

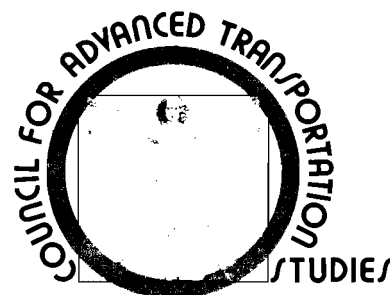
AGE-RELATED FACTORS IN DRIVING SAFETY

DEBORAH VALENTINE
MARTHA WILLIAMS
ROBERT K. YOUNG

RESEARCH REPORT 53

FEBRUARY 1978

TEXAS OFFICE OF TRAFFIC SAFETY



The University of Texas at Austin

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AGE-RELATED FACTORS IN
DRIVING SAFETY

Deborah Valentine
Martha Williams
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The University of Texas at Austin
Austin, Texas 78712

For

Texas Office of Traffic Safety
State Department of Highways and Public Transportation
Austin, Texas

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16. Abstract Accident and violation rates are higher for older and younger drivers. Causative or confounding variables studied in relation to this phenomenon have included experience, exposure rates, hazard miles driven, personality, sensory decrements, medical problems and inadequate socialization processes. The results suggest different processes at work for older versus young drivers resulting in higher accident rates at both ends of the age continuum. Strategies of prevention suggested include educational techniques and stricter testing and licensing standards.					
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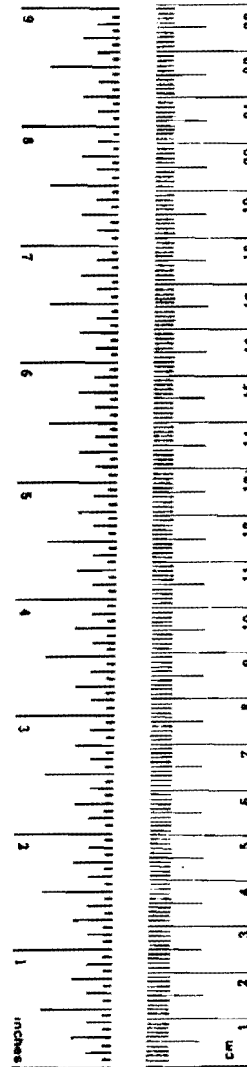
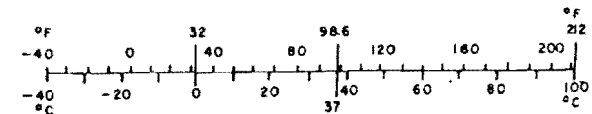
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Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
VOLUME				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
AREA				
cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (exact)				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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EXECUTIVE SUMMARY

Young drivers are overrepresented in accident and violation statistics.¹ Higher accident rates are reported for both young males and young females, and young males also have particularly high violation rates.² The "dangerous years" from 19 through 22 are marked by especially severe accidents involving costly personal injuries, and traffic tickets are more frequent at these ages.³ However, in many of the age-accident studies, researchers have not controlled for confounding variables such as driver experience, amount of exposure, hazardous driving conditions and police bias in reporting when correlating age and accident data.

Fell, Mudrowsky and Tharp compared individuals involved in accidents with controls in the general population and found the accident group to be less experienced and less familiar with their vehicles.⁴ The accident group included older drivers as well as younger ones. Kimball, Ellingstad and Hagen found inexperienced drivers to be inferior in psychomotor performance, less consistent with regard to speed and more likely to make errors.⁵ Unfortunately, it was not possible to control for age in the comparison groups in this study and

¹ Senator Phillip Hart, "Let's Reward Good Drivers," True, 50, No. 386 (July 1969), p. 16; "The Young Driver Generation," Journal of American Insurance, 49 (Summer 1973), pp. 16-17; Stanley H. Schuman, Donald C. Pelz, Nathaniel J. Ehrlich, and Melvin L. Selzer, "Young Male Drivers: Impulse Expression, Accidents, and Violations," Journal of the AMA, 200, No. 12 (1967), pp. 1026-1030.

² Donald C. Pelz and Stanley H. Schuman, "Are Young Drivers Really More Dangerous After Controlling for Exposure and Experience?" Journal of Safety Research, 3, No. 2 (June 1971), p. 70.

³ Donald C. Pelz and Stanley H. Schuman, "What is the 'Dangerous Age' for Young Drivers?" Traffic Safety, 70, No. 8 (August 1970), pp. 24-25, 35-36; Donald C. Pelz and Stanley H. Schuman, "Dangerous Young Drivers," HSRI Research [Highway Safety Research Institute, The University of Michigan], No. 2 (June 1968), p. 7.

⁴ James C. Fell, Edward F. Mudrowsky, and Kenneth J. Tharp, "A Study of Driver Experience and Vehicle Familiarity in Accidents," Accident Analysis and Prevention, 5, No. 4 (December 1973), pp. 261-265.

⁵ Kent A. Kimball, Vernon S. Ellingstad, and Roger E. Hagen, "Effects of Experience on Patterns of Driving Skill," Journal of Safety Research, 3, No. 3 (September 1971), pp. 129-135.

therefore age and experience were confounded (experienced groups were also older). However, the studies of Cleland and Kirkham and Pelz and Schuman suggest that accounting for exposure does little to alter the appearance of previously reported accident statistics implicating the young driver.⁶

Some studies have been conducted to determine age effects with experience and exposure simultaneously controlled. Ferdun, Peck and Coppin report age related only to male accidents in one such study.⁷ Pelz and Schuman state that the most hazardous drivers are those 18-20 years old with low mileages logged (less exposure and experience).⁸ Harrington, studying exposure, experience, age and accidents, concludes that young drivers learn to avoid accidents by driving more. However, their attitudes show little change for the better until their fourth year of driving.⁹

"Hazard miles" are generally measured by determining number of miles driven during high accident times. Studies utilizing this measure generally suggest that younger drivers drive more during hazardous time periods of the day and week. Inexperience in driving coupled with driving during more hazardous times could account for some portion of the age-accident relationship.

Alcohol seems also to be a contributing factor in accident rates among youths. Carlson states that there may be a learning-to-drive period followed by a learning-to-drink period.¹⁰ In both periods accidents increase. However, Zylman believes that young drivers are involved in more crashes not because of

⁶E.A. Cleland and Richard Kirkham, The Relative Involvement of Young Drivers in Traffic Accidents, Research Report no. 2 (Nedlands, Western Australia: University of Western Australia, Department of Psychology, August 1971), p. 6; Donald C. Pelz and Stanley H. Schuman, Motivational Factors in Crashes and Violations of Young Drivers (Ann Arbor, Mich.: Highway Safety Research Institute, University of Michigan, 1971), p. 72.

⁷G.S. Ferdun, R.C. Peck, and R.S. Coppin, "The Teenaged Driver," Highway Research Record, 163 (1967), pp. 31-53.

⁸Pelz and Schuman, "What is the 'Dangerous Age' for Young Drivers?", op. cit., p. 25.

⁹David M. Harrington, "The Young Driver Follow-up Study: An Evaluation of the Role of Human Factors in the First Four Years of Driving," Accident Analysis and Prevention, 4 (1972), pp. 191-240.

¹⁰William L. Carlson, "Age, Exposure and Alcohol Involvement in Night Crashes," Journal of Safety Research, 5, No. 4 (1973), pp. 247-259.

the use of alcohol but rather because youth itself is the important variable.¹¹ Others argue that alcohol-related crashes increase significantly as drinking ages are lowered, suggesting that alcohol is especially detrimental to youth.¹²

Personality factors also seem to be related to the accidents of youths. Individuals with an unusual number of accidents have been found to be high in impulse expression in driving behavior and more limited in education. Less maturity, smoking, lower socioeconomic status, failure in school, hostility, and criminal behavior have also been associated with accidents among young males.¹³ Pelz and Schuman conclude that aggression plus high alcohol consumption correlate positively with high violation records.¹⁴ Carlson and Klein hypothesize that young drivers with delinquent traffic records come from homes which show evidence of inadequate socialization processes.¹⁵

The older driver (over sixty) also has a higher than expected accident rate. Critical factors here seem to be changes in sensory capacity, reaction times and short-term memory. In addition, young and old drivers differ in the kinds of driving errors made. Older-driver errors are more related to decrements in perception and psycho-physical skills.¹⁶ It should also be noted that older drivers have a decreased ability to survive accidents once they occur or to recover from them when injured.

In terms of prevention many researchers suggest increased educational efforts or stricter testing as strategies to counter age-related driving problems.

¹¹Richard Zylman, "Youth, Alcohol, and Collision Involvement," Journal of Safety Research, 5, No. 2 (June 1973), pp. 58-72.

¹²Paul C. Whitehead, John Craig, Nanci Langford, Carol MacArthur, Bruce Stanton, and Roberta G. Ferrence, "Collision Behavior of Young Drivers," Journal of Studies on Alcohol, 36, No. 9 (1975), pp. 1208-1223.

¹³Pelz and Schuman, "Dangerous Young Drivers," op. cit.: Schuman, Pelz, Ehrlich, and Selzer, op. cit.

¹⁴Donald C. Pelz and Stanley H. Schuman, "Drinking, Hostility and Alienation in Driving of Young Men," paper prepared for the Third Annual Alcoholism Conference, Washington, D.C., June 20, 1973.

¹⁵William L. Carlson and David Klein, "Familial Versus Institutional Socialization of the Young Traffic Offender," Journal of Safety Research, 2, No. 1 (1970), pp. 13-25.

¹⁶David M. Harrington and Robin S. McBride, "Traffic Violation by Type, Age, Sex, and Marital Status," Accident Analysis and Prevention, 1 (May 1970), pp. 67-79.

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PREFACE

This is the sixth in a series of research reports describing activities and findings on accident research as part of the work conducted by the Council for Advanced Transportation Studies at the University of Texas at Austin under the auspices of the Texas Office of Traffic Safety, State Department of Highways and Public Transportation.

This report is concerned with the relationship of driver age to accident rates.

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The authors wish to gratefully acknowledge the research assistance of Kay Schauer and Gary Hales and the secretarial assistance of Helen McGinty and Sandy Bannister whose contributions to this report were invaluable. We would also like to commend Del Ervin and Mildred Martin for library assistance and Art Frakes for editorial assistance. We appreciate the efforts and contributions of these talented individuals.

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TABLE OF CONTENTS

LIST OF FIGURES	xv
LIST OF TABLES	xvii
I. INTRODUCTION	1
II. EXPERIENCE	6
III. EXPOSURE	9
IV. EXPERIENCE AND EXPOSURE	17
V. HAZARD MILES	19
VI. ALCOHOL AND AGE	24
VII. PERSONALITY VARIABLES AND AGE	31
VIII. OLDER DRIVERS AND TRAFFIC ACCIDENTS/VIOLATIONS	38
IX. ACCIDENTS ASSOCIATED WITH AGE IN INDUSTRIAL SETTINGS	44
X. CRITICISM OF AGE-ACCIDENT RESEARCH	47
WORKS CITED	51
SUPPLEMENTARY BIBLIOGRAPHY	55
THE AUTHORS	56

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LIST OF FIGURES

Figure 1.	Mean number of all accidents versus age	2
Figure 2.	Mean number of violations plus warnings versus age . .	2
Figure 3.	Motor vehicle accident fatality rates by age and sex in the U.S. for the year 1963	4
Figure 4.	Motor vehicle accident fatality rates by age and sex .	4
Figure 5.	Mean annual mileage versus age	10
Figure 6.	Mean accident scores for males within mileage brackets versus age	11
Figure 7.	Mean violation and warnings scores for males within mileage brackets versus age	11
Figure 8.	Accidents per 1,000 license holders by age and sex of driver responsible	13
Figure 9.	Annual total miles by age and sex of driver	14
Figure 10.	Accidents per 100 million miles by drivers responsible, Western Australia, 1968	15
Figure 11.	Distribution of three driver age groups by accident day	20
Figure 12.	Distribution of three driver age groups by accident hour	21
Figure 13.	Distribution of Washtenaw County drivers in single- vehicle crashes and in noncrash population, alcohol- related	25
Figure 14.	Distribution of Washtenaw County drivers in single- vehicle crashes and in noncrash population, nonal- cohol-related	26
Figure 15.	Percentage of young male drivers reporting accidents and/or violations in the preceding year and selected biographical items, by age	33
Figure 16.	Percentage of young male drivers reporting selected driving behaviors, by age	33
Figure 17.	Percentage of young male drivers reporting items related to emotions and social pressures, by age . . .	34
Figure 18.	Percentage of drivers involved in accidents and "at fault," by age	39

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LIST OF TABLES

TABLE 1.	INCREASE IN ALCOHOL-RELATED ACCIDENTS AND IN TOTAL ACCIDENTS AMONG YOUNG DRIVERS IN LONDON, ONTARIO, AFTER THE CHANGE IN THE LAW ON LEGAL AGE	29
TABLE 2.	COMPARISON OF THREE-YEAR ACCIDENT AND VIOLATION RATES FOR 1807 DRIVERS WITH AND 922 WITHOUT A MEDICAL CONDITION	42

I. INTRODUCTION

It is generally accepted by accident researchers that the young driver is over-represented in the frequency of vehicular accidents and traffic violations. Hart reports that drivers under 25 years old comprise 21 percent of the driving population but have one-third of all accidents.¹ The Journal of American Insurance concurs.² Their figures indicate that in 1970, 35 percent of all accidents involved young drivers; Schuman et al. report similar findings.³

Pelz and Schuman obtained the driving records of 3000 suburban Detroit drivers aged 16-24 and 35-44 by examining official records and by conducting personal interviews.⁴ The results were used in several reports. Figure 1 charts the mean numbers of all crashes of any degree of severity during 1970 regardless of who was responsible, including all minor accidents except bumps in parking lots. The ages on the horizontal axis represent the ages of the driver in June of 1970 in order to correspond as closely as possible to the time of the crash.

