of this, an estimated 76 per cent was driven in the daytime and 24 per cent at night.]

Comparisons between male and female exposure rates.

Considering the ratios of exposure between male and female drivers, the following observations were made regarding the number of miles reported by those cooperating in this study and shown in the tables and figures in Chapter IV, Collection and Analysis of the Data.

Average weekly mileage. Males drove nearly three times as far as females, until they reached the 60 - 64 year old age group; between 64 - 79 males drove about twice as much and at 80 - 84, the ratio increased to five times the mileage reported by females.

Daytime mileage. Males drove nearly four times the amount females within the 20 - 34 year old age groups reported; then three times as much until they reached the 50 - 54 age group. From 55 - 74 male mileage decreased and female mileage increased, still males showed twice female mileage. Both males and females in the 75 - 84 age groups, drove fewer miles, but males continued to drive twice as much as females.

Nighttime mileage. Males consistently drove several times the amounts of mileage estimated by female drivers,

until age 65 - 69. From 20 - 64 years of age, males drove three times to four times the mileage reported by females. This ratio decreased to two to one, for ages 65 - 69. At age 70 - 74 the two sexes reported equal numbers of miles. After age 75, few miles were reported by females.

Country mileage. As has been indicated in other areas of exposure, males continued to drive between three and four times more than females, until they reached age 50 - 54. Then the ratio dropped to nearly two to one and continued at that ratio until age 80 - 84, when no mileage was reported by females.

City mileage. Males drove nearly three times as many miles as females until they reached 55 - 59, from 60 - 74 they drove twice as much and after age 74, few miles were reported by either sex.

Characteristics of male drivers. The growth and decline in each area of exposure as shown in Figure 4 on page 61 indicates the following patterns of exposure for male drivers, in Michigan.

Male drivers between 20 and 29 show a gradual increase in the number of miles they drive in all areas, except the nighttime. Nighttime driving appears to be at a plateau until drivers reach the 45 - 49 year old age group.

The peak mileage for all areas of exposure is reached at this 45 - 49 year old age group, except city mileage

which peaks at 50 - 54 years of age. A gradual decline in exposure follows the peak until the 60 - 64 age group. Thereafter, the number of miles in all areas drop rapidly until they reach the 75 - 79 age group. Subsequently the weekly, daytime, nighttime and city mileage increase sharply to 80 - 84 age group, then drop in the same manner.

Characteristics of female drivers. In Figure 5 on page 62 the general driving characteristics of female drivers, in Michigan, reflect a more stable and gradual growth in miles driven until they reach age 65 - 69, except for the areas of daytime and city mileage which begin to decrease at age 60 - 64. More pronounced decreases in driving appear and continue at age group 70 - 74.

Comparisons between male and female drivers, under 20 years of age. The following information, represents exposure data from a relatively small group of drivers, because few persons 17 and 18 years of age have a license to renew. Michigan's minimum age for an operator's license is 16, and is issued for a three year period. This accounts for the sudden increase in numbers of drivers at age nineteen.

There are two primary characteristics in these younger drivers.

1. Eighteen year old male drivers doubled the number of miles reported for seventeen year olds. Examining

the various areas of exposure, eighteen year old males drove five and one-third times more daytime mileage; five and three-fourths times more city mileage than seventeen year olds. Nearly equal rates of exposure were found for both the nighttime and country exposure areas for seventeen and eighteen year old drivers.

In every exposure area, the number of miles reported by the nineteen year olds was less than that of the eighteen year olds. However, only the nineteen year old age group contained a sample size that could be considered a representative group.

2. Females between the ages of seventeen and twenty, were few in number and reported mileage in each area that showed the same general characteristics as those of the males.

Large increases in mileage were reported by eighteen year olds; the marked reduction in mileage for nineteen years of age, was similar to that reported by the males, but less extreme.

Table 12, on page 74 presents the relationships between ages and exposure more concisely. However, this data, because of the small sample of drivers in these age groups, should not be interpreted as being representative of all other youthful drivers.

TABLE XII
 MEAN MILEAGE OF DRIVERS SEVENTEEN TO
 NINETEEN YEARS OF AGE

Age	Weekly Mileage	Daytime Mileage	Nighttime Mileage	Country Mileage	City Mileage
<u>MALE</u>					
17	108	37	108	110	35
18	243	191	119	132	202
19	117	104	85	117	100
<u>FEMALE</u>					
17	26	19	7	5	25
18	78	43	53	50	61
19	59	37	27	44	40

II. CONCLUSIONS

This study based upon 6358 questionnaires completed by Michigan drivers renewing their driver licenses, was conducted to describe rates of exposure for drivers of each age, for an average week, during the daytime, nighttime, in the country and city.

Several conclusions have been determined as a result of this study.

1. Drivers will complete questionnaires requiring detailed information about their driving activities during the daytime, nighttime, and in the country and city.
2. Michigan drivers have approximately the same level of exposure from age twenty-five through sixty-four.
3. Daytime mileage is usually double nighttime mileage.
4. Female drivers, drive fewer miles, but drive more consistently in all areas of exposure for a longer period of time than males do.
5. Male drivers, drive from three to four times as much as female drivers, generally until the time when most employers recognize a retirement age of approximately sixty-five years.
6. Exposure data, as determined in this study does not follow a normal distribution curve.
7. The exposure characteristics within all age groups of Michigan drivers is widely dispersed.

III. NEED FOR FURTHER RESEARCH

The findings have shown the general characteristics of all Michigan drivers, and the exposure trends of male and female drivers. Two recommendations are suggested for implementing these findings:

1. All drivers records and estimates of exposure verified by comparing them to the exposure tables presented in this study, and
2. all traffic accident and violation records for drivers be evaluated by comparing them to exposure rates for their respective age groups.

Several areas deserve consideration for future study. Certain factors, such as the influence which marital status, education, residence, occupation and socio-economic status may have upon when, where, and how much male or female drivers drive, were considered beyond the scope of this study.

Further study is needed in order to more accurately establish the amount of exposure for drivers under nineteen and areas of exposure in which they drive.

Some of the characteristics of exposure for older drivers also warrant additional study. A study that would provide reasons for fluctuations in exposure during the later years of life.

The present study indicates that there are some relationships between age and exposure. These relationships are not absolute, but provide an avenue of exploration and a basis for comparison and improving of analysis of drivers' records, accident statistics, and evaluation of drivers who have completed driver education programs.

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APPENDIX A

QUESTIONNAIRE

HOW MANY MILES DO YOU DRIVE!

To the best of our knowledge, no one has ever ASKED our drivers how far they travel by car, and the Michigan Department of State, as in other states, would like to know. To get the facts, we are asking your cooperation by answering the questions below.

We are requesting the information of persons who are renewing their driver licenses and, when the facts are assembled, we will have some very interesting figures as to how much the average Michigan driver travels in a week, during the day, at night, in the country, and in the city.

We sincerely thank you for your cooperation.

Lee C. Richardson, Director
Driver & Vehicle Services Division
Michigan Department of State

QUESTIONNAIRE

Name _____

Date of birth _____	Male	Married
	Female	Single

Occupation _____

How many miles do you think you drive:

During the average week _____ miles

Of the above total, how much is:

During the day _____ miles

At night (when headlights are
needed) _____ miles

How much of this driving is:

In the country _____ miles

In the city (within the city
limits) _____ miles

Please leave this with the examiner who will forward it to Lansing.

APPENDIX B

**LETTER TO SELECTED DRIVER LICENSE
EXAMINING STATIONS**

May 14, 1959

To the Principals of 26 Selected Driver License Examining Stations:

As an important step in a continuing study of the habits of motor vehicle drivers which is being made in Michigan and in other large states, we are requesting your assistance.

It is important that we know, from the drivers' own statements, just how much they drive each week, during the day, at night, in the rural areas, and in cities, and we know of no way we can better obtain the figures than at the examining station at time of renewal of their licenses.

Therefore, it will be very much appreciated if you will give each applicant for renewal a questionnaire and ask him if he will be good enough to fill out same and return it to you for forwarding to me. Please impress upon the licensee that it is to be on a voluntary basis only.

Yours very truly,

Lee C. Richardson
Director - Driver & Vehicle Services

LCR:dm

APPENDIX C

TABLES OF MEANS AND STANDARD DEVIATION MILEAGE FOR MICHIGAN DRIVERS

TABLE XIII

A TABLE OF MEAN AND STANDARD DEVIATION MILEAGE FOR ALL MICHIGAN DRIVERS

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Miles Driven During Nighttime			Miles Driven In Country			City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
17	7	61	60.16	7	27	18.10	6	41	53.30	3	75	59.30	7	29	18.08
18	18	259	190.91	14	159	195.15	13	108	74.51	10	124	80.44	14	172	191.97
19	200	139	142.89	184	82	87.07	167	68	90.88	120	98	144.92	189	81	78.65
20	97	145	178.56	93	101	158.20	78	50	50.44	64	85	123.54	91	83	85.26
21	90	167	233.77	77	120	200.81	69	67	71.45	49	107	167.94	80	102	123.04
22	117	235	283.57	109	164	188.84	90	87	102.68	70	188	253.04	108	129	168.43
23	198	183	180.52	190	128	132.13	158	66	82.29	133	99	101.37	187	114	143.28
24	137	196	212.95	128	140	156.19	101	80	97.62	71	144	183.74	125	112	125.42
25	121	250	260.12	113	207	234.84	90	75	85.66	73	167	221.22	109	152	180.11
26	152	265	248.10	140	188	226.47	115	107	203.66	90	232	302.97	138	133	146.84
27	163	200	232.82	158	144	185.19	133	71	88.13	111	119	169.64	154	121	160.29
28	146	202	236.53	137	141	143.06	114	79	168.54	89	140	183.19	136	106	127.76
29	151	220	229.27	145	165	189.05	121	75	92.96	89	139	189.31	149	135	140.54
30	160	217	254.44	147	162	203.76	124	70	99.42	98	160	210.28	148	114	132.07
31	177	254	314.76	157	192	267.13	137	95	193.18	109	170	295.94	161	157	215.35
32	202	226	281.94	187	166	201.98	162	80	132.15	119	175	271.64	188	123	121.71
33	200	219	264.79	189	168	211.19	153	68	115.77	112	146	223.61	186	138	187.70
34	186	209	247.30	175	168	184.43	141	59	77.41	115	157	227.00	165	110	126.68

TABLE XIII.---Continued

Driver's Age	Weekly Mileage			Miles Driven During Daytime						Miles Driven During Nighttime						Miles Driven In Country						Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD			
35	165	256	318.35	153	180	216.29	134	83	124.22	98	158	188.47	152	156	156.64									
36	166	233	243.08	147	185	189.53	117	78	150.01	102	157	236.15	149	140	136.34									
37	175	191	188.31	162	147	142.13	134	65	87.14	103	142	149.55	148	112	130.56									
38	163	247	329.13	145	174	207.77	125	102	190.86	95	175	278.77	150	131	130.80									
39	195	243	273.69	187	174	194.59	152	87	141.67	125	166	190.76	183	137	150.29									
40	156	204	198.86	140	158	162.75	118	60	76.87	94	146	147.83	142	116	132.74									
41	167	226	236.97	156	156	154.28	130	72	88.14	101	136	167.53	146	137	140.94									
42	150	232	240.78	135	175	182.87	113	75	98.11	117	158	222.65	131	134	126.50									
43	153	265	313.08	141	182	193.81	119	102	174.89	98	201	322.76	138	141	138.75									
44	144	201	190.26	133	161	183.05	117	53	51.45	78	143	157.76	131	121	112.12									
45	127	233	299.72	109	159	172.84	81	157	152.02	72	159	258.34	114	118	138.03									
46	99	274	331.86	94	179	190.88	85	105	182.12	68	186	348.31	92	148	136.94									
47	121	217	206.83	114	172	181.37	86	56	62.69	77	145	178.53	109	128	133.69									
48	123	276	329.82	117	181	204.68	91	96	156.16	80	173	250.81	108	125	127.30									
49	88	241	282.60	84	204	232.34	56	71	94.62	45	185	248.11	75	156	178.86									
50	112	239	371.21	102	151	145.19	80	58	59.18	69	118	144.16	105	157	357.09									
51	108	212	269.19	93	169	250.08	62	63	73.50	60	120	197.48	87	139	209.13									
52	101	233	293.00	88	173	222.77	67	102	211.99	53	157	276.72	89	157	171.86									
53	88	251	219.63	80	191	176.81	66	63	47.96	54	146	153.76	75	147	131.84									

