DOT-HS-806-593
DOT-TSC-NHTSA-84-3

Assessment of Driver Inexperience with an Automobile as a Factor Which Contributes to Highway Accidents

Paul Hoxie

Transportation Systems Center
Cambridge MA 02142

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Final Report

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16. Abstract

This study addresses the statistical relationship between driver familiarity with vehicles and accident frequency. In 1981, 8.9 percent of all drivers in NASS-reported automobile accidents had less than 150 miles driving experience with the accident vehicle. Our best estimate of the share of driving done by this group is 1.5 percent. The study examined the NASS data for reporting bias and performed statistical tests to determine whether other factors explain the hightened risk. The study concluded that driving experience with the vehicle per se is an important factor influencing accident risk.

The study suggests an inexpensive countermeasure and recommends that additional information which could be collected in NASS might lead to an even more cost-effective countermeasure.

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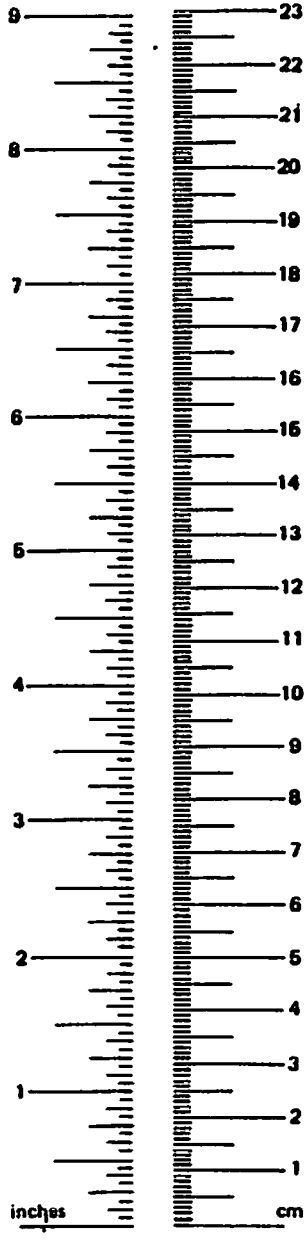
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

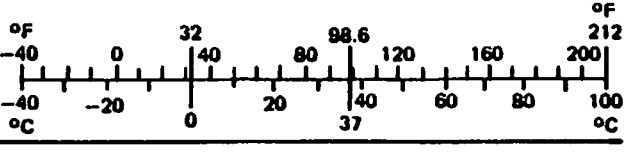
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	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

*1 in. = 2.54 cm (exactly). For other exact conversions and more detail tables see NBS Misc. Publ. 286, Units of Weight and Measures. Price $2.25 SD Catalog No. C13 10 286.



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	36	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



PREFACE

The Assessment of Driver Inexperience With an Automobile As A Factor Which Contributes to Highway Accidents addresses the statistical relationship between driver familiarity with vehicles and accident frequency.

In 1981, 8.9 percent of all drivers in NASS-reported automobile accidents had less than 150 miles driving experience with the accident vehicle.* The best estimate of the share of driving done by ths group is 1.5 percent. The study examines the NASS data for reporting bias and performs statistical tests to determine whether other factors explain the heightened risk. The study concludes that driving inexperience with the vehicle per se is an important factor influencing the accident risk.

The study suggests an inexpensive countermeasure and recommends that additional information which could be collected in NASS might lead to an even more cost-effective countermeasure.

The assessment has been prepared by the Research and Special Programs Administration, D.O.T., Transportation Systems Center, Kendall Square, Cambridge, MA, under sponsorship of the U.S. D.O.T./National Highway Traffic Safety Administration, Office of Research and Development, Washington, DC.

*An earlier study of driver familiarity with accident-involved passenger cars using NASS-reported accidents as a data source found this same percentage to be 8.8 in 1979, and 9.9 in 1980. Reference the following publication for additional details: M. Perel, "Vehicle Familiarity and Safety," NHTSA, Office of Vehicle Safety Research, Crash Avoidance Research Division, DOT-HS-806509, July 1983.

The support of many people improved this report. Ronald DiGregorio produced the countless NASS tables on which the report is based. Simon Prensky provided suggestions on the development of the total exposure estimates. Peter Mengert supplied expert statistical advice and helped with the development of the lower bound on the unfamiliar driver accident involvements. Henri Richardson and James Hedlund made many substantial suggestions which have improved the analysis. Robin Barnes typed and revised the report and Donald Sussman provided helpful editorial suggestions.