Figure 2 reports data for the mean number of violations (ticketed offenses) and warnings (non-ticketed) for the sample during 1970 in relation to the driver's age. Pelz and Schuman state that these data reveal that the average young male had 0.3 accidents during that year (30 per hundred). This is more than twice as many as the men aged 35-44. The average young male had almost 0.9 violations plus warnings (90 per hundred) or more than three times the average for older men. The women's figures were one-half as high as the men's; however, the young women had twice as many accidents and violations/warnings as the older women. The researchers report that all of these age effects were statistically significant.

¹Senator Phillip Hart, "Let's Reward Good Drivers," True, 50, No. 386 (July 1969), p. 16.

²"The Young Driver Generation," Journal of American Insurance, 49 (Summer 1973), pp. 16-17.

³Stanley H. Schuman, Donald C. Pelz, Nathaniel H. Ehrlich, and Melvin L. Selzer, "Young Male Drivers: Impulse Expression, Accidents and Violations," Journal of the AMA, 200, No. 12 (1967), pp. 1026-1030.

⁴Donald C. Pelz and Stanley H. Schuman, "Are Young Drivers Really More Dangerous After Controlling for Exposure and Experience?" Journal of Safety Research, 3, No. 2 (June 1971), pp. 68-79.

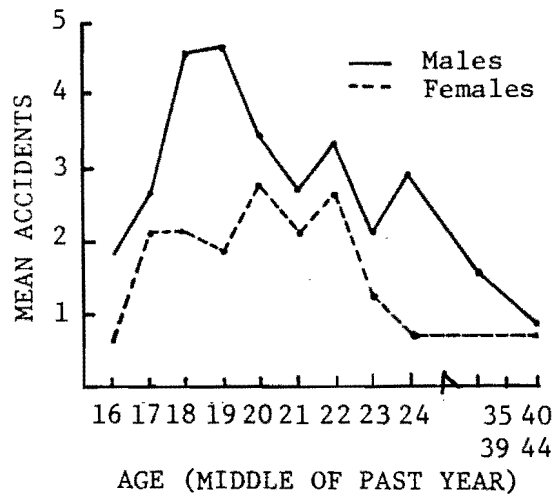


Figure 1. Mean number of all accidents versus age.

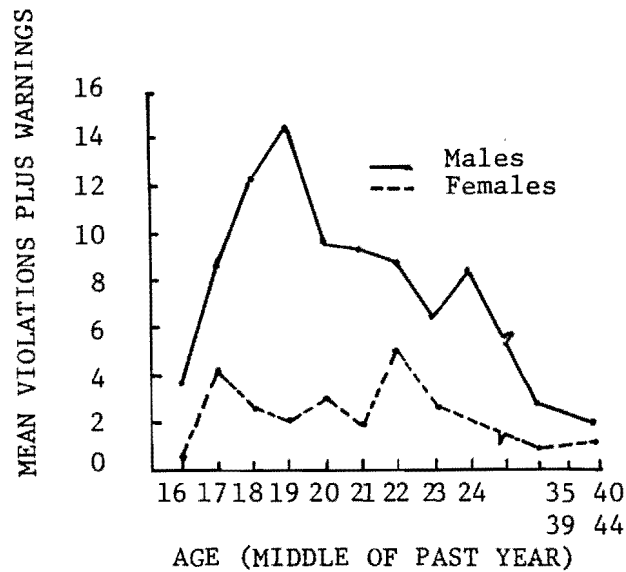


Figure 2. Mean number of violations plus warnings versus age.

FROM: Donald C. Pelz and Stanley H. Schuman, "Are Young Drivers Really More Dangerous After Controlling for Exposure and Experience?" Journal of Safety Research, 3, No. 2 (June 1971), pp. 70 & 71, figures 1 & 2.

Another interesting finding in the Pelz and Schuman study is that the accident rate more than doubled between the ages of 16 and 19 (from under 20 crashes per 100 drivers to over 45) and showed a decline toward middle age, with small secondary peaks at ages 22 and 24. A similar, but more pronounced age effect was found for violations and warnings, indicating that the 18 and 19-year-old drivers were particularly high traffic offenders. This age effect was not found among the female drivers.

Pelz and Schuman substantiated their findings with regard to the 18 and 19-year-old drivers in a study which interviewed 729 young men under 25 and 76 men aged 35-44 from a representative sample in the suburban areas of Ann Arbor and Detroit, Michigan.⁵ Self-reported information on accidents and violations was gathered, as was information from official state files. The researchers reported that the mean number of accidents, weighted for severity, rose steadily from age 16 to 20 and thereafter dropped sharply. The mean violation points also rose steadily up to age 20 and dropped thereafter. Again, they noted a small secondary peak at age 23 for both accident and violation rates.

In Pelz and Schuman's 1968 study of 288 unmarried, male licensed drivers randomly selected for interviews at drive-in restaurants in Washtenaw County, Michigan, the authors concluded that "While the youngest drivers had the most accidents, it was not until the 'dangerous years' from 19-22 that their accidents became severe (involving personal injury), and traffic tickets increased."⁶ (See Figure 3.)

O'Neill reports similar findings in her study of all licensed drivers in Washington State on December 31, 1966.⁷ O'Neill obtained information including age, sex, number of citations in 1966 and number of accidents (regardless of culpability) in 1966 for 1.7 million drivers. O'Neill's findings confirmed other research in that a statistically greater proportion of drivers under 30

⁵ Donald C. Pelz and Stanley H. Schuman, "What is the 'Dangerous Age' for Young Drivers?" Traffic Safety, 70, No. 8 (August 1970), pp. 24-25, 35-36.

⁶ Donald C. Pelz and Stanley H. Schuman, "Dangerous Young Drivers," HSRI Research [Highway Safety Research Institute, The University of Michigan], No. 2 (June 1968), p. 7.

⁷ Peggy Ann O'Neill, "Relationship of Accident Involvement and Number of Citations," Traffic Quarterly, 2, No. 2 (October 1968), pp. 583-594.

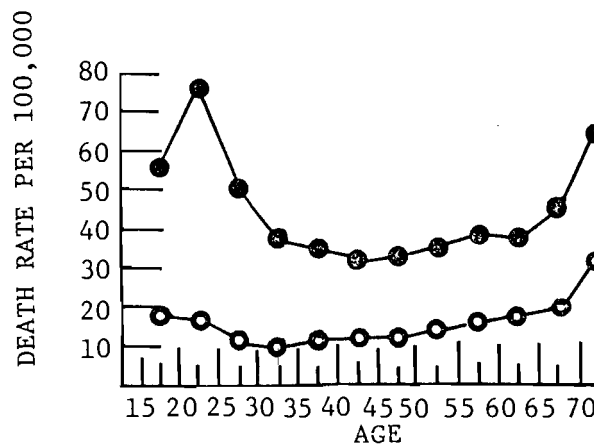


Figure 3. Motor vehicle accident fatality rates by age and sex in the U.S. for the year 1963.

FROM: Donald C. Pelz and Stanley H. Schuman, "Dangerous Young Drivers," HSRI Research [Highway Safety Research Institute, The University of Michigan], No. 2 (June 1968), p. 1, figure 1.

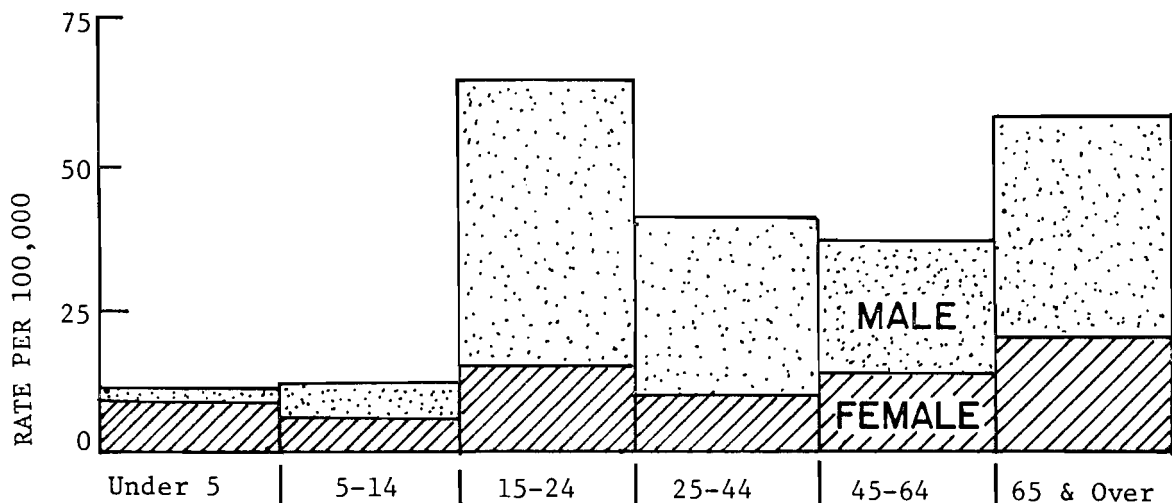


Figure 4. Motor vehicle accident fatality rates by age and sex.

FROM: Ross A. McFarland, "The Incidence and Causes of Motor Vehicle Accidents Among 'Unimpaired' Youthful Drivers," paper presented at the AMA Symposium, Washington, D.C., September 13, 1968, p. 27, figure 3.

than of drivers 30 or older were involved in accidents. O'Neill's data also supported the Pelz and Schuman 1971 study in that she found that a statistically greater proportion of drivers in the age group 16-19 had accident involvement than did drivers in the age group 20-24. Unfortunately, however, O'Neill does not report findings for a single age group but rather an age range. O'Neill concludes from her data, however, that drivers under 30 are overrepresented among drivers with records of citations or accidents, whereas drivers over 30 are underrepresented among drivers with records of citations or accidents.

Aaron criticizes age-related accident research on the basis of its failure to make single year age distinctions among what is commonly termed the young driver.⁸ Pelz and Schuman's results also indicate that further research in this area may be fruitful.

To summarize, it appears that the driver under 30 is overrepresented in the total number of vehicular accidents and traffic violations. It is further speculated that the 18 and 19-year-old male is of special interest with regard to his especially high incidence of accidents and violations. Although women have approximately one-half the violation and accident rates of men, the young woman driver has significantly more accidents than the older woman. McFarland shows the distinction by age of motor vehicle accident fatalities (Figure 4).⁹

The previously mentioned research describes results obtained using methods which ignore possibly important variables by merely calculating the number of violations and accidents for a certain population by age and sex. These other important variables include the driver's experience, the amount of exposure (number of miles driven), the amount of hazardous driving conditions, and possible biases in official police records. Other research has been performed to attempt to answer such specific questions as "Does the young driver have proportionally more accidents due to inexperience? Due to substantially more miles driven? Due to more hazardous driving conditions?" A summary of this research follows.

⁸James E. Aaron, "Behavior and Attitudes of Young Drivers," paper prepared for the Highway Traffic Safety Center, Michigan State University, East Lansing, Michigan, n.d.

⁹Ross A. McFarland, "The Incidence and Causes of Motor Vehicle Accidents Among 'Unimpaired' Youthful Drivers," paper presented at the AMA Symposium, Washington, D.C., September 13, 1968.

II. EXPERIENCE

Isolation and control for experience have been given serious consideration in the attempt by researchers to understand the age-accident relationship. Researchers speculate that inexperienced driving may be a primary cause of the disproportionately high accident and violation rate of young drivers rather than the drivers' youth and/or the characteristics of teenagers and young adults.

Fell, Mudrowsky, and Tharp studied 802 individuals involved in a total of 434 accidents.¹⁰ This sample was gathered by the Cornell Aeronautical Laboratory multidisciplinary team accident investigation study. A control group of 400 individuals from the general driving population was gathered. The Kolmogorov-Smirov two-sample test indicated that the distributions of the two populations were identical. Driving experience (months and/or years) was collected for the "accident sample" and vehicle familiarity (months and/or years) was also recorded for both male and female drivers by conducting interviews with the accident-involved drivers. The driving experience data and vehicle familiarity information were obtained by interview during three separate vehicle inspection road blocks conducted by the New York State Police. Fell and his associates reported that the drivers involved in accidents had significantly less driving experience than the general driving population ($p < .05$). They also reported that individuals involved in accidents had a shorter time period of driving the accident vehicle than drivers in the general population ($p < .01$). Many of the cases investigated included older drivers with very little experience and vehicle familiarity; thus, the effects, they conclude, were not produced uniquely by youthful drivers' involvement in accidents.

Kimball, Ellingstad, and Hagen conducted a study to examine the patterns of performance differences existing between experienced and inexperienced automobile drivers.¹¹ A driving simulator was used as the testing apparatus

¹⁰James C. Fell, Edward F. Mudrowsky, and Kenneth J. Tharp, "A Study of Driver Experience and Vehicle Familiarity in Accidents," Accident Analysis and Prevention, 5, No. 4 (December 1973), pp. 261-265.

¹¹Kent A. Kimball, Vernon S. Ellingstad, and Roger E. Hagen, "Effects of Experience on Patterns of Driving Skill," Journal of Safety Research, 3, No. 3 (September 1971), pp. 129-135.

which measured speed control variables and steering control variables. Subjects were divided into three groups. The experienced driver group consisted of 11 men (aged 22-29 years), Novice Group A consisted of 8 male subjects with ten or more hours of driving experience (aged 14-15 years), and the third group of drivers, Novice Group B, was composed of 12 male subjects (aged 14-15 years) who possessed less than ten hours driving experience. Kimball and associates report that the experienced driver group had superior psychomotor performance (operator input and response), less error and a greater degree of consistency with regard to rate of speed.