TABLE XIII.--Continued

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Miles Driven During Nighttime			Miles Driven In Country			Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
54	98	211	252.78	86	149	143.19	72	78	183.18	60	131	251.73	86	129	122.82
55	118	250	270.05	109	190	196.30	97	87	138.24	79	128	135.48	110	164	247.79
56	91	248	243.47	79	179	164.57	68	85	135.75	60	137	216.12	80	148	160.73
57	83	176	130.24	73	130	107.44	58	52	46.02	55	83	65.17	71	117	107.31
58	62	242	219.61	59	189	165.79	47	91	89.22	39	143	219.29	55	156	150.94
59	80	241	246.30	67	177	186.15	52	104	156.39	45	176	228.06	65	149	151.17
60	64	282	287.14	56	191	186.86	43	91	135.66	41	214	282.70	57	144	138.82
61	85	242	247.32	78	183	190.61	62	93	173.83	52	173	223.61	77	139	146.81
62	46	168	108.96	41	137	129.76	29	50	43.75	26	126	118.52	36	104	80.08
63	62	213	225.34	58	169	161.32	42	82	189.53	42	157	203.44	55	124	96.86
64	57	174	173.45	53	137	156.77	41	53	62.64	39	96	98.93	49	110	151.02
65	44	216	159.50	42	163	125.27	31	65	51.98	31	133	126.54	36	120	107.74
66	42	150	98.70	42	119	79.13	32	40	36.75	28	68	46.68	41	106	84.27
67	50	161	108.16	46	132	95.40	32	43	37.03	30	99	79.33	44	107	46.82
68	41	133	76.42	39	108	69.47	29	33	22.52	32	91	61.69	37	62	51.00
69	37	176	169.42	34	128	91.94	27	67	100.15	26	107	88.28	33	108	122.74
70	27	222	186.47	24	144	165.12	16	66	63.53	14	130	176.91	25	116	112.16
71	35	149	126.00	30	122	100.00	19	84	82.00	23	93	59.00	30	90	102.00
72	19	191	150.00	17	139	111.00	12	46	31.00	14	96	69.00	16	95	107.00

TABLE XIII.--Continued

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Miles Driven During Nighttime			Miles Driven In Country			Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
73	15	205	142.00	13	138	97.00	11	38	35.00	9	98	84.00	12	136	131.00
74	11	140	114.00	11	115	93.00	9	29	28.00	9	130	116.00	10	46	33.00
75	15	110	84.00	13	100	85.00	8	22	16.00	9	68	72.00	11	74	91.00
76	12	100		10	86		4	17		6	30		8	60	
77	13	204		12	166		10	65		8	170		11	120	
78	8	82		7	68		4	20		4	77		6	32	
79	3	95		3	61		1	100		2	52		3	60	
80	1	50		1	40		1	10					1	50	
81	5	228		5	129		2	250		2	100		5	189	
82	3	72		2	65		2	52		2	65		2	52	
83	2	150		2	150					1	100		1	100	
84	2	25		2	20		1	10		1	10		2	20	
85	1	100		1	75		1	25		1	90		1	100	
86	1	100		1	100								1	100	
87	2	90		2	85		1	10		1	100		1	100	

TABLE XIV

A TABLE OF MEAN AND STANDARD DEVIATION MILEAGE FOR MALE DRIVERS

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Nighttime			Country			Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
17	3	108	65.61	3	36	18.85	2	107	42.50	2	110	40.00	3	335	21.21
18	15	304	182.92	11	191	208.22	11	118	74.01	9	131	81.65	11	202	204.00
19	135	177	153.82	124	104	95.58	117	85	101.35	89	117	161.83	128	100	85.47
20	51	219	214.67	48	160	200.22	43	70	56.07	37	110	153.34	47	124	98.09
21	56	227	271.69	46	167	244.93	41	96	71.41	31	145	196.41	50	133	140.43
22	85	298	305.46	80	205	202.33	65	111	110.01	54	223	274.96	79	164	184.26
23	130	242	191.73	125	169	143.29	107	88	91.52	100	118	106.46	121	151	162.58
24	96	252	226.65	91	176	167.08	71	103	106.40	58	162	193.30	86	142	137.25
25	92	313	266.78	87	258	244.73	72	91	56.36	57	206	236.24	84	189	188.19
26	106	350	248.07	97	249	246.69	88	135	225.69	68	294	323.71	98	168	159.89
27	120	147	253.05	117	177	203.85	104	83	94.68	87	140	185.20	114	148	177.48
28	102	265	255.78	96	181	150.85	83	101	192.55	70	169	195.43	96	142	130.33
29	105	289	241.71	103	212	204.24	89	95	100.15	68	172	205.29	103	174	148.99
30	112	282	276.71	101	214	225.90	90	88	110.41	75	197	226.84	103	143	145.73
31	117	348	347.88	109	248	301.50	100	120	220.92	86	205	323.38	106	207	245.46
32	141	282	309.70	129	210	223.32	117	94	146.42	88	215	299.44	130	148	127.59
33	141	291	285.53	130	227	230.48	111	88	130.36	92	173	238.27	132	177	208.92
34	126	285	268.43	117	232	195.01	104	74	84.46	91	190	244.46	108	149	140.33

TABLE XIV.--Continued

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Miles Driven During Nighttime			Country			Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
35	127	308	343.57	119	214	232.07	104	98	136.21	81	182	198.85	120	179	164.23
36	124	284	258.46	109	223	200.43	91	92	165.94	80	184	258.27	113	162	143.40
37	114	252	204.63	104	194	155.45	94	82	97.36	78	167	162.09	95	148	149.95
38	108	324	374.56	99	223	229.36	87	131	220.29	75	205	303.80	102	160	138.20
39	137	313	296.14	131	223	211.45	113	107	158.09	96	208	199.43	127	169	163.96
40	102	267	213.71	89	209	176.51	81	76	86.98	68	180	157.28	90	150	151.94
41	113	281	254.57	106	190	158.84	98	84	96.11	78	158	182.47	101	160	142.51
42	96	301	259.20	85	228	199.81	74	95	108.53	61	213	251.34	84	169	135.50
43	104	351	346.15	96	238	208.96	85	129	198.49	74	252	355.50	93	176	150.60
44	91	263	206.60	85	211	207.97	69	70	52.82	55	181	171.99	85	154	121.54
45	89	300	334.61	76	201	189.40	56	218	146.51	54	198	286.04	78	148	156.05
46	69	352	366.24	64	231	205.98	62	131	206.19	51	231	391.21	64	182	141.87
47	86	274	216.98	79	223	196.07	61	69	66.14	57	181	193.53	75	162	146.30
48	88	343	346.53	86	217	203.50	67	114	168.58	65	196	266.89	77	157	136.84
49	49	353	330.88	45	303	268.58	31	102	114.09	26	269	296.89	41	229	210.35
50	77	311	427.03	70	191	157.59	57	70	65.15	50	146	159.07	72	202	422.42
51	69	277	313.36	57	231	300.16	43	77	82.35	39	152	236.31	55	183	248.55
52	71	285	329.84	61	212	253.85	48	130	244.04	40	189	309.11	62	195	191.12
53	67	291	234.61	61	221	188.65	51	70	49.90	45	160	163.88	59	160	142.40

TABLE XIV.---Continued

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Miles Driven During Nighttime			Miles Driven In Country			Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
54	66	256	289.86	56	182	160.04	48	100	219.31	44	153	287.93	58	153	134.85
55	78	321	302.66	71	246	218.71	59	111	160.86	50	161	155.95	71	220	290.62
56	70	293	260.08	61	209	174.06	53	102	149.02	47	160	238.14	61	175	174.33
57	64	198	132.63	56	144	108.29	48	56	48.72	42	88	68.88	56	134	112.38
58	51	280	223.23	48	221	167.39	41	99	91.62	32	167	234.74	45	179	155.67
59	61	281	262.39	50	200	199.97	43	122	166.72	37	198	244.82	53	158	154.10
60	52	313	299.92	48	202	192.19	37	100	143.50	36	228	293.80	48	157	146.54
61	64	287	262.34	61	207	200.86	50	107	190.09	41	200	237.52	59	162	158.19
62	36	199	100.10	31	164	135.95	26	54	44.36	22	141	121.65	31	110	83.51
63	50	251	228.32	47	188	171.65	35	91	206.12	34	176	220.13	43	143	97.69
64	42	189	140.71	38	144	107.27	35	57	67.44	34	112	108.85	43	107	82.46
65	33	246	149.16	31	184	109.53	25	71	54.22	23	153	121.05	26	138	110.81
66	30	160	100.37	30	126	82.67	24	43	38.79	20	74	45.55	30	111	89.71
67	44	175	107.57	41	142	96.14	32	43	37.03	27	106	80.39	40	115	42.59
68	32	148	75.94	30	121	72.35	25	36	23.18	26	97	63.52	31	64	55.24
69	31	192	176.84	29	141	91.41	23	71	106.66	22	115	91.90	29	116	127.25
70	24	241	189.02	21	156	173.06	15	67	65.47	12	130	176.91	22	125	116.42
71	30	160	130	25	130	104	18	53	85	19	104	56	25	102	108
72	15	222	153	13	163	116	11	46	33	12	106	65	12	109	118

TABLE XIV.--Continued

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Nighttime			Country			Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
73	14	210		12	137		10	47		8	98		11	139	
74	11	140		11	115		9	29		9	131		10	46	
75	13	161		12	104		7	23		8	75		10	77	
76	11	173		9	78		4	17		5	31		7	60	
77	12	200		11	157		9	63		7	156		10	119	
78	8	82		7	67		4	20		4	77		6	32	
79	2	132		2	87		1	50		1	50		2	87	
80															
81	4	283		4	158		2	250		2	90		4	236	
82	3	78		2	65		2	52		2	65		2	52	
83	2	150		2	150					1	100		1	200	
84	2	25		2	20		1	10		1	10		1	10	
85	1	100		1	75		1	25		1	90		1	10	
86	1	100		1	100								1	100	
87	2	90		2	85		1	5		1	50		2	40	

TABLE XV

A TABLE OF MEAN AND STANDARD DEVIATION MILEAGE FOR FEMALE DRIVERS

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Miles Driven During Nighttime			Country			Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
17	4	26	14.74	4	17	16.18	4	7	2.77	1	5		4	25	15.41
18	3	78	86.25	3	43	40.28	2	53	47.50	1	5		3	62	62.76
19	65	59	65.49	60	37	36.10	50	27	35.01	31	44	46.26	61	40	37.62
20	46	63	56.77	45	38	35.39	35	26	27.69	27	50	43.41	44	39	31.65
21	34	69	86.15	31	48	51.10	28	26	46.91	18	40	58.14	30	50	55.82
22	32	66	85.26	29	51	61.34	25	24	31.97	16	71	83.64	29	34	28.80
23	68	70	72.40	65	50	47.59	51	22	21.29	33	42	52.04	66	44	48.12
24	41	65	81.79	37	51	68.81	30	24	29.66	13	67	100.49	39	45	50.09
25	29	50	61.77	26	37	41.89	18	13	11.90	16	31	23.35	25	28	48.45
26	46	70	117.17	43	50	49.14	27	18	17.88	22	40	52.51	40	45	40.45
27	43	69	58.19	41	49	37.84	29	24	29.36	24	43	35.61	40	43	30.08
28	44	57	62.58	41	47	50.48	31	20	20.70	19	31	27.59	40	47	60.12
29	46	42	62.50	42	50	49.91	32	22	28.85	21	33	24.06	46	47	60.12
30	48	65	64.43	46	48	39.35	34	22	16.33	23	39	38.74	45	48	49.12
31	60	72	77.61	48	64	57.90	37	27	28.63	23	36	35.85	55	58	70.79
32	61	98	133.76	58	67	80.39	45	41	73.70	31	63	108.36	58	67	83.88
33	59	49	40.77	59	37	31.18	42	17	15.98	20	22	12.51	54	43	43.84
34	60	49	20.96	58	39	30.87	37	16	16.91	24	33	27.75	57	36	26.91