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1.0 INTRODUCTION

In 1981, 8.9 percent of all drivers in NASS-reported automobile accidents had less than 150 miles driving experience with the accident vehicle. While there is no accurate estimate of the share of all driving performed by this group, our best estimate is about 1.5 percent (see Table 1). Thus, familiarity with the vehicle appears to be an important factor contributing to accidents. The objective of this study is to examine the NASS data further to determine whether the result holds up under more detailed scrutiny. Specifically, (1) is the result caused by a reporting bias in NASS; and (2) are other factors which are known to influence accident rates responsible for the effect?

The two sections below present data in answer to these questions. A third section summarizes other factors which may contribute to accidents involving drivers with less than 150 miles experience with the vehicle. The conclusions and recommendations are presented in the fourth section.

TABLE 1

ESTIMATING THE SHARE OF DRIVING WHERE DRIVERS HAVE LESS THAN 150 MILES EXPERIENCE WITH THE VEHICLE

		Best Estimate	High Share Est.
I	Newly Purchased Cars		
	1. New Car Sales 1981(A)	8,637,536	same
	2. Fraction of cars purchased new	0.473(B)	0.40
	3. Total car sales in 1981 (#1/#2)	18,244,870	21,593,840
	4. Estimated drivers/household vehicle(C) (including borrowers)	3	5
	5. Mileage in newly-purchased household vehicles by drivers with less than 150 miles experience (#3 * #4 * 150)	8.2×10^9	16.2×10^9
II	New Drivers		
	6. Maximum number of drivers of any age in 1981 (24 year-olds)(D)	3,954,000	4,200,000
	7. Fraction of households without a car (1980)(E)	.128	
	8. Average cars per household (1980)(F)	1.30	
	9. Average cars per household with a newly licensed driver #8 ÷ (1-#7)	1.49	2.24(G)
	10. Annual mileage where new drivers have less than 150 miles experience with the car (#6 * #9 * 150)	$.9 \times 10^9$	1.4×10^9
III	Rental Drivers		
	11. Rental car fleet 1981(H)	462,000	same
	12. Average annual lease/rental car mileage/vehicle 1981(H)	31,894	same
	13. Estimated fraction of mileage where drivers have less than 150 miles experience with the vehicle	0.5	1.0

TABLE 1

ESTIMATING THE SHARE OF DRIVING WHERE DRIVERS HAVE LESS THAN 150 MILES EXPERIENCE WITH THE VEHICLE (CONT'D)

	14. Rental car mileage where drivers have less than 150 miles experience with the vehicle (#11 * #12 * #13)	7.4×10^9	14.7×10^9
IV	Total		
	15. Total vehicle miles where drivers have less than 150 miles experience with the vehicle (#5 + #10 + #14)	16.5×10^9	32.3×10^9
	16. Total VMT for passenger cars in 1981(I)	$1{,}110 \times 10^9$	same
	17. Fraction of VMT where drivers have less than 150 miles experience with the vehicle (#15 ÷ #16)	1.5%	2.9%

NOTES AND SOURCES:

A. Ward's Automotive Yearbook 1982, p. 101. Includes 1,218,416 fleet cars (business leased, government, rental, taxi) "Automotive Fleet" Fact Book, April 1982, p. 23. They are treated as household vehicles.

B. 1977 NPTS.

C. Note that there were about 2.02 people over 16 per household in 1982, based on data Table 25 in Household and Family Characteristics: March 1982 by Steve W. Rawlings, Bureau of Census, May 1983.

D. Since newly licensed drivers are not reported, the best estimate of this number is the maximum number of drivers of any single age group. Newly licensed drivers in excess of this number cannot be sustained. Source: Highway Statistics 1981 FHWA.

E. MVMA Motor Vehicle Facts and Figures 1982, p. 45.

F. Transportation Energy Conservation Data Book: Edition 5, Oak Ridge National Laboratory, November 1981, pp. 4-19.

G. Average number of vehicles (include trucks, motorcycles, etc.) per household with three adults in 1977. Source: Transportation Energy Conservation Data Book: Edition 5, Oak Ridge National Laboratory, November 1981, pp. 2-24.