Novice Group A (more than ten hours experience) were reported to have the least consistent tracking performance, with extreme speed variability and a low average speed. Novice Group B (less than ten hours driving experience) had consistent speed controls and maintained a lower rate of motion but made more steering inputs to achieve only marginal control of the vehicle. These researchers conclude that "the acquisition of psychomotor skill in the driving task develops at a relatively slow rate and as a function of experience at the task. . . . a critical aspect of this skill acquisition depends upon the integration of steering and speed control aspects of the task, and . . . this integration requires a substantial amount of driving experience."¹² Unfortunately, due to the differing ages of the subject groups (Experienced 22-29 and Novice 14-15), youth alone may be partially responsible for the reported differences.

Mohler, Bedell, Ross, and Veregge gathered data from 450,494 pilots with active (including student) Airman Certificates in midyear 1965.¹³ After calculating accident information, these researchers stated that the student pilots had more air accidents than would be expected. This, however, was not statistically significant at the .05 level. In an earlier accident

¹²Ibid., p. 135.

¹³Stanley R. Mohler, Rowland H.S. Bedell, Alan Ross, and Everett J. Veregge, Aircraft Accidents by Older Persons (Washington, D.C.: Federal Aviation Administration, Office of Aviation Medicine, 1967).

study by Zeller and Moseley¹⁴, as reported by Sleight, Air Force pilots' experience in relation to age (individuals 45 years and older introduced to a new jet fighter aircraft) led them to the conclusion that the experience factor was extremely important.

¹⁴A.F. Zeller and H.G. Moseley, "Aircraft Accidents as Related to Pilot Age and Experience," paper presented at the 27th Annual Meeting of the Aero-Medical Association, April 18, 1956, cited by Robert B. Sleight and Kenneth G. Cook, Problems in Occupational Safety and Health, vol. 1: A Critical Review of Select Worker Physical and Psychological Factors, Washington, D.C.: U.S. Department of Health, Education and Welfare, November 1974.

III. EXPOSURE

It tentatively appears that driving experience has an effect on accident rate; however, experience defined by months and years of driving may not reflect actual number of miles driven. Driving exposure is an additional variable which must be accounted for before many researchers can fully accept that either the youthful driver or the inexperienced driver (measured by time rather than miles driven) has a disproportionate rate of accidents and violations. Cleland and Kirkham state that "it cannot legitimately be argued that any particular group of drivers is any more dangerous than any other group unless their accident figures can be weighted with an accurate measure of exposure."¹⁵ Further exploration of the effect experience has in relation to accident involvement, accounting for exposure, is discussed later.

The Pelz and Schuman 1971 study with a sample of 3,000 suburban drivers, as described earlier, also studied mileage or exposure of drivers.¹⁶ Estimates were made of each person's annual mileage by asking a battery of questions including: number of times driven to school, work, errands around town, out-of-town trips, etc. Estimates were calculated based on the number of trips and the typical mileage on each trip as compared with the amount of time driving for different purposes and standard mile per hour estimates as reported by the respondent. Figures 5-7 illustrate their findings.

Figure 5 illustrates the mean annual mileage versus age for males and females, revealing that mean mileage for men increased sharply from 3,000 miles at age 16 to 12,000 miles at age 19, and thereafter rose gently with a slight decrease at age 21. The curve for women was somewhat similar but only half as high and dropped somewhat after age 23.

Figure 6 illustrates the mean accident score for males within mileage brackets versus age. Pelz and Schuman note that (a) in four of the five

¹⁵E.A. Cleland and Richard Kirkham, The Relative Involvement of Young Drivers in Traffic Accidents, Research Report no. 2 (Nedlands, Western Australia: University of Western Australia, Department of Psychology, August 1971), p. 6.

¹⁶Pelz and Schuman, "Are Young Drivers Really More Dangerous After Controlling for Exposure and Experience?", op. cit.

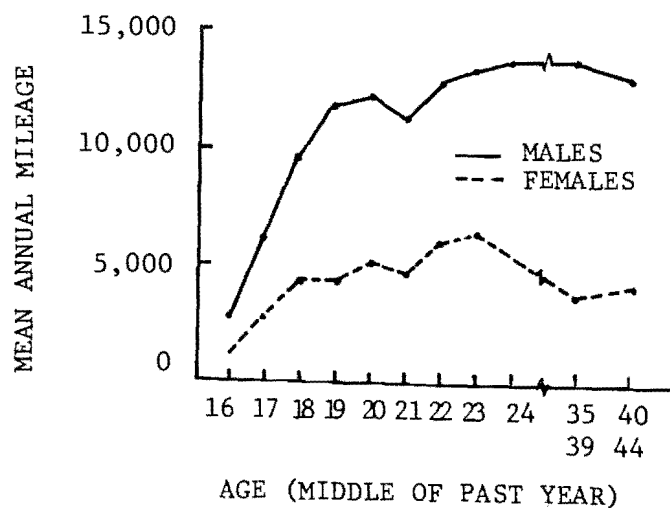


Figure 5. Mean annual mileage versus age.

FROM: Donald C. Pelz and Stanley H. Schuman, "Are Young Drivers Really More Dangerous After Controlling for Exposure and Experience?" Journal of Safety Research, 3, No. 2 (June 1971), p. 72, figure 3.

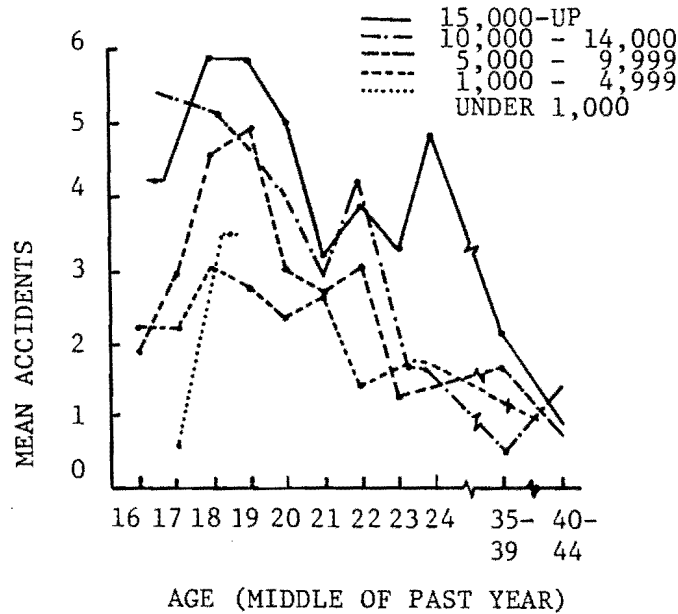


Figure 6. Mean accident scores for males within mileage brackets versus age.

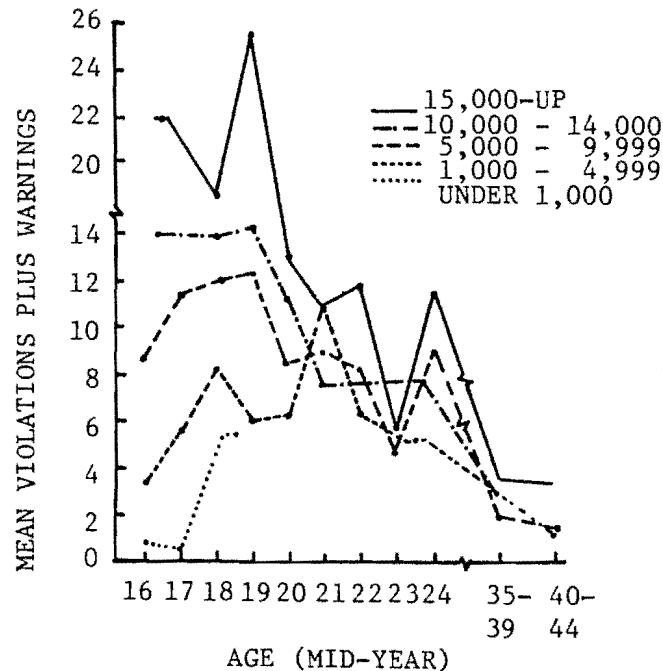


Figure 7. Mean violation and warnings scores for males within mileage brackets versus age.

FROM: Donald C. Pelz and Stanley H. Schuman, "Are Young Drivers Really More Dangerous After Controlling for Exposure and Experience?" Journal of Safety Research, 3, No. 2 (June 1971), p. 73, figures 4 & 5.

mileage brackets, accident scores were low at first and rose to a peak at 18 or 19, (b) accident rates were higher for men who drove more, but the amount of their increase in accidents was far below their proportional increase in mileage, (c) after age 21 the rates in all mileage brackets were similar except for the highest bracket of 15,000 miles or more.

Figure 7 shows the mean violations plus warnings scores for males within mileage and driving conditions. Pelz and Schuman state that

. . . by using only that portion of the accident or violation scores which could not be predicted by several exposure factors, we found that the danger continued to be greatest for young males who were either 18 or 19 years old. For young women the picture was much less sharp, with a slight tendency for accidents to rise at age 20 or 22.¹⁷

Cleland and Kirkham sampled households in the Perth Metropolitan Area, Western Australia, as well as from other County Districts.¹⁸ The total usable sample consisted of 922 households from which biographical data were collected by personal interviews in the respondents' homes. Each respondent was asked to keep a one-week log of his or her driving. This recording was used to calculate an estimated annual mileage. Cleland and Kirkham chose one-week recorded mileage due to the difficulty of obtaining accurate and practical mileage reports by methods such as roadside surveys (prohibitive cost), reflection on past mileage (tendency to underestimate for a one-week period and a tendency to overestimate for a greater than one-week period).

Figure 8 shows the accidents per 1,000 license holders (age and sex of driver responsible) of the sample. Figure 9 shows the annual total miles of the exposure estimates (age and sex) of the sample. Figure 10 represents the resulting accident statistics when the responsibility for accidents for every 100 million miles driven for each age and sex group was taken into account.

It is apparent that drivers under 21 years of age constitute a high risk group. Cleland and Kirkham conclude that young male drivers are the largest

¹⁷ Ibid., p. 76.

¹⁸ Cleland and Kirkham, op. cit.

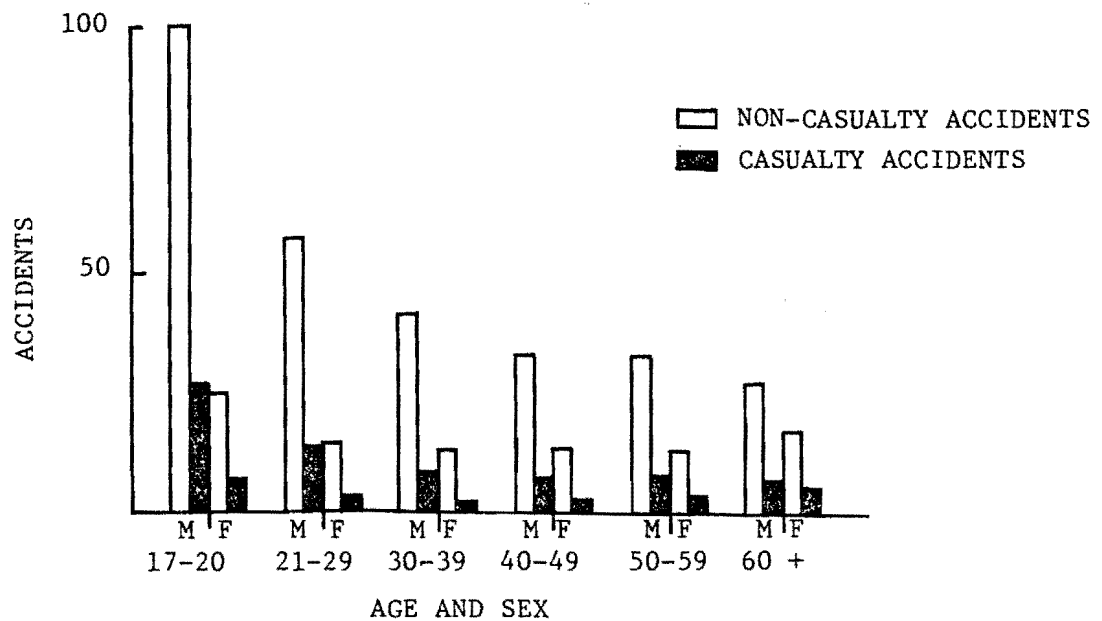


Figure 8. Accidents per 1,000 license holders by age and sex of driver responsible.

FROM: E.A. Cleland and Richard Kirkham, The Relative Involvement of Young Drivers in Traffic Accidents, Research Report 2 (Nedlands, Western Australia: University of Western Australia, Department of Psychology, August 1971), p. 7, figure 1.