TABLE XV.--Continued

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Miles Driven During Nighttime			Miles Driven In Country			Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
35	38	81	75.25	34	60	57.59	30	27	26.31	17	47	35.77	32	67	73.41
36	42	91	93.68	38	76	88.14	26	30	43.33	22	57	56.65	36	70	77.13
37	61	78	60.54	58	64	47.93	45	24	27.52	31	63	43.82	58	48	28.38
38	55	94	105.88	46	67	78.05	38	34	46.39	20	62	83.01	48	71	86.45
39	58	76	72.54	56	59	53.58	39	27	32.02	29	28	16.96	56	64	72.42
40	54	83	76.32	51	68	76.03	37	24	20.14	26	56	56.25	52	56	50.54
41	54	112	137.23	50	85	115.46	32	34	37.09	23	61	54.88	45	86	122.89
42	54	110	135.29	50	85	98.10	39	36	56.57	33	57	92.42	47	72	75.42
43	49	87	71.65	45	62	59.18	34	35	46.62	24	43	40.21	45	68	65.02
44	53	95	84.78	48	71	60.45	48	29	38.20	23	55	49.97	46	58	50.75
45	38	77	56.28	33	61	49.38	25	22	14.90	18	44	60.93	36	54	38.54
46	30	94	92.22	30	67	71.91	23	36	37.79	17	53	49.79	28	70	82.87
47	35	77	69.22	35	59	42.66	25	25	38.96	20	42	40.21	34	55	47.08
48	35	107	201.39	31	80	171.68	24	43	96.92	15	74	120.69	31	46	35.18
49	39	101	85.47	36	81	62.57	25	32	33.87	19	69	44.93	34	68	55.48
50	35	81	57.03	32	65	44.34	23	29	20.77	19	43	34.34	33	57	44.33
51	39	96	77.48	36	72	58.55	19	32	29.46	21	66	63.45	32	63	59.76
52	30	110	100.19	27	84	69.54	19	33	36.17	13	57	69.98	27	71	53.50
53	21	126	76.49	19	95	71.85	15	40	30.25	9	77	43.34	16	98	61.00

TABLE XV.--Continued

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Miles Driven During Nighttime			Miles Driven In Country			Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
54	32	118	97.71	30	88	72.54	24	32	37.55	16	71	68.72	28	80	70.63
55	40	111	86.36	38	87	69.00	28	38	36.09	29	71	54.60	39	61	53.53
56	21	99	49.82	18	76	50.04	15	24	17.24	13	51	35.00	20	66	53.90
57	19	104	89.63	17	81	88.35	10	30	17.89	13	67	47.89	15	54	47.38
58	11	69	65.46	11	51	42.00	6	32	33.39	7	32	30.92	10	54	58.73
59	19	113	113.23	17	109	115.66	9	21	11.97	8	78	59.47	12	111	130.69
60	12	147	165.38	8	121	130.73	6	33	34.00	5	109	146.03	9	74	41.48
61	21	103	110.76	17	96	111.66	12	32	31.85	11	70	113.25	18	63	50.70
62	10	59	55.50	10	54	50.29	3	15	7.07	4	45	46.50	5	63	32.03
63	12	56	120.49	11	91	61.19	7	36	23.21	8	73	50.93	12	58	56.14
64	15	135	238.23	15	118	239.11	7	34	21.42	11	56	47.97	12	118	268.47
65	11	127	156.02	11	105	146.29	6	41	36.28	8	77	125.05	10	74	82.94
66	12	124	89.32	12	102	66.50	8	33	28.56	8	54	46.67	11	91	65.06
67	6	60	30.96	5	52	27.68				3	38	26.25	4	36	19.80
68	9	82	52.66	9	66	47.17	4	19	8.20	6	67	45.70	6	52	12.50
69	6	92	83.10	5	51	44.86	4	43	48.32	4	63	45.62	4	44	47.48
70	3	83	23.57	3	58	58.93	1	50		2	50	25.00	3	50	20.41
71	5	79		5	74		1	25		4	61		5	30	
72	4	68		4	60		1	35		2	28		4	54	

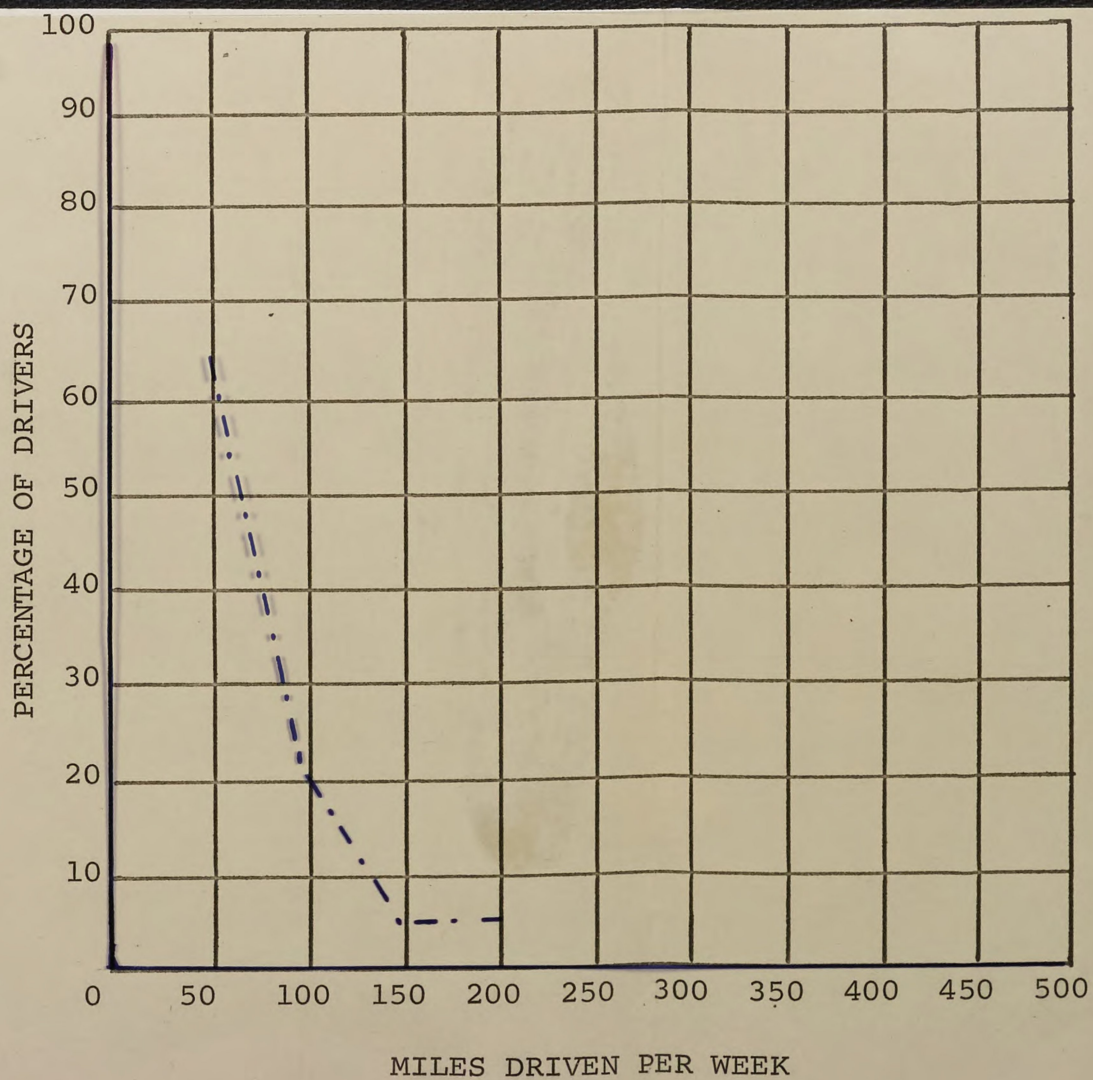
TABLE XV.---Continued

Driver's Age	Weekly Mileage			Miles Driven During Daytime			Miles Driven During Nighttime			Miles Driven In Country			Miles Driven In City		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
73	1	200		1	150		1	50		1	100		1	100	
74	0														
75	2	100		1	45		1	5		1	10		1	40	
76	1	75		1	75					1	25		1	50	
77	1	100		1	90		1	10		1	100				
78	0														
79	1	10		1	10					1	5		1	5	
80	1	50		1	40		1	10					1	50	
81	1	10		1	10								1	10	

Pocket has: 15 overlays
1 graph

16





LEGEND

_____ Age 24

_____ Age 34

• — • — • Age 53

COLOR CODE FOR TYPES OF EXPOSURE

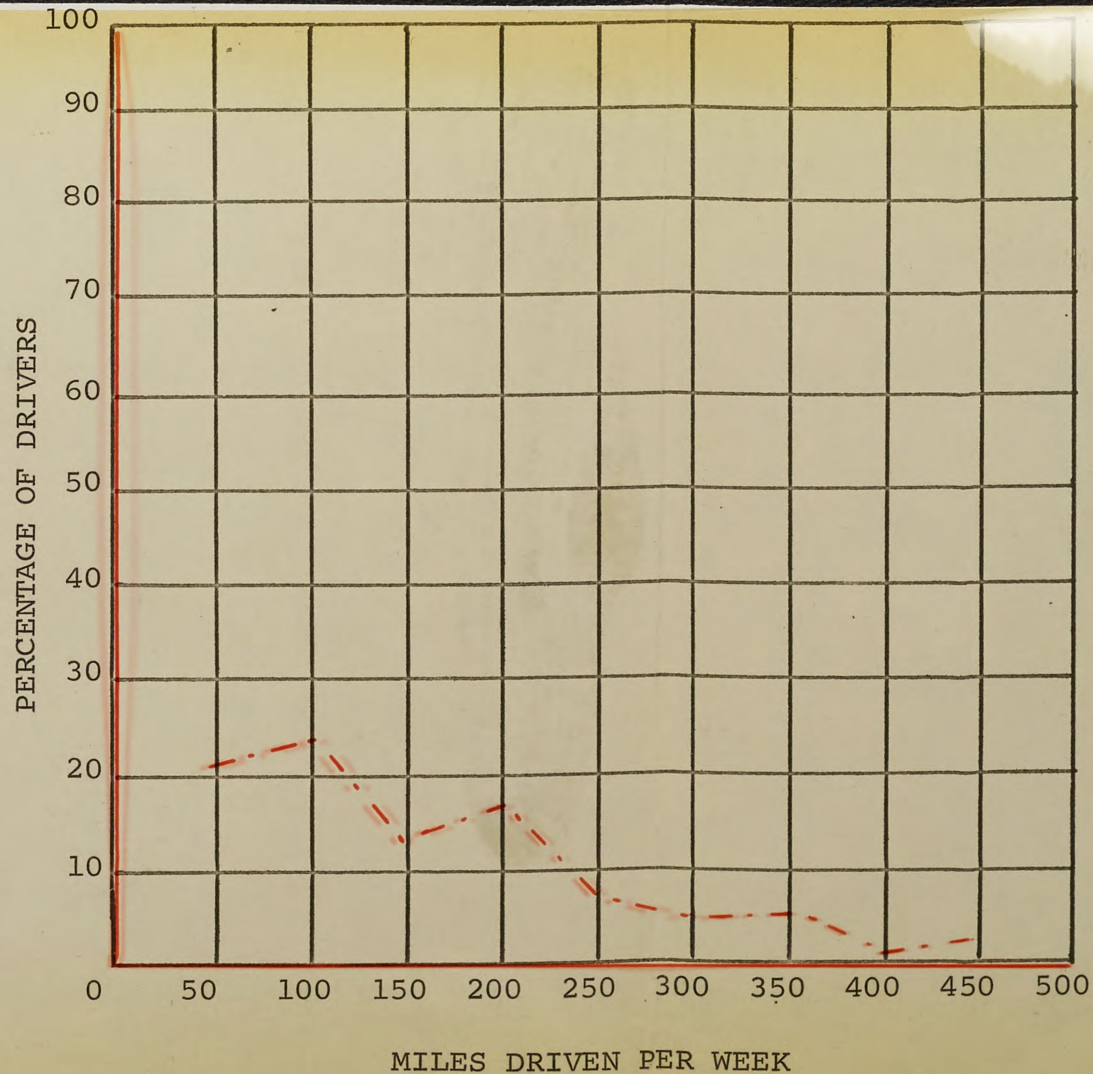
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Daytime - Red