H. "Automotive Fleet" Fact Book, April 1982, pp. 21 and 32.

I. Highway Statistics 1982, FHWA.

2.0 EXAMINATION OF REPORTING BIAS

2.1 Drivers Without a Reported Familiarity

Table 2 shows that even if all of the drivers with unknown familiarity were familiar with the vehicle, unfamiliar drivers would still account for 5.6 percent of the drivers in NASS-reported accidents which is still more than the 1.5 percent which would be expected based only on miles driven. Still, because the drivers with unknown familiarity with the accident vehicle are such a large fraction of all drivers (36.4 percent), the actual distribution of these unknown drivers between the familiar and unfamiliar groups could change the conclusions about the influence of other factors. So, the distribution of other factors for the unknown group is presented on all tables in this report.

Note that a difference of five percentage points or more is significant at approximately the 95 percent confidence level (see Appendix B). In the remainder of this report, five percentage points will be viewed as the critical level in assessing differences between the unfamiliar and familiar driver groups.

2.2 Overreporting by Certain Primary Sampling Units (PSU'S)

Coding errors or misunderstandings could cause certain PSUs to over report unfamiliar drivers. Table 3 presents the percentage of driver accident involvements in each PSU for four groups of drivers: (1) unfamiliar drivers with less than 150 miles experience with the vehicle; (2) familiar drivers with more than 150 miles experience with the vehicle; (3) all drivers, including both familiarity levels and unknown familiarity; and (4) drivers with unknown familiarity. These four categories are used throughout this section. Appendix A shows the SAS program defining these groups. Unfamilliar drivers appear somewhat overrepresented in PSU 76 but not enough overrepresented to indicate errors.

TABLE 2

DRIVERS IN NASS-REPORTED ACCIDENTS BY
FAMILIARITY OF THE DRIVER WITH THE VEHICLE

	RAW SAMPLE DATA			DATA INFLATED TO U.S. TOTALS		
	NUMBER	PERCENT OF KNOWN	PERCENT OF TOTAL	NUMBER	PERCENT OF KNOWN	PERCENT OF TOTAL
Unfamiliar (≤150 Miles)	374	8.9	5.6	439,316	8.8	5.5
Familiar (>150 Miles)	3844	91.1	58.0	4,532,838	91.2	56.6
Unknown	2411	---	36.4	3,028,483	---	37.9
Total	6629*	---	100.0	8,000,636	---	100.0

SOURCE: 1981 NASS

*Note that 6629 passenger cars were contained in the version of the 1981 NASS which was available at the time of this data analysis (April 1983). Since then, the final edited version of the 1981 NASS has been completed. It contains 6603 passenger cars. The difference probably reflects redundant or erroneous observations deleted in the final version.

TABLE 3
PERCENTAGE OF DRIVERS BY PSU AND FAMILIARITY

PSU	UNFAMILIAR DRIVERS	FAMILIAR DRIVERS	ALL DRIVERS	UNKNOWN FAMILIARITY
1	5.5	5.6	7.0	9.3
2	3.4	5.1	3.9	2.1
3	4.0	6.1	5.4	4.5
4	6.3	5.9	4.5	2.1
5	2.1	7.6	4.8	.9
6	.9	2.2	1.9	1.5
7	5.0	2.3	2.2	1.7
26	6.3	4.8	4.7	4.2
27	3.6	2.3	2.8	3.5
28	1.8	3.1	4.0	5.8
29	.3	1.5	5.3	11.7
30	4.4	3.3	3.5	3.7
31	.1	.3	.5	.9
32	1.2	1.0	1.0	.9
33	1.4	1.7	1.1	.3
51	11.7	6.6	9.8	14.3
52	5.3	3.9	2.8	.8
53	2.2	2.4	1.7	.5
54	2.1	4.1	3.2	2.1
55	.4	4.0	2.5	.6
76	9.7	4.0	3.2	1.1
77	.9	2.9	3.9	6.0
78	5.5	4.6	5.6	7.1
79	1.6	1.0	1.3	1.7
80	8.6	6.7	5.9	4.3
81	1.4	1.3	1.6	2.2
82	1.4	2.3	2.2	2.1
83	---	.6	1.0	1.8
84	.5	.8	.8	.8
85	2.5	2.0	1.9	1.6
	100.0	100.0	100.0	100.0

SOURCE: 1981 NASS inflated to U.S. Totals

2.3 Overreporting Less Serious Accidents

Drivers who are unfamiliar with their vehicle may notify the police of less serious accidents more often than familiar drivers. Table 4 presents the reported police injury severity by driver familiarity. Table 4 shows that unfamiliar drivers have slightly more "possible injuries" than other driver groups. This is not conclusive because unfamiliar drivers may be involved in different types of accidents than familiar drivers. Table 5 presents the percentage of drivers in accidents of different types by driver familiarity. Rear-end collisions appear to be underrepresented for unfamiliar drivers and non-collision accidents appear to be overrepresented. The distribution of injury severity by accident type may reveal that less severe accidents are more often reported when unfamiliar drivers are involved.