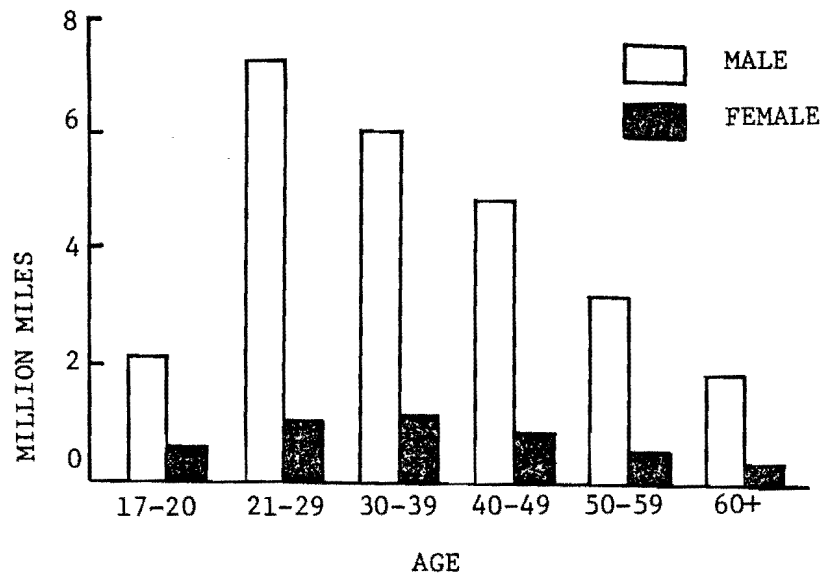


Figure 9. Annual total miles by age and sex of driver.

FROM: E.A. Cleland and Richard Kirkham, The Relative Involvement of Young Drivers in Traffic Accidents, Research Report 2 (Nedlands, Western Australia: University of Western Australia, Department of Psychology, August 1971), p. 15, figure 3.

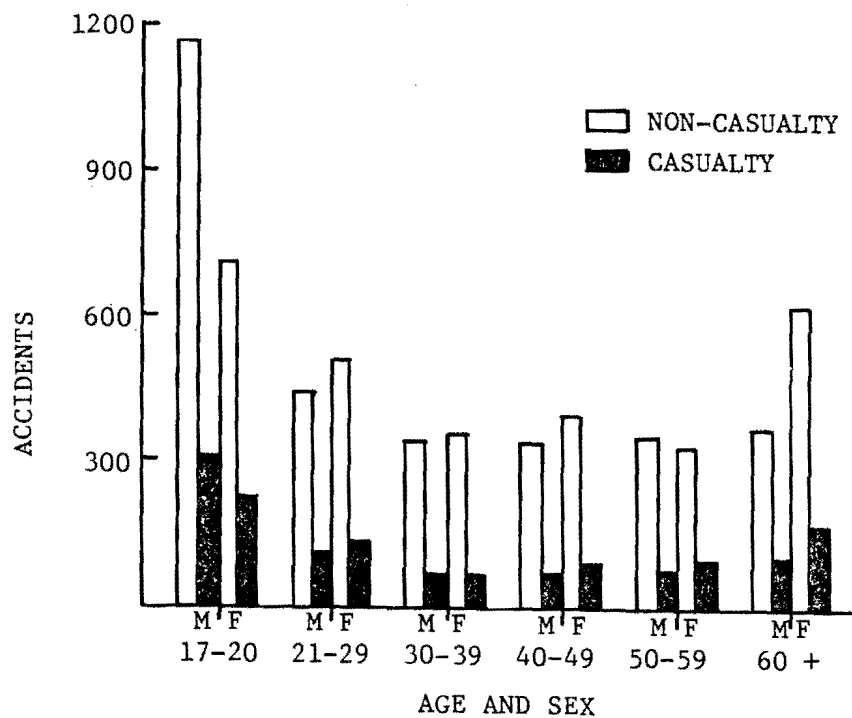


Figure 10. Accidents per 100 million miles by drivers responsible, Western Australia, 1968.

FROM: E.A. Cleland and Richard Kirkham, The Relative Involvement of Young Drivers in Traffic Accidents, Research Report 2 (Nedlands, Western Australia: University of Western Australia, Department of Psychology, August 1971), p. 16, figure 4.

contributors to accident statistics, taking into account quality and quantity of exposure. The authors also conclude that females under 21 and over 60 are responsible for a disproportionate number of accidents per miles driven. They also state that a U-shaped relationship appears to exist between age and responsibility for accidents for males. A further conclusion with regard to age is that men in their 20s appear to be responsible for slightly more accidents per mile than older men.

In this study, as in the Pelz and Schuman 1971 study, it appears that accounting for exposure does little to alter the appearance of previously reported gross accident statistics.

IV. EXPERIENCE AND EXPOSURE

Several studies have been conducted to determine the effect of age on accident and violation rates with both experience and exposure controlled. Ferdun, Peck, and Coppin mailed 10,250 questionnaires to California drivers (aged 16-19½ years) in 1964.¹⁹ The questionnaire requested information regarding method of learning to drive, whether the respondent took a drivers education course, exposure, driving experience, marital status, parental regulation, and purchase of vehicle. The authors report a 65% return rate. Although the respondents had significantly fewer violations than non-respondents, according to official records ($p < .01$), there was no significant difference with regard to accident rate nor any difference with regard to age group bias.

The authors report that young male teens had a higher accident rate per miles driven than older teens ($p < .05$). They also report that as driving experience increased, violations increased. Ferdun and associates conclude that exposure and experience were more important factors than age in determining accident and violation rates. Also, they state that age was related only to male accident rates, with older males having fewer accidents than younger males. Among females, the authors conclude that females with more experience had fewer accidents but more violations.

The results of Pelz and Schuman's study of 729 male drivers under 25 and 76 males aged 35-44 years interviewed in the suburban areas of Ann Arbor and Detroit showed that mileage rose steadily and steeply from ages 16 to 20.²⁰ The 16-17 year olds showed an expected number of violations; however, the 18-20 year olds were clearly above expectation level. The authors conclude that at each age, those with high mileage were safer. Those individuals with medium mileage had a higher accident rate and low mileage drivers were the least safe. These results agree with the Ferdun, et al. study; however, Pelz and Schuman found that the mean number of accidents (weighted for severity)

¹⁹G.S. Ferdun, R.C. Peck, and R.S. Coppin, "The Teenaged Driver," Highway Research Record, 163 (1967), pp. 31-53.

²⁰Pelz and Schuman, "What is the 'Dangerous Age' for Young Drivers?", op. cit.

rose steadily from age 16 to 20, unlike Ferdun's results. Pelz and Schuman, thus, state that the most hazardous drivers are those 18-19 years old with low mileage, concluding that one learns to drive safely by driving.

Since both the Ferdun, et al. and the Pelz and Schuman studies rely on self-reporting experience and exposure, accuracy is questionable. Harrington studied age-related accident and violation rates in five California counties.²¹ His subjects included all 16-17 year old licensed drivers in 1963 (N=13,915). He gathered accident and conviction data through 1967, issued questionnaires, obtained school records and performed one-hour interviews with members of both the high accident group (males with three or more accidents and females with two or more accidents) and the low accident group (no accidents) for a total of 443 interviews. Information included exposure and experience data. Harrington concludes that "the discrepancy between the accident and conviction trends, and the increase in mileage across years without corresponding increase in accidents, provide evidence that young drivers learn a great deal about accident avoidance with increasing practice, but seem to show little change in attitudes toward the traffic laws until their fourth year of driving."²²

Again, Pelz and Schuman's results regarding the higher accident rates of 18 and 19 year olds are unsubstantiated.

²¹David M. Harrington, "The Young Driver Follow-up Study: An Evaluation of the Role of Human Factors in the First Four Years of Driving," Accident Analysis and Prevention, 4 (1972), pp. 191-240.

²²Ibid., p. 234.

V. HAZARD MILES

Hazard miles driven can also be an important variable contributing to an increase in vehicular accidents. Hazard miles are generally defined as miles driven during various times in the day when the likelihood of accidents and injury is greater.

B.J. Campbell described the characteristics of accidents which occurred among 32,387 drivers.²³ The subjects were divided according to three age groups: 25 years and less, 26-59 years and 60 years and over. The author determined from driving records the day of the week and the time of day of accidents.

Figure 11 shows the distribution of the driver age groups by accident day. Figure 12 shows the distribution of the driver groups by accident hour. Although all groups show more weekend than weekday accidents, the difference is greater for the younger group. Young drivers have the highest weekend and lowest weekday proportion of accidents for all three groups. The accidents of the oldest group vary the least, with the lowest weekend and the highest weekday accident rate. Older drivers also have a higher proportion of accidents during the day than at night, while young drivers have 68 percent of their accidents at night. It appears that drivers are driving at times and under circumstances that expose them to different sets of risks. Campbell clearly states that the data described cannot be used to calculate the relative probability of accident involvement by any group; rather, it describes the characteristics of the accidents that do occur.

Carlson interviewed 748 night drivers randomly selected in Washtenaw County, Michigan, by a survey team.²⁴ Crash data were also obtained for Washtenaw County from January 1968 to June 1971. Results of this study indicate that 16 and 17 year olds are over-involved in night, single-vehicle crashes

²³B.J. Campbell, "Driver Age and Sex Related to Accident Time and Type," Automotive Crash Injury Research (Buffalo, N.Y.: Calspan Corporation, October 1964).

²⁴William L. Carlson, "Age, Exposure and Alcohol Involvement in Night Crashes," Journal of Safety Research, 5, No. 4 (1973), pp. 247-259.

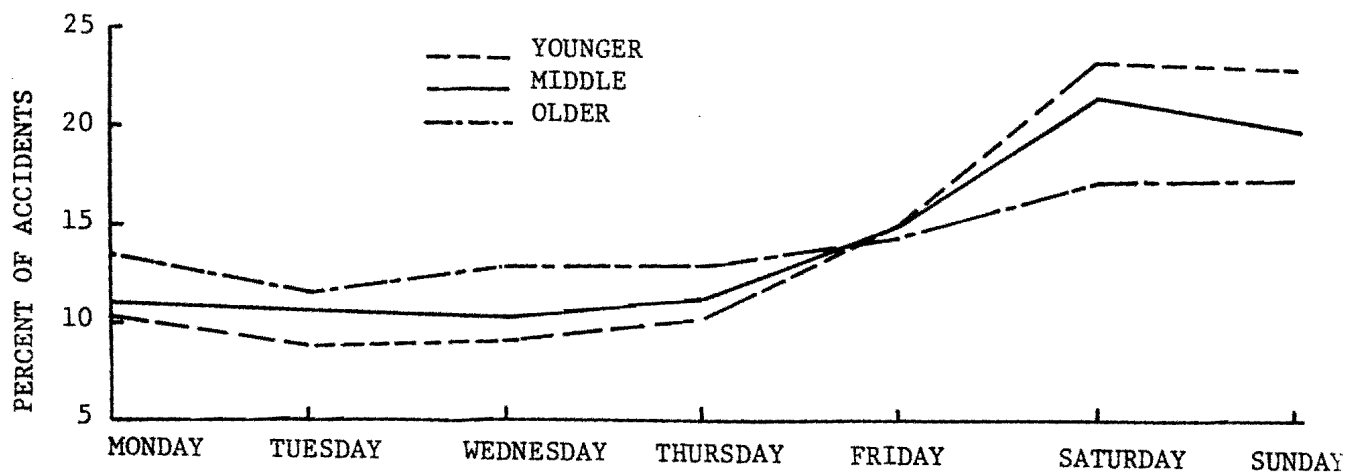


Figure 11. Distribution of three driver age groups by accident day.

FROM: B.J. Campbell, "Driver Age and Sex Related to Accident Time and Type," Automotive Crash Injury Research (Buffalo, N.Y.: Calspan Corporation, October 1964), p. 4, figure 3.

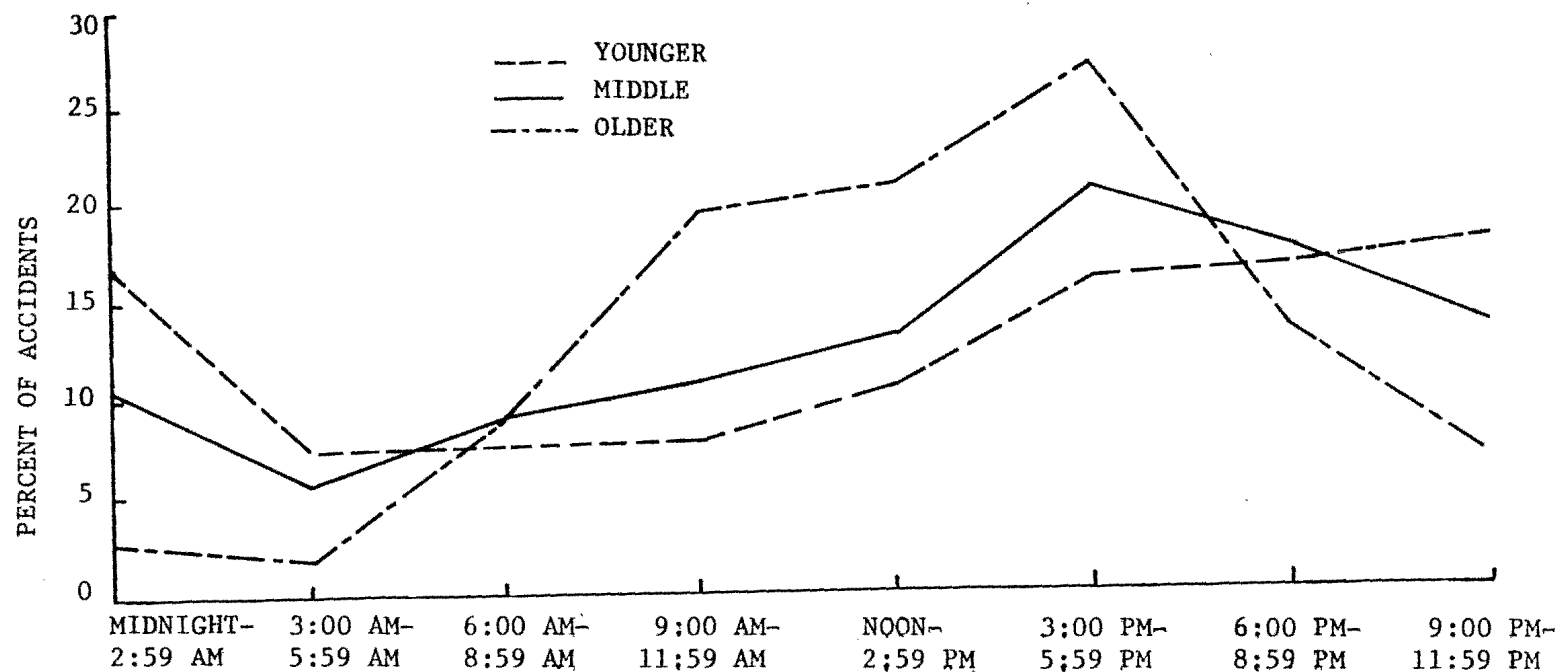


Figure 12. Distribution of three driver age groups by accident hour.