Nighttime - Blue

Country - Green

City - Brown



LEGEND

— Age 24

- - - Age 34

. . . Age 53

COLOR CODE FOR TYPES OF EXPOSURE

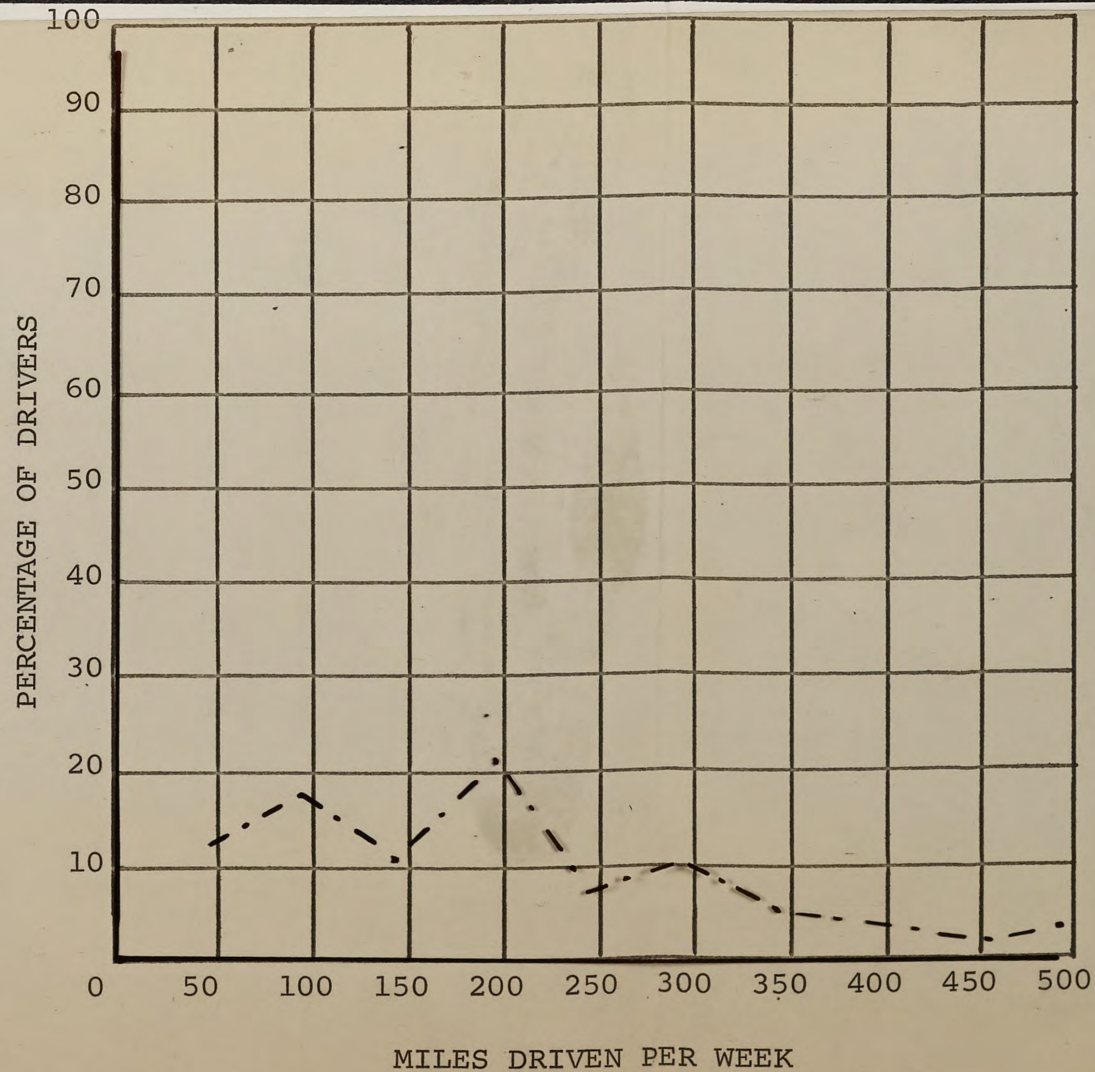
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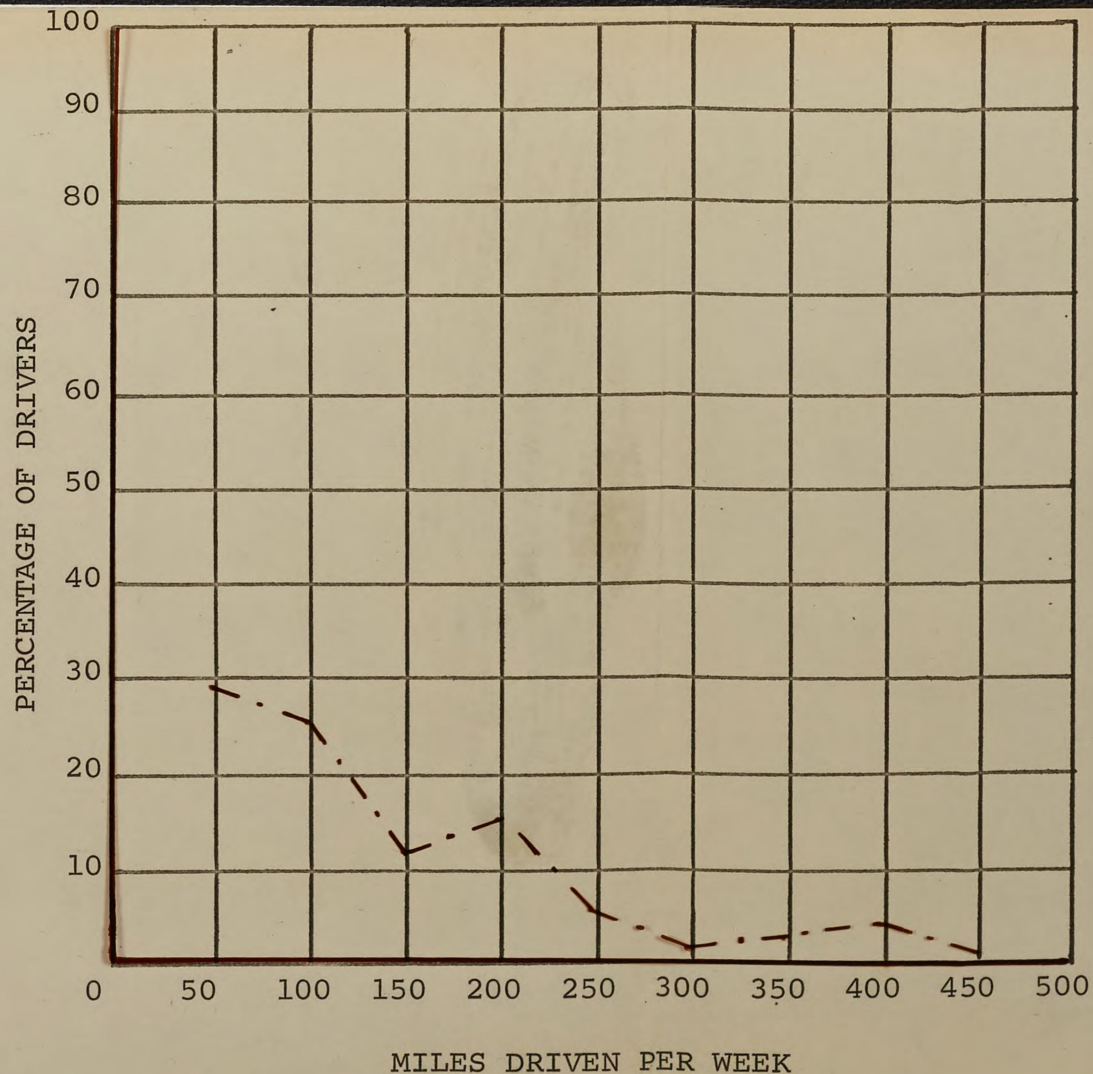


LEGEND

— Age 24
- - - Age 34
· - · - · Age 53

COLOR CODE FOR
TYPES OF EXPOSURE

Total - Black
Daytime - Red
Nighttime - Blue
Country - Green
City - Brown



LEGEND

— Age 24

- - - Age 34

· - · - · Age 53

COLOR CODE FOR TYPES OF EXPOSURE

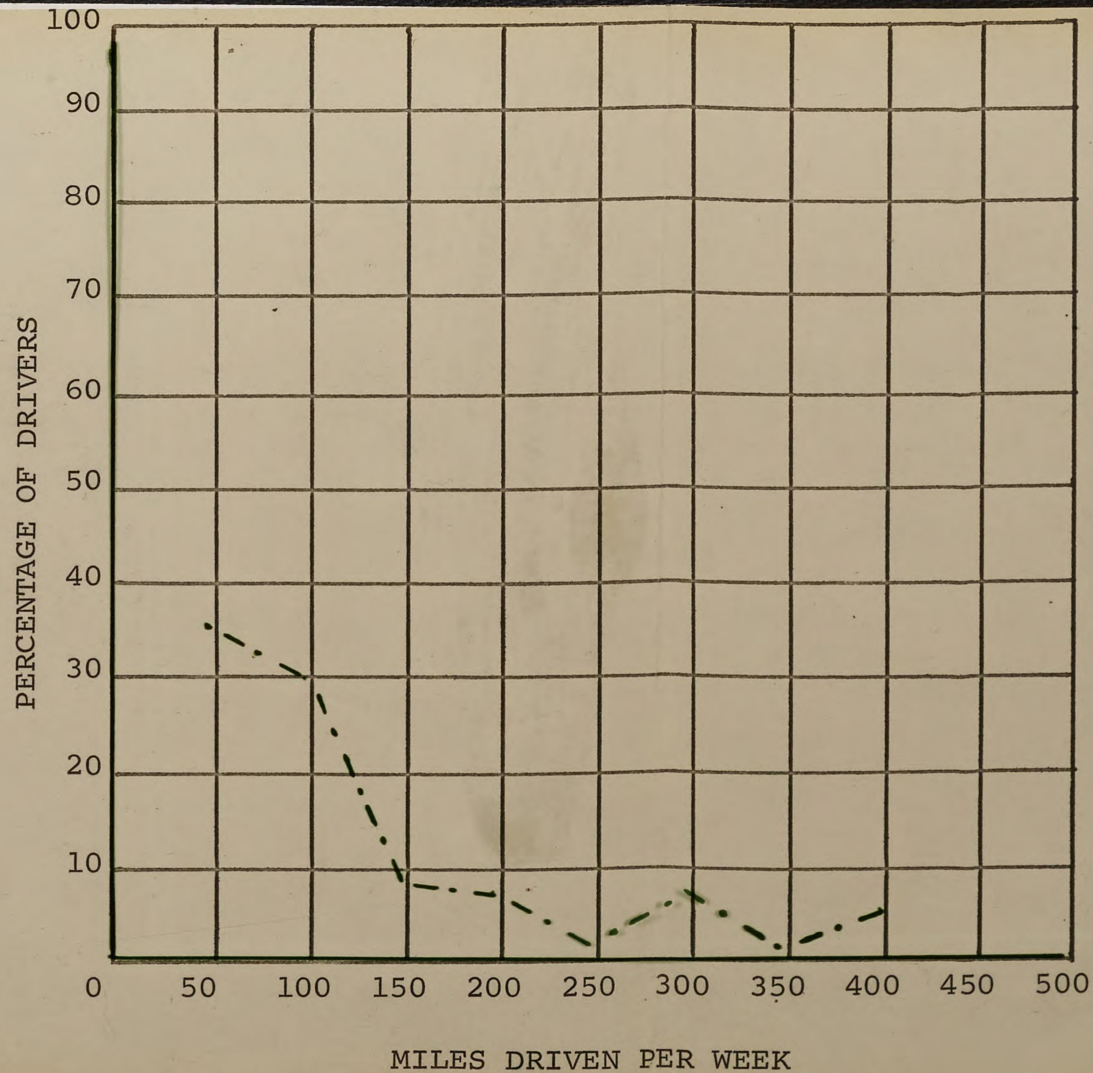
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Daytime - Red

Nighttime - Blue

Country - Green

City - Brown



LEGEND

— Age 24

- - - Age 34

. - . Age 53

COLOR CODE FOR TYPES OF EXPOSURE

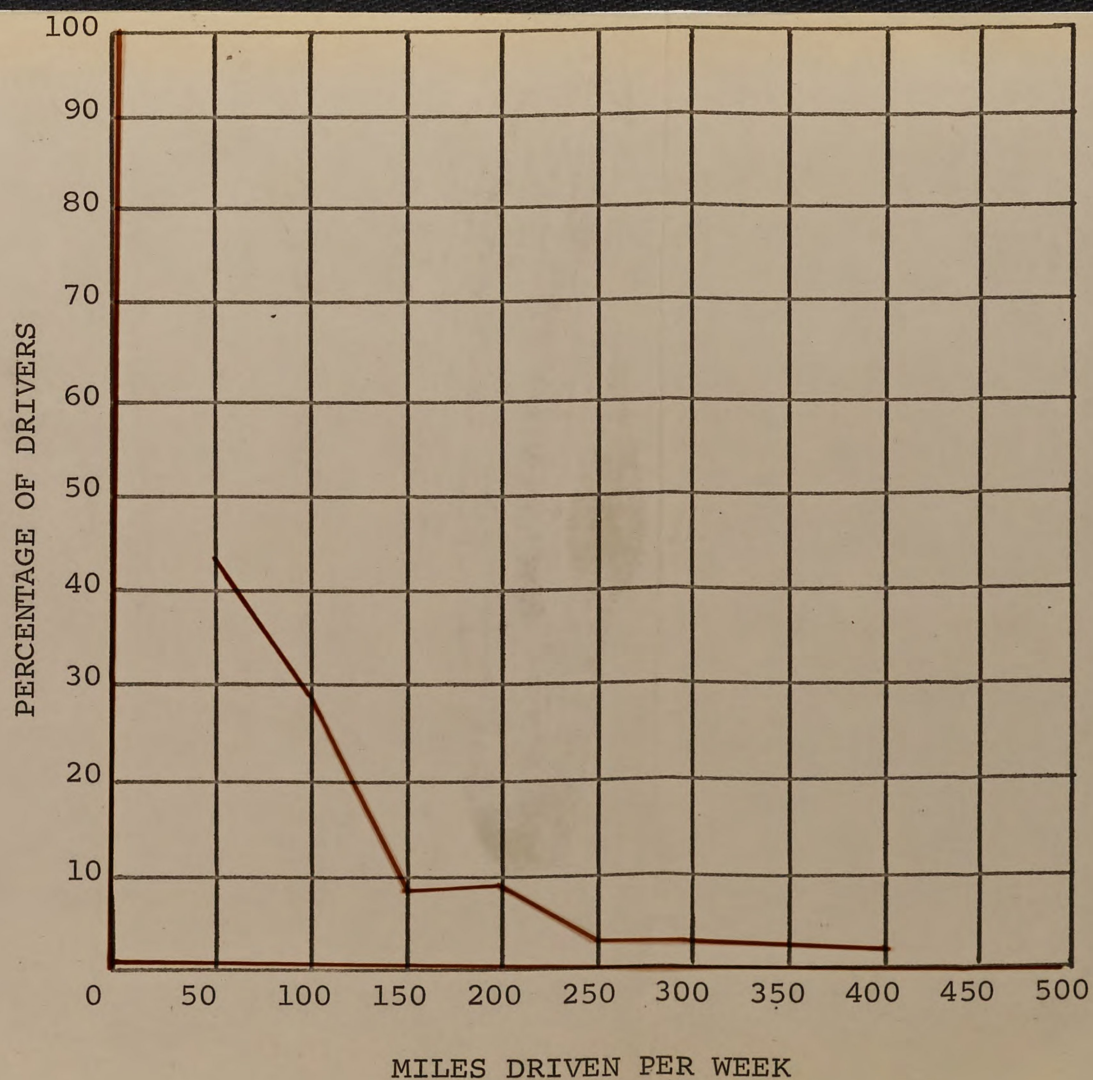
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Daytime - Red

Nighttime - Blue

Country - Green

City - Brown



LEGEND

— Age 24

— Age 34

· — · Age 53

COLOR CODE FOR TYPES OF EXPOSURE

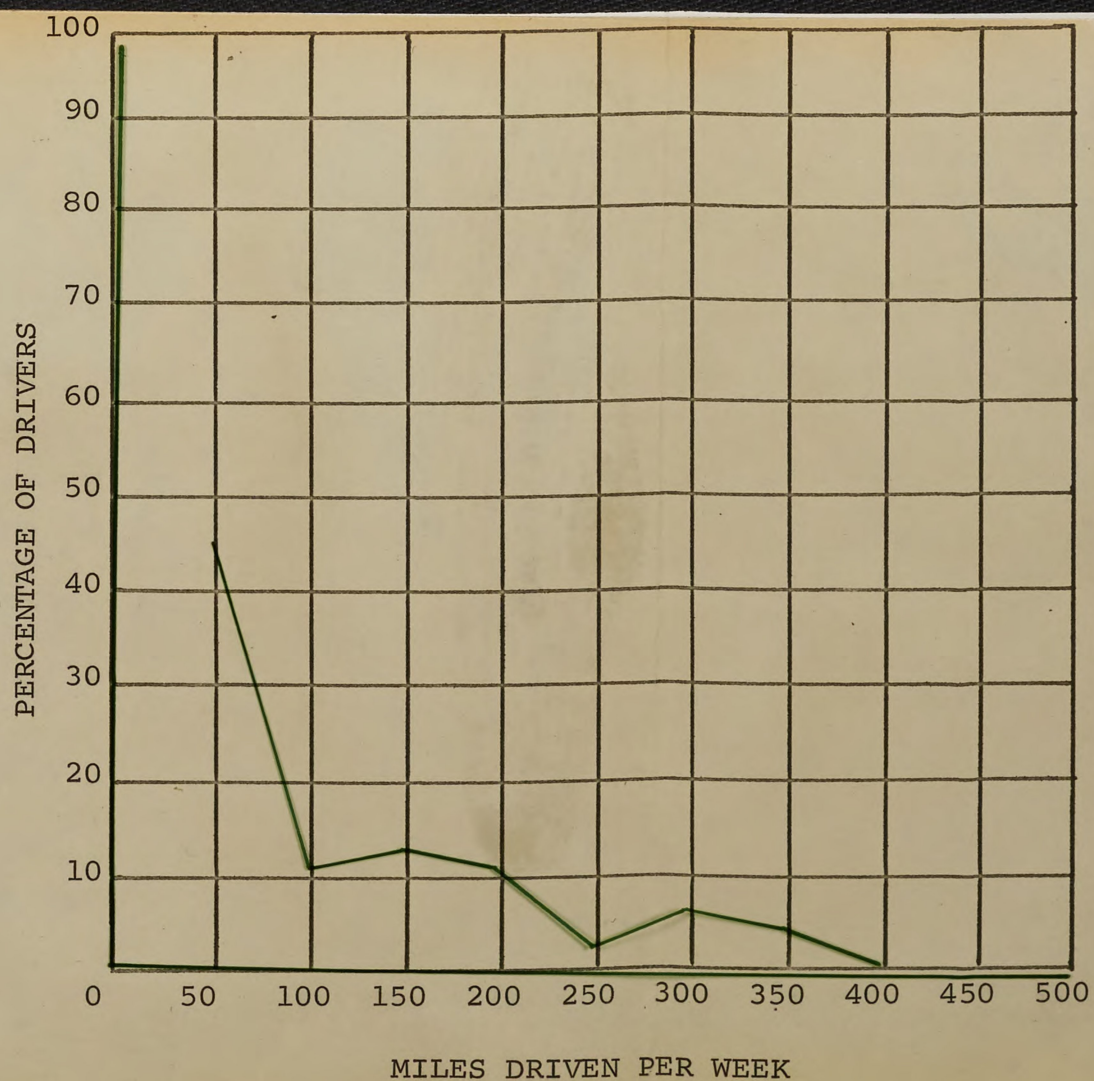
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Country - Green