FROM: B.J. Campbell, "Driver Age and Sex Related to Accident Time and Type,"
Automotive Crash Injury Research (Buffalo, N.Y.: Calspan Corporation, October 1964),
p. 7, figure 7.

compared to exposure. The author speculates that this may be due to learning effects. The 16-25 year old age group was involved in 54 percent of the non-injury crashes and 59 percent of the injury crashes but had low exposure; again the learning effect may be responsible.

Although it is not possible to objectively determine hazardous driving times, it seems apparent that night driving on weekends is a particularly vulnerable time for the young driver. Klein suggests that hazardous exposure to risk other than total mileage driven, such as road and traffic conditions, roadside characteristics, and number of vehicle occupants, should also be investigated.²⁵

Authors such as Cleland and Kirkham and Klein suggest that there may be police bias in the issuing of violations and warnings, that culpability may be readily assigned to the young male driver solely on the basis of the general belief that the young male is a dangerous driver.²⁶

Although clear results are clouded by the variables which must be controlled in order to reveal accurate data on the age-accident relationship, the research indicates that young drivers definitely have more accidents and violations than older drivers. Driving inexperience may certainly account for some of the inflated accident statistics among the younger drivers. The complex skills and judgment required to operate a vehicle safely and avoid accidents are learned through experience in driving.

Exposure (number of miles driven) also seems to have an effect on the age-accident relationship. A proportionately higher accident rate is found among young people with low exposure. The more an individual drives the less likely it is (proportionally) that he/she will be involved in accidents. This again indicates that exposure or experience is a factor.

²⁵David Klein, "A Reappraisal of the Violation and Accident Data on Teenaged Drivers," Traffic Quarterly, 20 (October 1966), pp. 502-510.

²⁶Cleland and Kirkham, op. cit.; David Klein, "The Teenaged Driver: A Research Paradigm," Traffic Quarterly, 22, No.1 (January 1968), pp. 97-108.

Tentative support of this suggestion can be found in F.L. McGuire, "The Nature of Bias in Official Accident and Violation Records," Journal of Applied Psychology, 53, No. 7 (June 1973), pp. 300-305.

A question exists with regard to specific years of higher risk for young drivers. Pelz and Schuman's research indicates that the 18 and 19 year olds have a higher risk than either younger drivers or older drivers.²⁷ Although these findings are unsubstantiated, further research is indicated.

It is also interesting to note that violation rates increase as young drivers gain more experience. Speculation regarding this phenomenon is that young people become less cautious after acquiring new driving skills but are better able to avoid accidents than they were previously. The high violation rate does begin to subside after age 20, however.

²⁷Pelz and Schuman, "What is the 'Dangerous Age' for Young Drivers?", op. cit.

VI. ALCOHOL AND AGE

Alcohol consumption among youthful drivers has also been a consideration of researchers. The recent change in the age for acquiring full adult rights, including the purchase of alcohol, from 21 years to 18 years, has stimulated researchers to explore the effect on traffic accident rates.

Carlson randomly sampled 748 night drivers in Washtenaw County, Michigan.²⁸ Selected by a survey team, 87.5 percent agreed to participate, were interviewed and were given alcohol-level tests. In addition, crash data from January, 1968, to June 1971, were obtained for single vehicle crashes occurring between 7:00 p.m. and 3:00 a.m. in the same area. Exposure was controlled by using the number of driving trips rather than mileage.

Figure 13 shows the distribution of Washtenaw County drivers involved in alcohol-related single-vehicle crashes and in the noncrash population. Results indicate that alcohol-related driving increased through age 29 and decreased for the 30-34 age group. It was also reported that very few 16 and 17-year-old drivers drink but that these have a high involvement in alcohol-related driving until age 21 ($p < .05$). Figure 14 shows the distribution of Washtenaw County drivers in single-vehicle crashes which were nonalcohol-related and in the noncrash population which were nonalcohol-related.

Carlson found that the non-drinking drivers aged 16-18 were significantly overinvolved in single-vehicle crashes ($p < .01$). In general, the author reports that the 16-25 age group was involved in 45 percent of the non-injury crashes and 29 percent of the injury crashes. This group, however, had significantly lower exposure ($p < .05$). Thus, he concludes that the learning effect may be responsible. Carlson states that the specific components of crash overinvolvement by drivers under age 25 result from a learning-to-drive period followed by a learning-to-drink-and-drive period.

Pelz, McDole, and Schuman sampled 1670 men aged 16-25 in southeast Michigan and reviewed accident records from four states from 1968-1970.²⁹ The

²⁸ Carlson, op. cit.

²⁹ Donald C. Pelz, Thomas L. McDole, and Stanley H. Schuman, "Drinking-Driving Behavior of Young Men in Relation to Accidents," Journal of Studies on Alcohol, 36, No. 7 (July 1975), pp. 956-972.

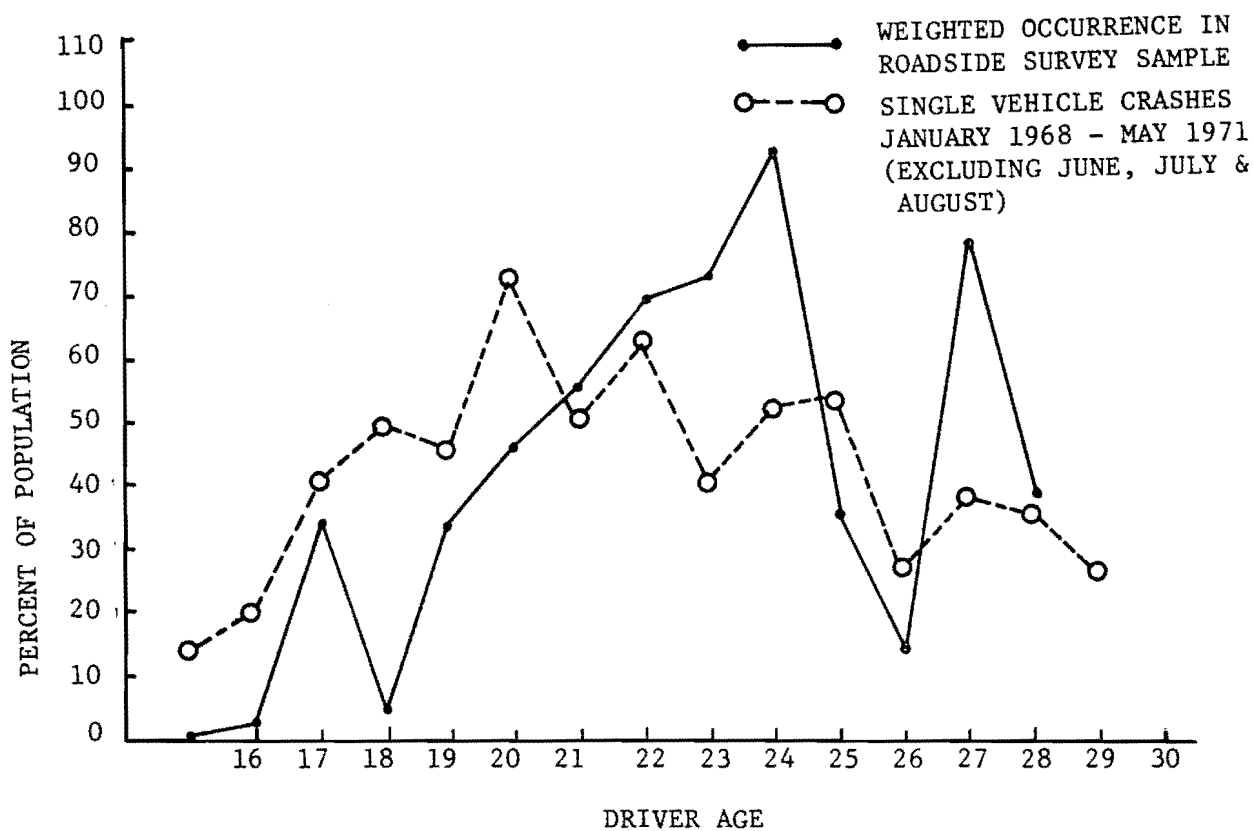


Figure 13. Distribution of Washtenaw County drivers in single-vehicle crashes and in noncrash population, alcohol-related.

FROM: William L. Carlson, "Age, Exposure, and Alcohol Involvement in Night Crashes," Journal of Safety Research, 5, No. 4 (1973), p. 253, figure 5.

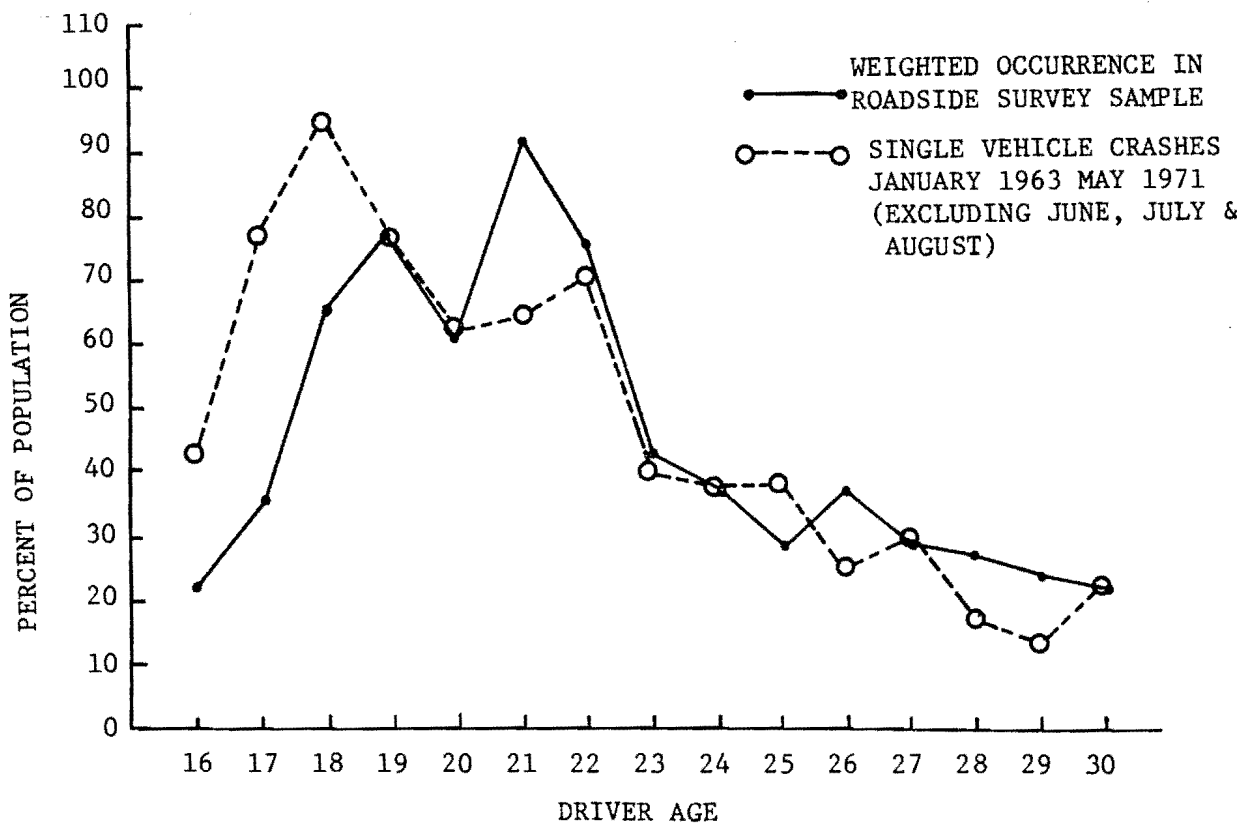


Figure 14. Distribution of Washtenaw County drivers in single-vehicle crashes and in noncrash population, nonalcohol-related.

FROM: William L. Carlson, "Age, Exposure, and Alcohol Involvement in Night Crashes," Journal of Safety Research, 5, No. 4 (1973), p. 252, figure 4.

authors state that drinking-driving occurrences rose rapidly with increased age among teen males. By age 20, over one-half drank weekly and one-fifth drank both weekly and heavily. The results indicate that non-drinking crashes were more frequent between ages 18 and 20 while alcohol-involved crashes were more frequent for the 22 to 24 age group. The authors found that those who drove after drinking had significantly more violations but did not have more accidents. However, the more severe the crash, the more frequently alcohol was involved. The authors also conclude that there was no increase in accidents when drinking at 18 became legal; however, they do not comment on the possible difference in the severity of the accidents.

Zylman states that

. . . there is little objective evidence that excessive drinking (or its accompanying disapproved behaviors) is even as frequent among youth as in any of the older age groups. . . .

The practice of driving-after-drinking by young people is not as widespread as generally believed. Under the age of 18, driving-after-drinking is quite rare. Frequency and intensity of driving-after-drinking, however, increase rapidly for 18 and 19 year old drivers; and the 20 to 25 year old group resembles that of drivers older than 25.³⁰

Zylman believes that young drivers are involved in more crashes than older drivers not because of the use of alcohol but rather because youth is the important predictor of collision involvement.

Zylman discusses the Grand Rapids data of 9,300 drivers randomly selected at times and places where accidents occurred.³¹ Zylman concludes that when allowances are made for exposure, young drivers have the worst collision record. This overinvolvement, he states, is due not to the use of alcohol but more to the characteristics of age. However, drivers under 18 increase their collision-vulnerability after small amounts of alcohol.

³⁰Richard Zylman, "Youth, Alcohol, and Collision Involvement," Journal of Safety Research, 5, No. 2 (June 1973), p. 69.

³¹Richard Zylman, "Age is More Important than Alcohol in the Collision Involvement of Young and Old Drivers," Journal of Traffic Safety Education, 20, No. 1 (October 1972), pp. 7-8, 34.

The research reviewed agrees that, although alcohol consumption prior to driving increases the likelihood of accidents, the age of the driver is still the important variable when accident involvement is considered.

Whitehead, et al. hypothesize that the change in alcohol-purchasing age from 21 to 18 had the independent effect of increasing the incidence of alcohol-involved collisions and total collisions among young drivers.³² Whitehead and his associates reviewed collision records from the Ontario Ministry of Transportation and Communication in London, Ontario, Canada, for the time between January, 1968, and June, 1973. Ontario lowered the legal drinking age in July, 1971; thus, data were collected for 16, 17, 18, 19, and 20 year olds plus 24 year old drivers which reflect accident occurrences prior to and following the establishment of the legality of 18 year olds' purchasing alcohol. The authors report that there was no change in alcohol-related collisions among females who were 16-18 years old and only a small increase at ages 18-20. Among young males aged 16-20, however, in the first year following the lowering of the drinking age to 18, alcohol-related collisions increased 174 percent while total collisions increased 28 percent. Alcohol-related collisions increased again the second year. There was no comparable increase in alcohol-involved collisions for the 24 year-old male drivers.

Whitehead, et al. report that after the change in the law, all ages showed an increase in both total number of accidents and alcohol-related accidents. Table 1 illustrates the increase in the total number of accidents and in alcohol-related accidents among the younger drivers as extrapolated from Whitehead, et al.

The data persuasively indicate the hazardous effects on the young of driving-after-drinking. Driving while under the influence of alcohol certainly does impair driving ability.³³ Young people who drive while intoxicated

³²Paul C. Whitehead, John Craig, Nanci Langford, Carol MacArthur, Bruce Stanton, and Roberta G. Ferrence, "Collision Behavior of Young Drivers," Journal of Studies on Alcohol, 36, No. 9 (1975), pp.1208-1223.

³³Robert K. Young, Deborah Valentine, and Martha Williams, Alcohol and Accidents, Research Report no. 49 (Austin, Texas: The University of Texas at Austin, Council for Advanced Transportation Studies, April 1977).

TABLE 1

INCREASE IN ALCOHOL-RELATED ACCIDENTS
AND IN TOTAL ACCIDENTS AMONG YOUNG
DRIVERS IN LONDON, ONTARIO, AFTER
THE CHANGE IN THE LAW ON LEGAL AGE

<u>AGE</u>	<u>INCREASE IN ALCOHOL-RELATED ACCIDENTS</u>	<u>INCREASE IN TOTAL NUMBER OF ACCIDENTS</u>
16 & 17	162%	20%
18	339%	42%
19	346%	37%
20	156%	16%
24	20%	10%

FROM: Paul C. Whitehead, et al., "Collision Behavior of Young Drivers," Journal of Studies on Alcohol, 36, No. 9 (1975), p. 1215, table 5.

are affected as indicated by higher accident rates. An interesting phenomenon occurs, however; during the first two years after a young person can purchase alcohol legally, accident rates are very high among young people who drink and drive. However, with increased experience in both driving and driving while drinking, accident rates begin to decrease. The learning curve, or experience, is a factor. This seems to indicate that the primary difference in the accident rates when the drinking age is reduced to 18 years old from 21 years old is that the two years following the legal drinking age change involve higher risks than those later. The crucial factor is that alcohol-intoxication while driving poses serious risks, particularly for the young, inexperienced driver.

VII. PERSONALITY VARIABLES AND AGE

Pelz and Schuman state that "If we can understand why fatalities peak under age 25 and thereafter decline, it is possible that we could deliberately accelerate the processes responsible for the decline."³⁴ It is for this reason that several researchers have studied various personality factors and characteristics of the young driver.

Pelz and Schuman and Schuman, Pelz, Ehrlich and Selzer interviewed 288 unmarried male licensed drivers (aged 16-24) randomly selected from drive-in restaurants in Washtenaw County, Michigan.³⁵ The authors report that those individuals characterized as accident-prone or violation-prone scored high on impulse expression in driving behavior, owned their cars, were working rather than in school, and had a limited education.

Also reported in Pelz and Schuman was a study of 452 randomly selected individuals (aged 16-24) in Washtenaw County who were interviewed and whose accident and violation records were reviewed.³⁶ The sample was divided into five groups as follows:

- I: young safe (aged 16-18): no accidents;
- II: old safe (aged 19-24): no accidents;
- III: reformed: no violations or accidents in past year but one earlier;
- IV: unsafe: one accident or violation in past year;
- V: dangerous: two or more accidents or violations in the past year.

The authors report the following results:

- (1) 50 percent of Groups I, II, and III, and 25 percent of Group V raced their cars.
- (2) 33 percent of Groups I, II and III, and 40-50 percent of Groups IV and V had driven motorcycles.
- (3) Twice as many individuals in Group V as in any other group spent ten or more hours per week in cars for fun.

³⁴Pelz and Schuman, "Dangerous Young Drivers," op. cit., p. 1.

³⁵Ibid.; and Schuman, Pelz, Ehrlich, and Selzer, op. cit.

³⁶Pelz and Schuman, "Dangerous Young Drivers," op. cit.

- (4) Individuals in Group V were more likely to own a car.
- (5) As violations and accidents increased, the amount of time spent on physical maintenance of the vehicles increased.
- (6) Individuals in Groups IV and V scored high in sensitivity to social pressure.

Figures 15-17 summarize Pelz and Schuman's findings with regard to biographical data (Figure 15), selected driving behavior (Figure 16), and items related to emotions and social pressures (Figure 17), by age.

Asher and Dodson performed a longitudinal study of 31 boys and 13 girls who were killed in Indiana automobile accidents between 1960-1969 and who had been tested in high school in 1960.³⁷ The authors found that individuals in the fatality group were lower on variables of educational achievement, were at the lower end of the socio-economic scale, and were less mature than the general population of students tested in 1960. They found, using a t test, that among 455 usable variables (Talent Data Bank), 95 variables were significant at the .05 level. A more detailed listing was not available. Asher and Dodson also concluded that completion of drivers education courses in high school was of no predictive importance.

McGuire issued questionnaires to 2961 Lackland Air Force Base males (aged 17-20) and also found that drivers education failed to demonstrate reduction of accident frequency.³⁸ McGuire's findings, however, differ from those of Asher and Dodson in reporting higher accident frequency among individuals belonging to higher socioeconomic levels. This could be due to a sample difference. McGuire also found that smoking was positively correlated to accident frequency. Kraus, Steele, Ghent and Thompson also report that individuals who were regular cigarette smokers before the age of 16 had a higher incidence of collisions; they studied 205 individuals under the age of 21 (in Kingston, Ontario, between March, 1968, and October, 1969) and a

³⁷ William Asher and Beverly Dodson, Social, Psychological and Educational Characteristics of Adolescents and Young Adults Killed in Indiana Automobile Accidents (Lafayette, Indiana: Joint Highway Research Project, Purdue University, October 28, 1970).

³⁸ Frederick L. McGuire, "Smoking, Driver Education and Other Correlates of Accidents Among Young Males," Journal of Safety Research, 4, No. 1 (March 1972), pp. 5-11.

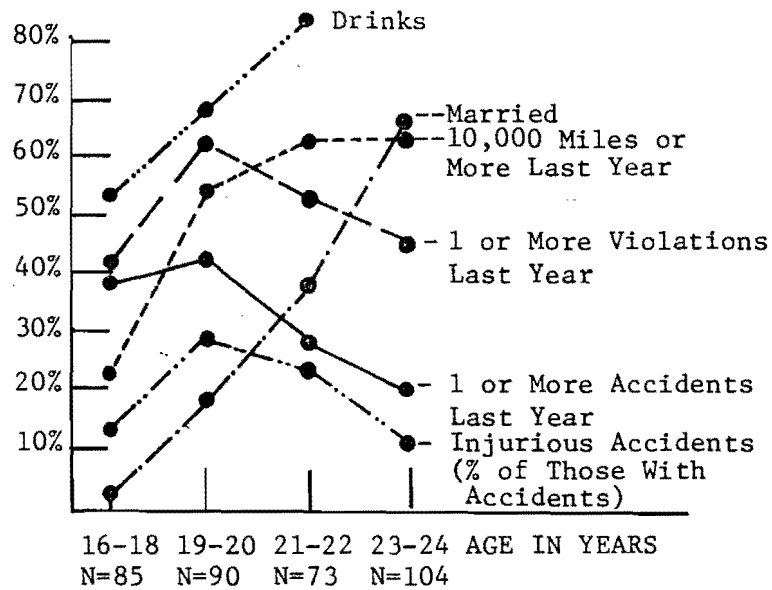


Figure 15. Percentage of young male drivers reporting accidents and/or violations in the preceding year and selected biographical items, by age.

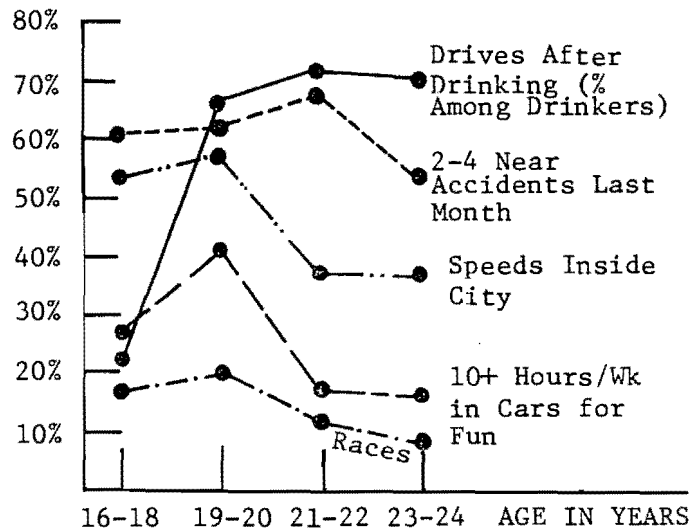


Figure 16. Percentage of young male drivers reporting selected driving behaviors, by age.

FROM: Donald C. Pelz and Stanley H. Schuman, "Dangerous Young Drivers," HSRI Research [Highway Safety Research Institute, The University of Michigan], No. 2 (June 1968), pp. 2 & 6, figures 2 & 7.

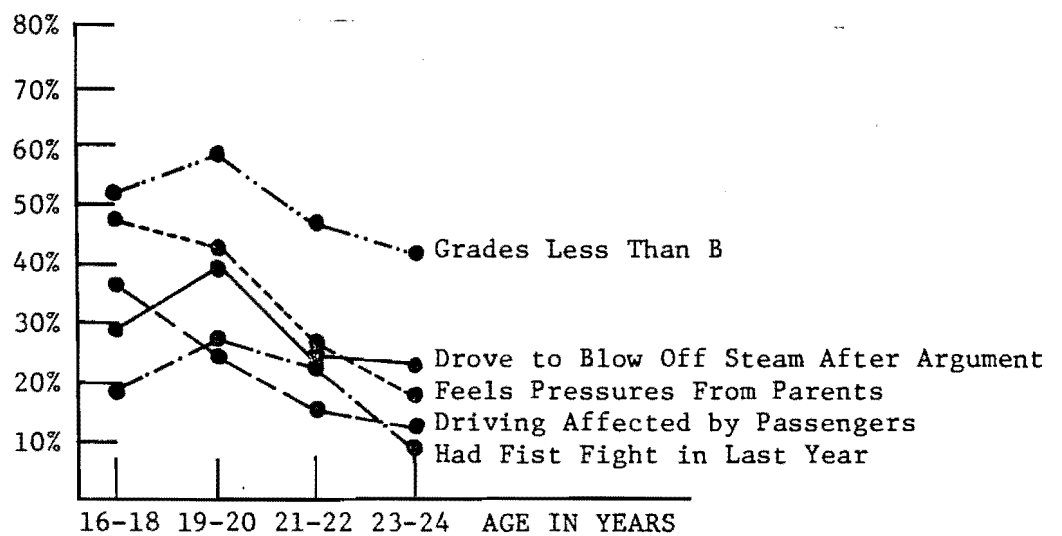


Figure 17. Percentage of young male drivers reporting items related to emotions and social pressures, by age.

FROM: Donald C. Pelz and Stanley H. Schuman, "Dangerous Young Drivers," HSRI Research [Highway Safety Research Institute, The University of Michigan], No. 2 (June 1968), p. 7, figure 8.

control sample of 205 comparable individuals.³⁹ The authors report other risk factors, including being charged with a criminal offense, having a full-time job at or before age 17, having failed one or more grades in or before the 8th grade, and having been in a vocational high school course, which correlate positively with accident frequency.