City - Brown

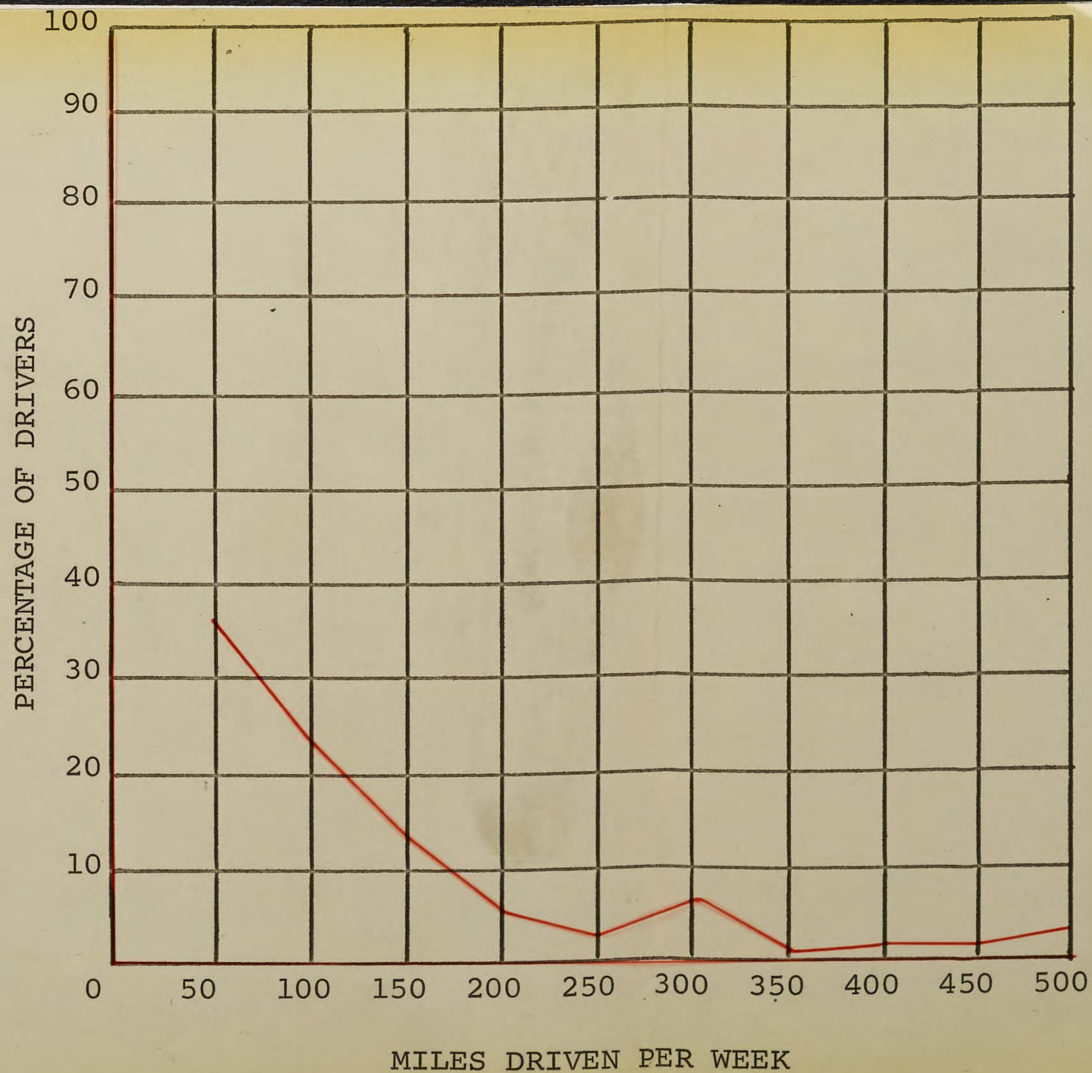


LEGEND

_____ Age 24
----- Age 34
..... Age 53

COLOR CODE FOR TYPES OF EXPOSURE

Total - Black
Daytime - Red
Nighttime - Blue
Country - Green
City - Brown



LEGEND

— Age 24

- - - Age 34

. . . Age 53

COLOR CODE FOR
TYPES OF EXPOSURE

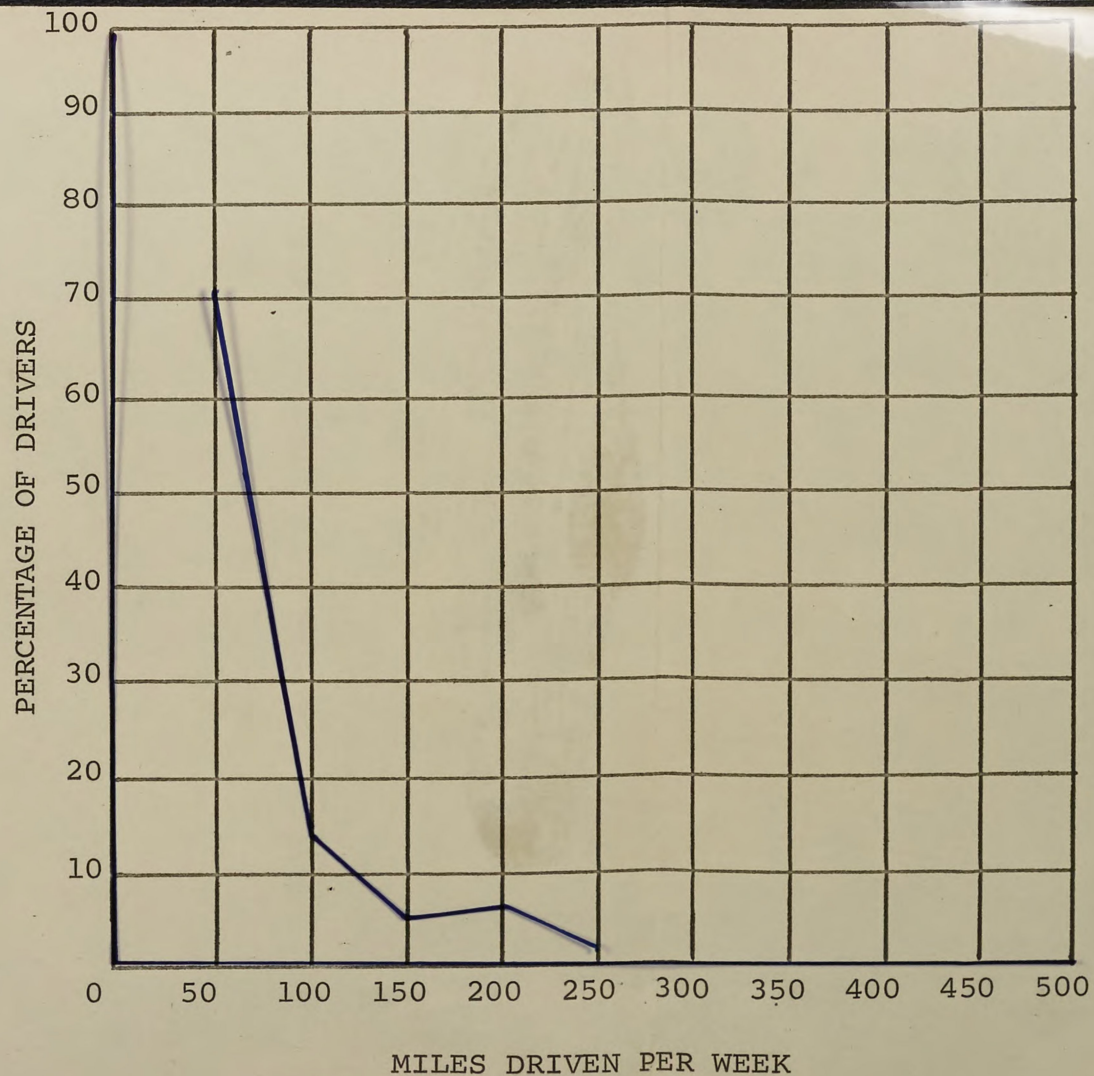
Total - Black

Daytime - Red

Nighttime - Blue

Country - Green

City - Brown



LEGEND

_____ Age 24

_____ Age 34

• — • — • Age 53

COLOR CODE FOR TYPES OF EXPOSURE

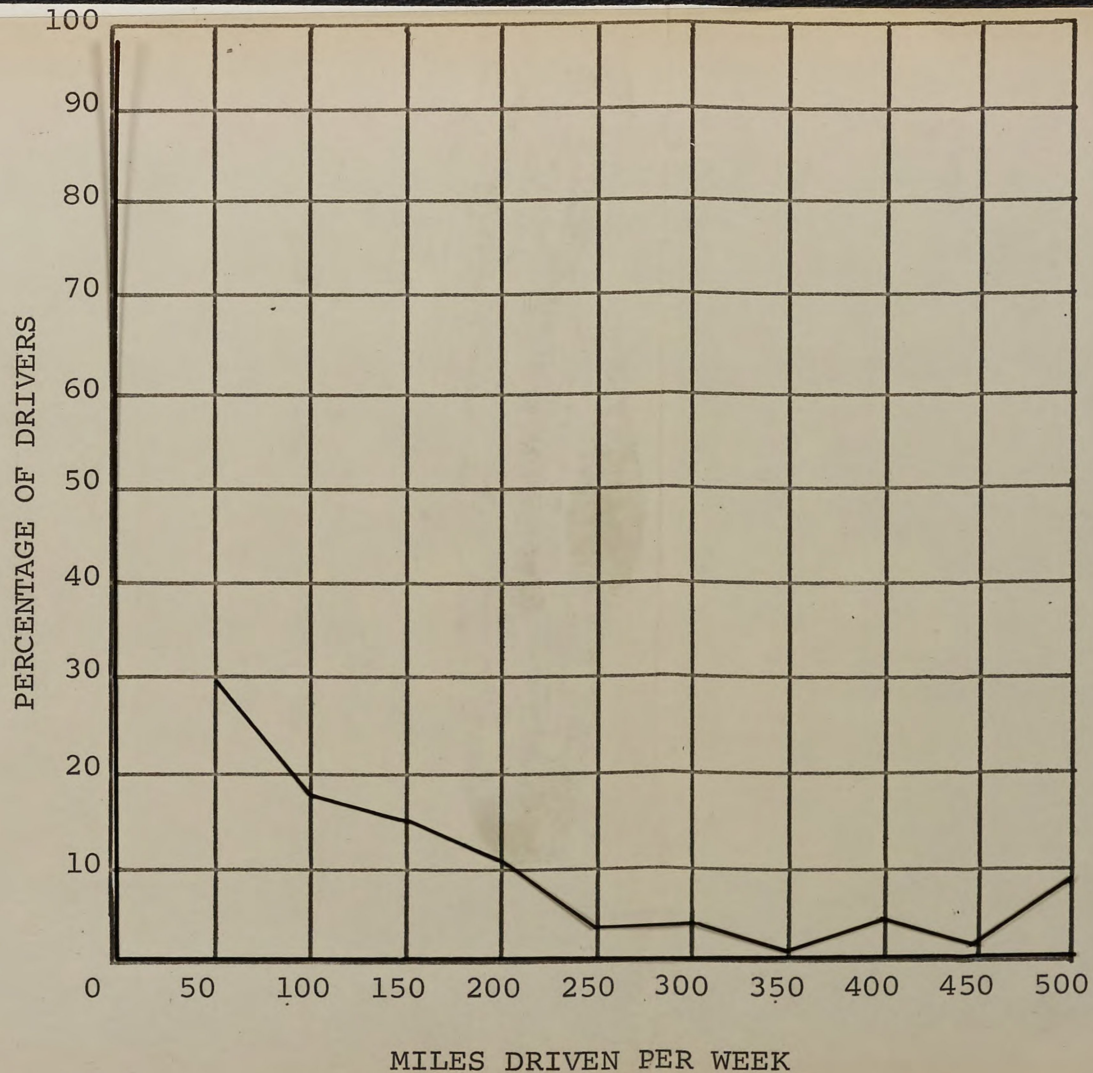
Total - Black

Daytime - Red

Nighttime - Blue

Country - Green

City - Brown



LEGEND

— Age 24

- - - Age 34

· · · Age 53

COLOR CODE FOR
TYPES OF EXPOSURE