In another study, which controlled for an exposure factor, Pelz and Schuman report that from their evaluation of official records and interviews of 1700 young males aged 16-25 from southeast Michigan, the 18 and 19 year old drivers had the highest accident, violation and warning records.⁴⁰ This age also had a high measure of hostility (anger, rebellion) and had an increase in driving-after-drinking. Their results also indicate that the number of violations increased when these young men rejected education, suffered from educational alienation and drove after drinking.

The authors also found that young men with strong hostility had about 9 more crashes per 100 than those drivers with little hostility. They state that this was a small but statistically significant difference.

Although heavy weekly drinkers had about 50 percent more infractions than non-drinkers, this relationship was minimized in the absence of underlying aggression. Thus, Pelz and Schuman conclude that aggression plus high alcohol consumption positively correlates with high violation and warning records.

Pelz and Schuman report on the same sample in another article and conclude that

Age 18 or 19 may be the cross-over point where hostility is still strong, and experimentation with alcohol is rapidly rising. The presence of both these factors may have even more potential for danger than either one separately; if so, their joint occurrence in young males just before adulthood may help to explain the elevated hazard at this age.⁴¹

³⁹A.S. Kraus, R. Steele, W.R. Ghent, and M.G. Thompson, "Pre-Driving Identification of Young Drivers with a High Risk of Accidents," Journal of Safety Research, 2, No. 2 (1970), pp. 55-66.

⁴⁰Donald C. Pelz and Stanley H. Schuman, "Drinking, Hostility and Alienation in Driving of Young Men," paper prepared for the Third Annual Alcoholism Conference, Washington, D.C., June 20, 1973.

⁴¹Donald C. Pelz and Stanley H. Schuman, Motivational Factors in Crashes and Violations of Young Drivers (Ann Arbor, Mich.: Highway Safety Research Institute, University of Michigan, October 13, 1971), p. 9.

Carlson and Klein gathered biographical data and obtained orientation test scores and grade point averages for 8094 male undergraduates (aged 18 through 20) from a large state university in Michigan who had Michigan driver's licenses.⁴² The researchers also collected the number of convictions and the frequency of noncrash violations, assigned seriousness points to these violations and recorded the number of crashes and other non-vehicular offenses. The traffic conviction and crash records for the preceding six years for the fathers of these young men were also collected.

Carlson and Klein hypothesized that young drivers with delinquent traffic records came from homes in which similar delinquency existed, and that these young men also manifested symptoms of inadequate institutional socialization, not merely in driving behavior but in other areas of life.

Carlson and Klein report the following results:

- (1) Sons of fathers with no traffic convictions had 75 percent fewer violation points per individual than sons of fathers with traffic convictions. Conversely, sons of fathers with convictions had 19 percent more violation points per individual than sons of fathers without convictions.
- (2) Students with grade point averages higher than 2.6 (4.0 = A) had 15 percent fewer convictions than those below 2.6. The G.P.A.s of students were inversely related to conviction frequency of the father.
- (3) Students who achieved below their tested ability tended to have more convictions.
- (4) Students with a high incidence of traffic violations showed a significantly higher number of violations of other laws.
- (5) No relationship was found between:
grade point average and crashes;
student's crashes and father's crashes; and
father's convictions and any other variable.

⁴²William L. Carlson and David Klein, "Familial versus Institutional Socialization of the Young Traffic Offender," Journal of Safety Research, 2, No. 1 (1970), pp. 13-25.

Although these results indicate some support for the stated hypothesis, exposure was not controlled. Carlson and Klein suggest, however, that drivers education training should include discussion of life values.

Due to the limited number of studies and the lack of replication to either support or refute the existing research, it is impossible to draw conclusions with regard to the personality variables which contribute to the high accident and violation rates of the young. However, the reviewed research may serve as a starting point for further investigation.⁴³

⁴³ Further discussion of personality factors with regard to traffic safety may be found in Deborah Valentine, Martha Williams and Robert K. Young, Personality Factors in Accident Causation, Research Report 48 (Austin, Texas: The University of Texas, Council for Advanced Transportation Studies, 1977).

VIII. OLDER DRIVERS AND TRAFFIC ACCIDENTS/VIOLATIONS

Although under less scrutiny than the younger driver, the elderly driver has received considerable attention from traffic researchers. Accident statistics have shown that the older driver has a much greater risk of accident involvement than would be expected. Figure 18 shows the percentage of drivers in various age groups who were involved in accidents and were held to be at fault in Great Britain in 1953, in Connecticut in 1955, and in California in 1958. The U-shaped curve is demonstrated and indicates the increase in accidents among drivers sixty years old and older. There is an especially sharp increase for the 70 to 80 year old driver. McFarland reports that although only 1.8 percent of licensed Connecticut drivers from June 1959 to June 1960 were 69-72 years old, 3.1 percent of these individuals were involved in accidents.⁴⁴

Because of evidence such as this, safety experts and researchers are concerned with the causes of accidents among the older driving population. R.A. McFarland, G.S. Tune, and A.T. Welford review the literature available on how age changes driving capacity.⁴⁵ The authors list several components which they speculate have an effect on the older person's ability to drive without accident. McFarland and his associates report that, with age, night vision is reduced and a longer period of time is necessary for the eye to readapt to the dark after exposure to bright light. Also reported is an impairment with age of the ability to see in the presence of glare and the general deterioration of vision, hearing, depth perception, and other sensory functions with age.

According to McFarland, research indicates that all types of accidents which show a significant increase with age can be attributed to slowness. Studies of perception, however, show many more profound changes with age than reaction times, which may also affect driving ability. Additional factors which are noted by McFarland include the fact that older people seem

⁴⁴Ross A. McFarland, "The Older Driver and Accidents," Police (July-August 1966).

⁴⁵Ross A. McFarland, G.S. Tune, and A.T. Welford, "On the Driving of Automobiles by Older People," Journal of Gerontology, 19, No. 2 (1964), pp. 190-197.

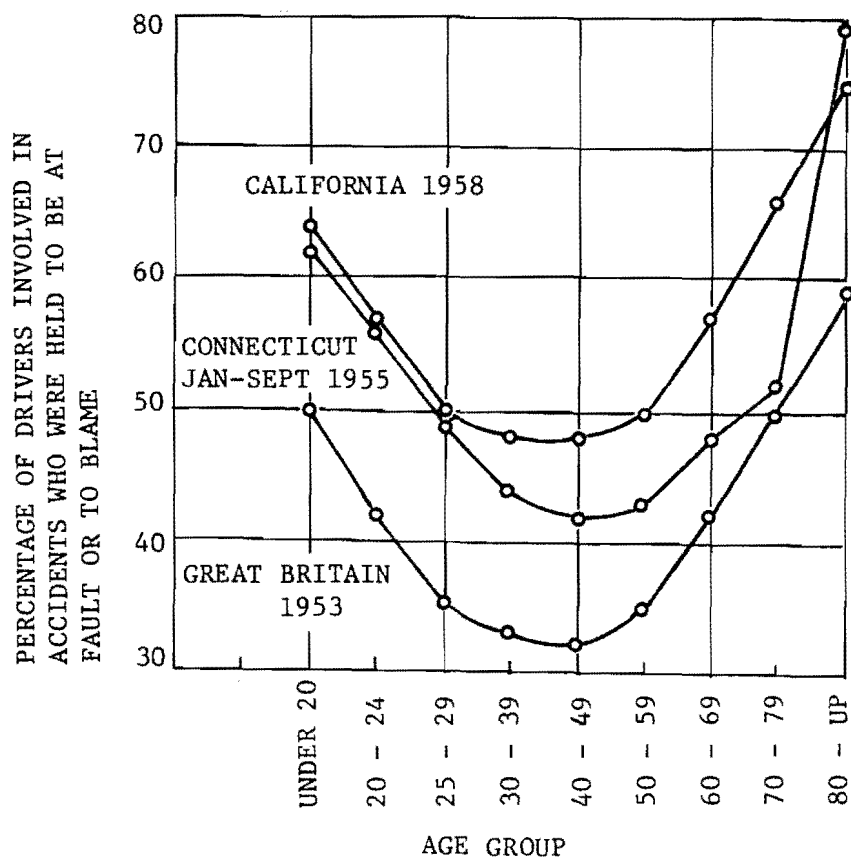


Figure 18. Percentage of drivers involved in accidents and "at fault," by age.

FROM: Ross A. McFarland, "The Older Driver and Accidents," Police (July-August 1966), figure 2.

less able to discriminate wanted from unwanted data when both are presented together and that there is a substantial decline with age in short-term memory, a function which has been shown to be bound up with problem solving and maintenance of orientation in space.

Thus, the aging process seems to have deleterious effects on driving capabilities. Research has been conducted to specifically identify the especially difficult or hazardous maneuvers for older drivers. Planek and Fowler gathered accident data from California and Virginia traffic records and analyzed these statistics across age groups.⁴⁶ These authors found that the older drivers had particular difficulty changing lanes, turning, passing and driving in reverse. They found that the older drivers were prone to make inattentive responses involving errors of omission, such as running red lights and stop signs.

McFarland concurs, stating that older drivers are frequently involved in accidents resulting from starting and turning and failure to give right of way.⁴⁷ The younger drivers are more likely to be involved in accidents resulting from speeding and use of faulty equipment, among other reasons.

Harrington and McBride, in their study of a large number of licensed drivers, report that sign violations were most frequent among the elderly.⁴⁸ These authors state that decrements in perception and psycho-physical skills are associated with aging, which probably plays an important role when perception, judgment and ability to carry out complex maneuvers are required.

Additional studies have been conducted in an attempt to measure the effects of poor health against increased accident rate. Waller reviewed the driving records of 444 individuals over 60 in a retirement community in

⁴⁶T.W. Planek and R.C. Fowler, "A Closer Look at the Older Driver," Traffic Safety (May 1969), p. 8.

⁴⁷Ross A. McFarland, "Age and Highway Accidents with Special Reference to Younger and Older Drivers," paper presented at the Second Congress of the International Association for Accident and Traffic Medicine, Stockholm, Sweden, August 9-12, 1966.

⁴⁸David M. Harrington and Robin S. McBride, "Traffic Violation by Type, Age, Sex, and Marital Status," Accident Analysis Prevention, 1 (May 1970), pp. 67-79.

California.⁴⁹ His sample was divided into four categories which included a physically healthy group (n = 83), a senile group (n = 82), a group with cardiovascular problems (n = 80) and a group evidencing both cardiovascular difficulties and senility (n = 199). A control group of 267 individuals with an age range of 30-59 who were also residents of the town in which the retirement community was located was used for comparison. Waller reported that the older individuals with cardiovascular disease had 1.6 times the number of crashes and 1.3 times the number of violations as those individuals in the control group. He also reported that there was a significant increase in accidents in the age group over 59 associated with senility or with senility and cardiovascular disease and a significant increase in violations in the group associated with senility and cardiovascular disease.

In another study, Waller compared the accident experience of 2160 drivers with medical conditions and 922 drivers not known to have any medical problems.⁵⁰ All individuals in the samples were licensed drivers and registered with the California Department of Motor Vehicles. The medical problems represented in the first group included epilepsy, diabetes, cardiovascular disease, alcoholism, and mental illness. Conviction for illegal use of drugs and a small group with miscellaneous disorders of mobility, coordination and vision, among others, were also represented.

Table 2 shows a comparison of the three-year accident and violation rates for drivers with and without medical conditions. It is interesting to note that the individuals over 60 with medical problems have a higher number of accidents per one million miles but their violation rate resembles the middle-aged group with medical problems. In the comparison groups, the elderly more closely resemble the young drivers.

Waller states, in conclusion, that

Medical conditions other than alcoholism affect 10 to 15% of middle-aged drivers and a somewhat larger proportion of older drivers . . . Removal of all these drivers

⁴⁹J.A. Waller, "Cardiovascular Disease, Aging and Traffic Accidents," Journal of Chronic Disease, 20 (1967), pp. 615-620.

⁵⁰J.A. Waller, "High 'Accident' Risk Among Middle-Aged Drivers and Pedestrians," Geriatrics, 21, No. 12 (1966), pp. 125-137.

TABLE 2

COMPARISON OF THREE-YEAR ACCIDENT AND VIOLATION RATES FOR 1807 DRIVERS WITH
AND 922 WITHOUT A MEDICAL CONDITION

Age	Drivers		Accidents per 1 million miles		Violations per 100,000 miles	
	With medical condition*	Comparison sample**	With medical condition***	Comparison sample	With medical condition***	Comparison sample
15 to 29	444	389	15.3	11.0	8.2	4.9
30 to 49	839	707	12.7	5.6	4.4	2.5
50 to 59	268	294	17.3	7.2	4.6	1.8
60 and over	256	240	24.3	11.4	4.2	3.0

FROM: J.A. Waller, "High 'Accident' Risk Among Middle-Aged Drivers and Pedestrians,"
Geriatrics, 21, No. 12 (1966), p. 127, table 2.

*Of this group, 352 persons did not drive during the three-year observation period, and age was unknown for 1 additional person who did drive.

**The sample of 922 license renewals was weighted to 1,646 to reflect the prevalence of drivers with licenses of different durations, since drivers with poor accident and violation records who receive two-year instead of five-year licenses would be over-represented without weighting. Sixteen records have been excluded because age was unknown.

***Accident and violation information was unavailable for 6 drivers in the medical sample.

from the road theoretically could reduce the accident toll by a maximum of about 25% (10% to 15% by reducing the number of drivers and an additional 10 to 15% by avoiding their excess medically related accidents . . .