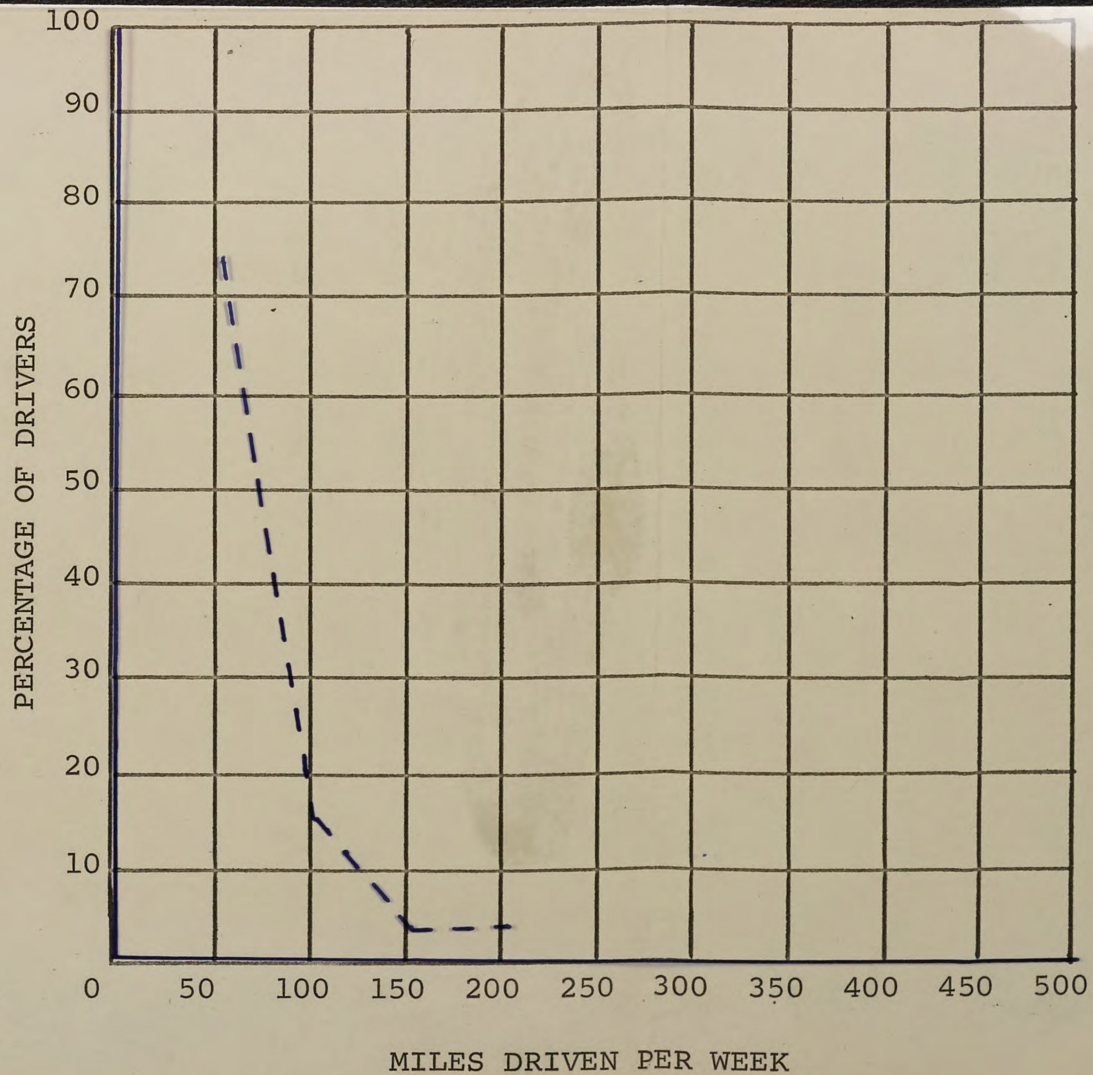
Total - Black

Daytime - Red

Nighttime - Blue

Country - Green

City - Brown

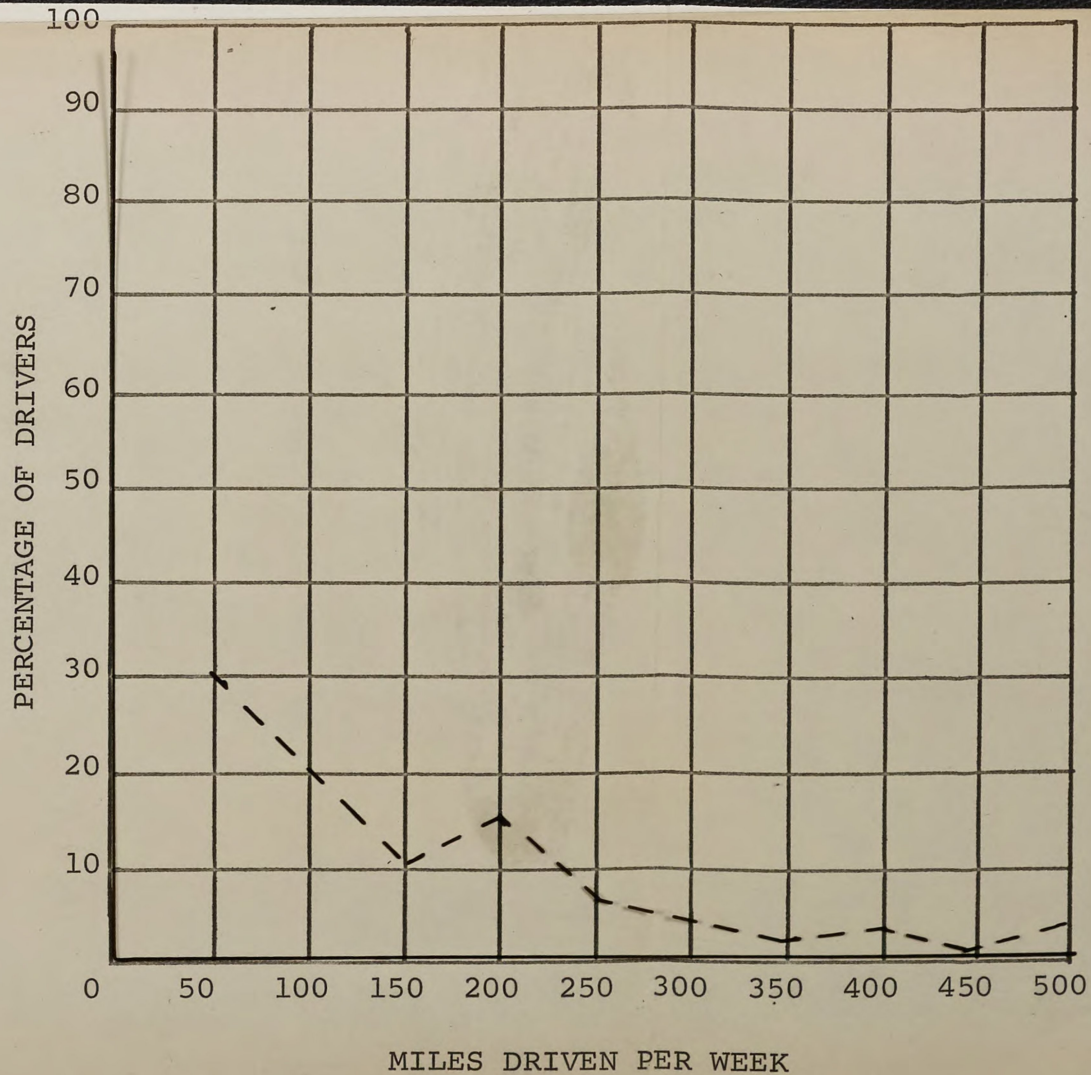


LEGEND

_____ Age 24
_____ Age 34
• — • — • Age 53

COLOR CODE FOR TYPES OF EXPOSURE

Total - Black
Daytime - Red
Nighttime - Blue
Country - Green
City - Brown

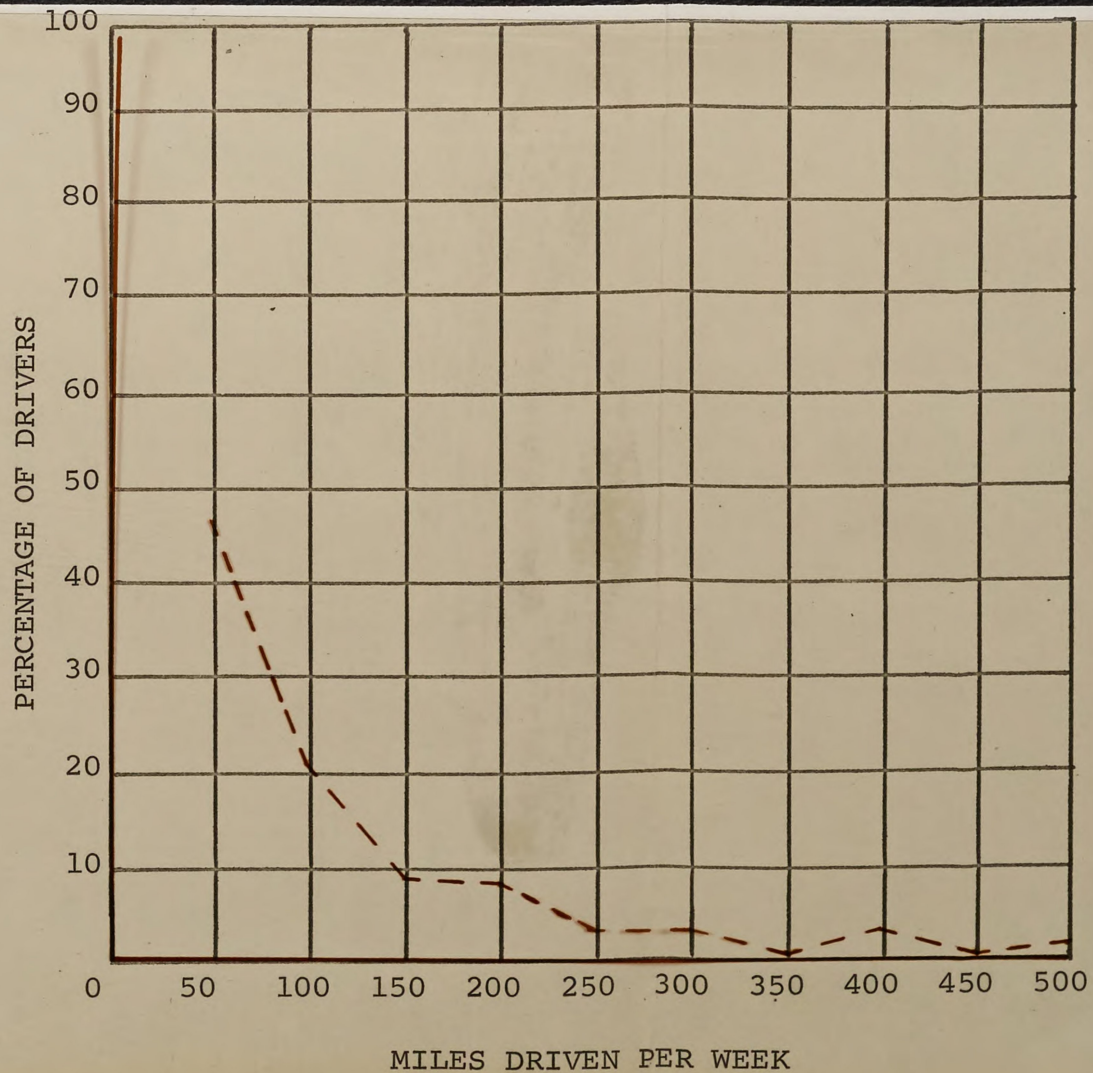


LEGEND

— Age 24
- - - Age 34
· — · — · Age 53

COLOR CODE FOR TYPES OF EXPOSURE

Total - Black
Daytime - Red
Nighttime - Blue
Country - Green
City - Brown



LEGEND

— Age 24

- - - Age 34

· — · — · Age 53

COLOR CODE FOR
TYPES OF EXPOSURE

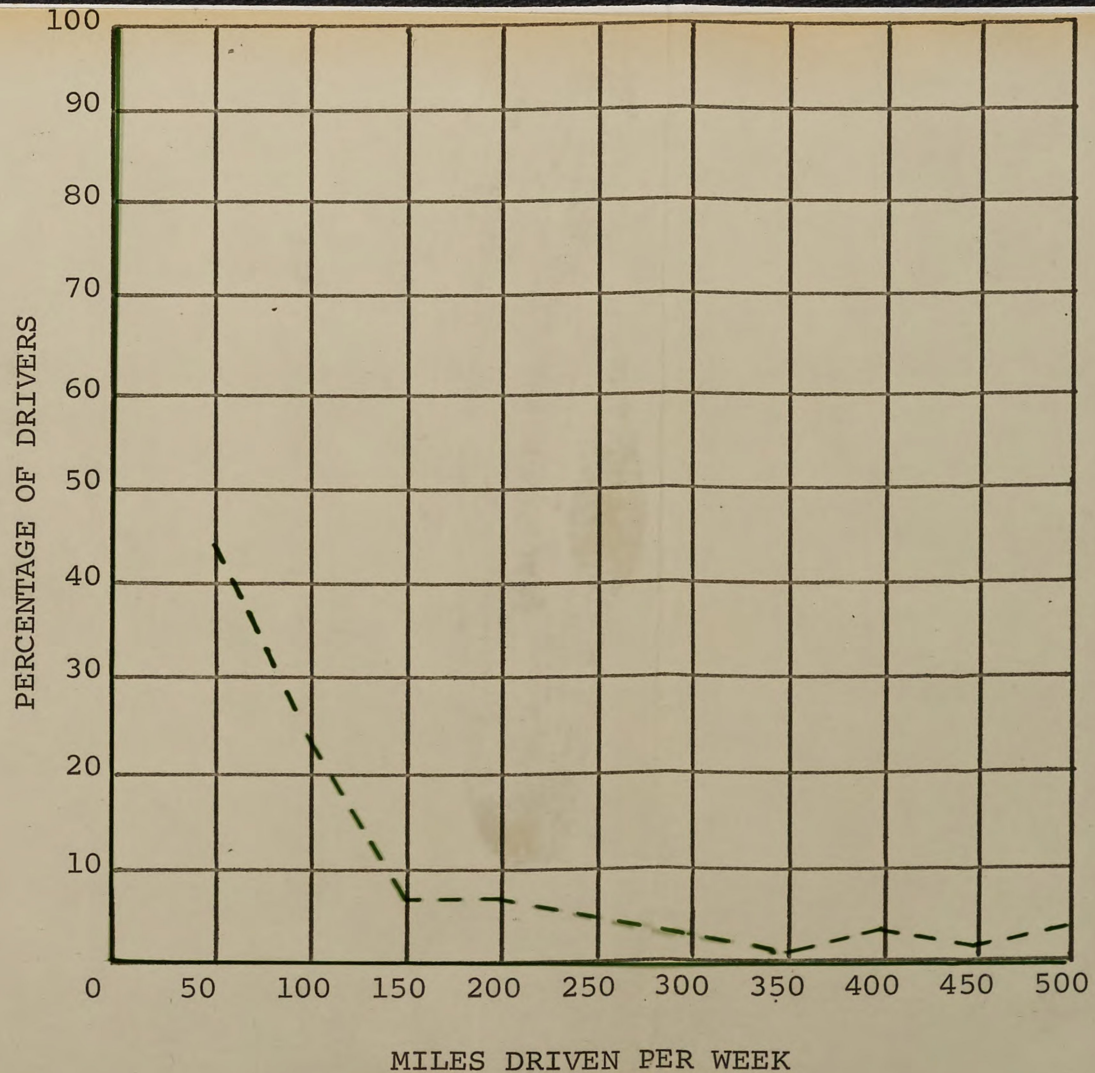
Total - Black

Daytime - Red

Nighttime - Blue

Country - Green

City - Brown

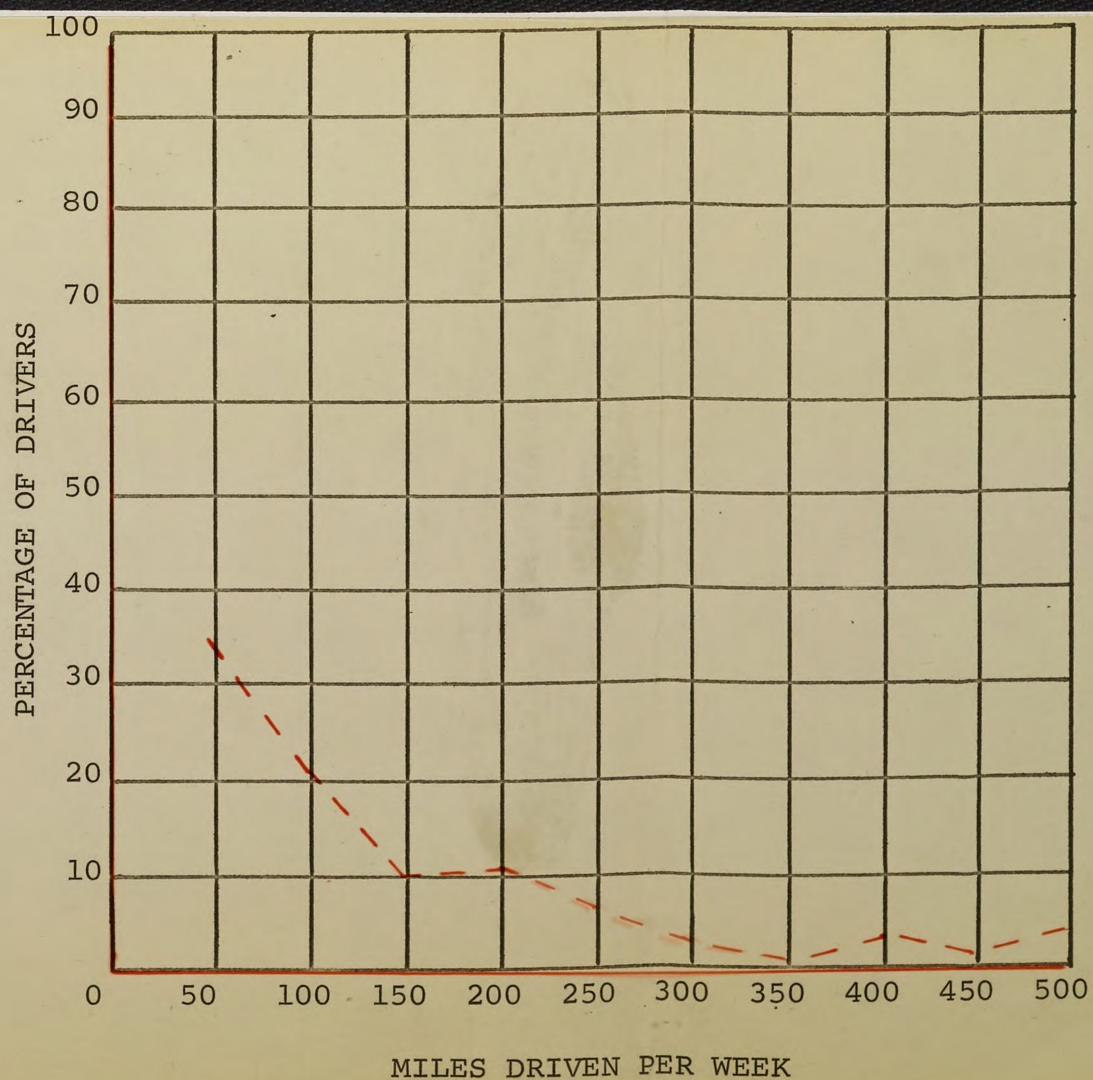


LEGEND

Age 24
Age 34
Age 53

COLOR CODE FOR TYPES OF EXPOSURE

Total - Black
Daytime - Red
Nighttime - Blue
Country - Green
City - Brown

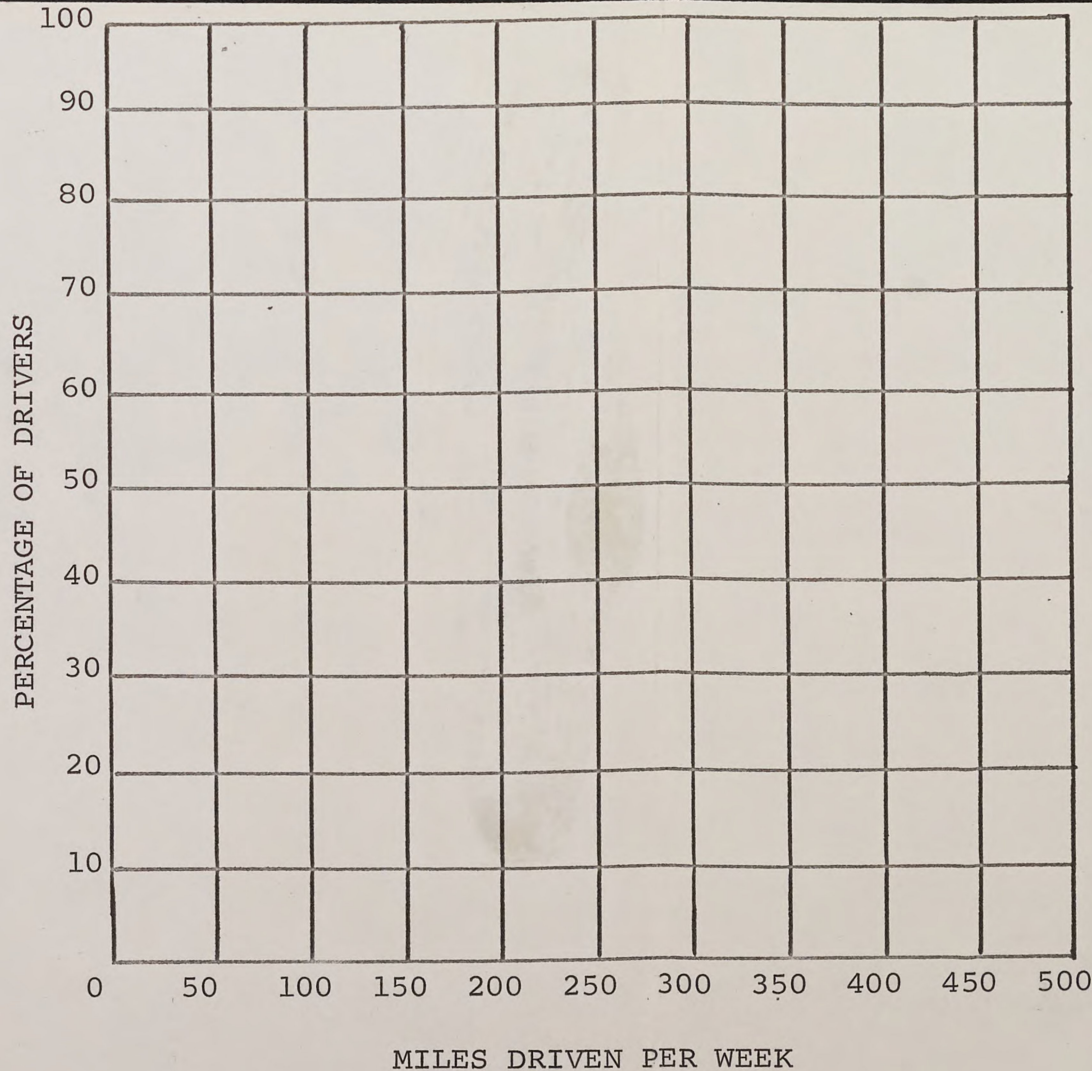


LEGEND

_____ Age 24
_____ Age 34
• — • — • Age 53

COLOR CODE FOR TYPES OF EXPOSURE

Total - Black
Daytime - Red
Nighttime - Blue
Country - Green
City - Brown



LEGEND

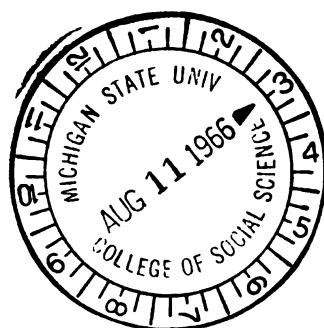
- _____ Age 24
- _____ Age 34
- — • — • Age 53

COLOR CODE FOR
TYPES OF EXPOSURE

- Total - Black
- Daytime - Red
- Nighttime - Blue
- Country - Green
- City - Brown

Pocket has: 15 overlays
1 graph

16





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