Two very serious limitations exist, however, in reaching this theoretical goal.⁵¹

Waller specifies that these two limitations are: 1) that one half of the drivers who have heart attacks behind the wheel are unaware of their heart condition until the accident occurs, and 2) that removal of driving privileges from this population may have serious economic repercussions for the community.

It may generally be concluded that the elderly driver does have a disproportionate number of crashes and violations but not so severe as the young driver. Wiener suggests that we also investigate the "normal driver," who has most of the accidents and violations, rather than continuing to focus on the "bad egg" driver.⁵²

Generally, the older drivers do not receive the same rigorous investigation as the younger drivers regarding variables affecting the driving record. Baker and Spitz, for example, suggest that research measuring severity of the crash is biased against the older driver.⁵³ The elderly have a decreased ability to survive accidents, the authors state, and, thus, the older people are overrepresented among the fatally injured and in medical seriousness, and resulting complications of even a minor crash increase severity ratings.

Planek and Fowler also point out that individual chronological age is not an entirely appropriate measure of accident expectancy.⁵⁴ Age represents different points on a young-old continuum, with individual differences being an important consideration.

⁵¹Ibid., p. 134.

⁵²Earl L. Wiener, "Licensing the Elderly Driver -- Legal and Scientific Problems," Traffic Safety (May 1973), pp. 8-11, 36-37.

⁵³S.P. Baker and W.U. Spitz, "Age Effects and Autopsy Evidence of Disease in Fatally Injured Drivers," Journal of AMA, 214 (1970), pp. 1079-1088.

⁵⁴Planek and Fowler, op. cit., p. 8.

IX. ACCIDENTS ASSOCIATED WITH AGE IN INDUSTRIAL SETTINGS

Accidents occurring in the industrial setting have also received attention among researchers. Results in such settings may have applicability to traffic control, and many of the findings are consistent with the findings of traffic accident studies. Unfortunately, establishing a clear relationship between age and accident occurrence is difficult because of the complexity of intervening variables, in this setting also. Once again, experience and length of time performing a job influence accident rate. Tiffin suggests that younger employees may be placed in more hazardous jobs, thus increasing accident occurrence.⁵⁵ He also points out that because the younger worker has fewer responsibilities he may be less safety cautious and may take more risks.

The risk involved on any individual job may also influence accident-severity rates. In addition, Powell, Hale, Martin and Simon suggest that technical factors such as differences in apparently identical machines, due to wear and maintenance, cannot be ignored.⁵⁶

It is important when considering the research that the above mentioned variables be taken into consideration. King and Speakman state that rather than taking a mass collection of data, a "detailed approach taking into account differences in age distribution of workers on different jobs, effects of selection, work history and experience of individuals, standards of reporting and types and degree of hazard of work" must be utilized.⁵⁷

A number of studies indicate that younger workers have more industrial accidents than older workers. Sleight and Cook review several studies which tentatively suggest this to be true. Sleight and Cook cite studies of miners which show that the highest number of accidents occur to the 21 to 30

⁵⁵J. Tiffin, Industrial Psychology (3rd edition) (New York: Prentice Hall, 1952).

⁵⁶P.I. Powell, M. Hale, H. Martin, and M. Simon, 2,000 Accidents: A Shop Floor Study of Their Causes (London, England: National Institute of Industrial Psychology, 1971).

⁵⁷H.F. King and D. Speakman, "Age and Industrial Accident Rate," British Journal of Industrial Medicine, 10 (1953), p. 56.

year old worker.⁵⁸ However, it is suggested that the high accident rates among the young are due to the high number of apprentices.

There is some evidence, however inconclusive, that the older worker suffers more accidents than the younger worker.⁵⁹ Again, monitoring severity of accidents by amount of work-time lost or Workman's Compensation benefits received does not take into account an older person's decreased ability to recover from an accident as quickly as a younger worker involved in a similar accident.

McFarland suggests that aging is an individual matter and that the important consideration is functional age rather than chronological age.⁶⁰ The author goes on to state that aging may have more significance for some occupational groups than for others.

King and Speakman believe that "the exact shape of the accident curve will vary according to the nature and stresses of the job and the working conditions so that the older workers may have a more or less favorable accident rate according to circumstances."⁶¹

Suggestions have been made regarding how to ensure the older workers' safety and to ensure appropriate job placement while maintaining employment. McFarland suggests that industry redesign tasks to emphasize the older workers' strengths, such as their ability to learn more readily and to learn by activity rather than memory.⁶² He also suggests that the pace of instruction be slower and that the instruction be given as directly and unambiguously as possible.

⁵⁸Robert B. Sleight and Kenneth G. Cook, Problems in Occupational Safety and Health, vol. 1: A Critical Review of Select Worker Physical and Psychological Factors (Washington, D.C.: U.S. Department of Health, Education and Welfare, November 1974).

⁵⁹Ibid.; and King and Speakman, op. cit., pp. 51-58.

⁶⁰Ross A. McFarland, "The Psychological Aspects of Aging," Bulletin of the New York Academy of Medicine, 32, No. 1 (January 1956, Second Semester), pp. 14-32.

⁶¹King and Speakman, op. cit., p. 58.

⁶²Ross A. McFarland, "The Need for Functional Age Measurement in Industrial Gerontology," Industrial Gerontology, Fall 1973.

McFarland and Philbrook suggest a method of job placement for older workers which matches the abilities of the person to the individual physical requirements of a specific job.⁶³ The authors state that knowledge of the physical demands of the job plus knowledge of the physical abilities of the person are essential and that both elements should be described in the same terminology and be sufficiently objective. The authors suggest that a Profile of Physical Abilities be completed by an industrial physician: it would reflect the degree, kind and duration of effort of which each worker was capable. This Profile would be matched with the requirements of a specific job, and appropriate job placement could be made.

Some general observations and conclusions regarding the relationship of age to accident occurrence in industry have been made by Sleight and Cook in their review of the literature.⁶⁴ Their evidence has been summarized as follows:

1. Workers in the age range of from about 25 or 30 years to about 55 years generally appear to have fewer accidents than might be expected by chance.
2. Tasks requiring a considerable amount of judgment and anticipation of unexpected conditions may result in the younger worker's being at a disadvantage.
3. If the task is so structured or the pace of performance is so rigidly determined that it does not permit the older worker to compensate, then the effects of aging can be severe.
4. Older workers will, in general, do less well on complex tasks requiring fast response.

These generalizations no doubt are also relevant to traffic safety, and traffic researchers should become acquainted with industrial accident studies.

⁶³Ross A. McFarland and Frank Randolph Philbrook, "Job Placement and Adjustment for Older Workers," Geriatrics, 13 (December 1958), pp. 802-807.

⁶⁴Sleight and Cook, op. cit.

X. CRITICISM OF AGE-ACCIDENT RESEARCH

The extreme difficulty of isolating age as a variable with regard to accidents has been illustrated. Although many authors have attempted to control for extraneous variables, criticisms of the studies must be mentioned.

Aaron, Sleight and Cook, and McFarland believe that chronological age is a poor criterion by which to judge accident behavior, due to the wide physiological, psychological and functional differences among individuals.⁶⁵ Pelz and his associates and Aaron specifically criticize age research on the young and traffic accidents because researchers have often lumped together the 16-25 year olds without analyzing the data by individual ages.⁶⁶

The problems of controlling for exposure and experience are inherent in age-accident research in both traffic and industrial settings. To find reliable measures of exposure and an adequate control group in experience, further exploration is needed.⁶⁷

Klein also discusses research problems in the area of police reporting: lack of follow-up, lack of interdisciplinary research, and inadequate attention to individual personality differences, among others.⁶⁸

Sleight and Cook, Tiffin, and others have mentioned the fact that there are selection factors operating in industry which interfere with age-accident research results.⁶⁹ Older workers, for example, may select-out the most suitable individual jobs and hence perform tasks less accident-labile for them.

⁶⁵ Aaron, op. cit.; Sleight and Cook, op. cit.; and McFarland, "The Psychological Aspects of Aging," op. cit.

⁶⁶ Pelz and Schuman, "Are Young Drivers Really More Dangerous After Controlling for Exposure and Experience?" op. cit., "Dangerous Young Drivers," op. cit., "What is the 'Dangerous Age' for Young Drivers?" op. cit., "Drinking, Hostility and Alientation in Driving of Young Men," op. cit., Motivational Factors in Crashes and Violations of Young Drivers, op. cit.; and Aaron, op. cit.

⁶⁷ Klein, "A Reappraisal of the Violation and Accident Data on Teenaged Drivers," op. cit.; and Sleight and Cook, op. cit.

⁶⁸ Klein, "A Reappraisal of the Violation and Accident Data on Teenaged Drivers," op. cit., and "The Teenaged Driver- A Research Paradigm," op. cit.

⁶⁹ Sleight and Cook, op. cit.; and Tiffin, op. cit.

Generally, it may be stated that, although evidence exists showing the young and the aged are more likely than would be expected by chance to have accidents (particularly vehicular accidents), the research results must be viewed with skepticism.

In addition to the suggestions mentioned earlier, methods for reducing accidents, giving particular attention to the age variable, have been proposed by other authors.

Aaron stresses the necessity for improving safety attitudes through modification of a person's value structure.⁷⁰ This he feels could be accomplished through driver education courses or seminars. Aaron lists 16 ways that drivers education could successfully improve student attitudes. This list includes, among other items, that the instructor be knowledgeable in the area of human behavior and broadly versed in traffic behavior. He states that the course should have a unit on attitudes and effects of personality woven throughout the course. Aaron also suggests that the help of school faculty as well as parents should be solicited.

Pelz and Williams mention some practical implications for accident prevention from their study of 17 and 18 year old students from 10 randomly selected high schools adjacent to Detroit.⁷¹ The authors report that workshops have potential for long-term development of positive highway behavior, particularly if applied selectively to educationally alienated students. They also suggest that workshops be held in the student's junior year of high school and emphasis be placed on group discussion supplemented with discussion of individual experiences. Pelz and Williams also found that mailings and assemblies conducted by police had no effect on driving behavior as measured by accident and violation rate.

McFarland and Newsome point to the alteration of the driving license test as a possible means for reducing accident rates.⁷² Newsome suggests

⁷⁰ Aaron, op. cit.

⁷¹ Donald C. Pelz and Patricia A. Williams, Countermeasures for Young Drivers (Ann Arbor, Michigan: Institute for Social Research, University of Michigan, July 1974).

⁷² Ross A. McFarland, "The Older Driver and Accidents," op. cit.; and L.R. Newsome, "Can We Improve the Driving Test?" Australian Psychologist, 10, No. 2 (July 1975).

investigating the reduction of the allowable number of re-tests, re-evaluating present criteria for passing, and adding to the test.

McFarland suggests that "tests of driving ability which are likely to be developed must be more complex than the conventional laboratory tasks and must measure the changing of driving ability with age."⁷³ He also says that certain tasks and abilities may be more appropriately measured at varying ages.

⁷³McFarland, "The Older Driver and Accidents," op. cit.

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THE AUTHORS

Deborah Valentine is a doctoral student in the Graduate School of Social Work at The University of Texas at Austin. She received her M.S.W. from The University of Texas at Austin (1973) and prior to that her undergraduate training in psychology at the University of Illinois (B.A., 1970).

Valentine was director of Social Services at the Settlement Club of Austin, a treatment center for disturbed adolescents, from 1973 to 1976. There she was in charge of intake, therapy, family treatment and discharge planning. Previously, she had worked in Illinois and Colorado, where she provided clinical services to brain damaged, autistic and emotionally disturbed children and adolescents.

Martha Williams, Professor of Social Work, joined the faculty of The University of Texas at Austin in 1966. She received both her undergraduate training in psychology (B.A., 1957) and her graduate training in psychology and management (M.A., 1962; Ph.D., 1963) at The University of Texas at Austin. She was a social science research associate in the Business School and the Law School at UT prior to joining the Social Work faculty. She is a member of the American Psychological Association and is a licensed psychologist in the State of Texas.

Williams' research and interests lie mainly in the areas of applied research methods, organizational psychology and evaluation research in human services organizations. She has published numerous articles on these topics.

Robert K. Young, Professor of Psychology, joined the faculty of The University of Texas in 1956. He received his B.A. in psychology from Miami University in 1951 and his Ph.D. in psychology from Northwestern University in 1954. While in the U.S. Army from 1954 to 1956, he served as chief of the Psychological Services Branch of the Quartermaster Research and Development Field Evaluation Agency at Fort Lee, Virginia.

Young is the author of many articles and books in the areas of learning, experimental design and statistics. He is a member of the American Psychological Association and is a licensed psychologist in the State of Texas. Young's interests lie in the areas of learning strategies, programmed instruction, and the use of statistical techniques in applied research.

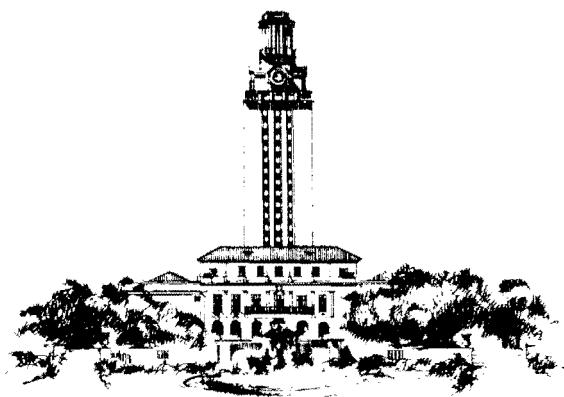
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