Table 6 presents the percentage of drivers in accidents for each police-reported injury severity level, by driver familiarity, for angle collisions, rear-end collisions and non-collision accidents.* In angle collisions, unfamiliar drivers are under represented in non-incapacitating injuries and overrepresented in both the no injury and possible injury categories. Unfamiliar drivers are overrepresented in the non-incapacitating and possible injury categories and underrepresented in the no injury category of rear-end collisions. In non-collision accidents, unfamiliar drivers are overrepresented in the possible injury category and underrepresented in both the no-injury and injured categories.

Unfamiliar drivers are consistently overrepresented in the possible injury category. Since no category is consistently underrepresented and "possible injury" is not clearly more or less severe than other categories, no conclusion can be reached about a reporting bias between familiar and unfamiliar drivers.

In summary, the analysis indicates that neither drivers without a reported familiarity nor reporting errors by certain PSUs nor over reporting of less severe accidents by unfamiliar drivers causes a reporting bias which accounts for the substantial over representation of unfamiliar drivers in NASS reported accidents.

*Note that five percentage points is not a significant difference in Table 6 because the number of driver involvements is lower than used in Appendix B. It still provides a rough guide.

TABLE 4
POLICE REPORTED INJURY SEVERITY BY DRIVER FAMILIARITY
(PERCENT OF DRIVERS BY FAMILIARITY GROUP)

POLICE SEVERITY	UNFAMILIAR DRIVERS	FAMILIAR DRIVERS	ALL DRIVERS	UNKNOWN FAMILIARITY
No Injury	66	68	67	65
Possible Injury	18	13	14	16
Non-Incapacitating Injury	12	14	14	14
Incapacitating Injury	3	4	4	5
Killed	0	0	0	0
Injured; Severity Unknown	0	0	0	0
	100	100	100	100

SOURCE: 1981 NASS inflated to U.S. totals

TABLE 5
MANNER OF COLLISION BY DRIVER FAMILIARITY
(PERCENT OF DRIVERS BY FAMILIARITY GROUP)

MANNER OF COLLISION	UNFAMILIAR DRIVERS	FAMILIAR DRIVERS	ALL DRIVERS	UNKNOWN FAMILIARITY
Non-Collision	26	20	21	23
Rear-End	18	28	26	25
Head-On	3	5	4	4
Angle	43	41	42	43
Side Swipe Same Direction	6	4	4	4
Side Swipe Opposite Direction	4	2	2	2
	100	100	100	100

SOURCE: 1981 NASS inflated to U.S. totals

TABLE 6
POLICE REPORTED INJURY SEVERITY BY DRIVER FAMILIARITY FOR ANGLE AND REAR-END COLLISIONS AND NON-COLLISIONS (PERCENT OF INVOLVEMENT BY DRIVER GROUP)

	UNFAMILIAR DRIVERS	FAMILIAR DRIVERS	ALL DRIVERS	UNKNOWN FAMILIARITY
ANGLE COLLISIONS				
No Injury	77	72	72	72
Possible Injury	17	12	12	12
Non-Incapacitating	4	13	12	12
Killed or Incapaciting	2	3	4	4
	100	100	100	100
REAR-END COLLISION				
No Injury	50	73	66	54
Possible Injury	31	17	22	31
Non-Incapacitating	18	8	10	13
Killed or Incapaciting	1	2	2	2
	100	100	100	100
NON COLLISION				
No Injury	50	54	57	61
Possible Injury	19	12	11	9
Non-Incapacitating	23	23	22	20
Killed or Incapaciting	8	9	9	10
Injured, Severity Unknown	0	2	1	0
	100	100	100	100

SOURCE: 1981 NASS inflated to U.S. totals

3.0 OTHER PRIMARY FACTORS

A number of factors which are known to influence accident rates may be correlated with driver familiarity with the accident vehicle. Tables 7-11 present the distributions of driver age-sex, experience driving the road, months driving experience, license status, and alcohol involvement for the unfamiliar, familiar, unknown familiarity, and all drivers groups. In each of these tables, drivers who would be expected to have higher accident rates are overrepresented in the unfamiliar driver group. Drivers with invalid licenses or learner's permits account for 12 percent of the unfamiliar drivers but only 5 percent of all drivers. Young males and females account for 54 percent of the unfamiliar drivers but only 44 percent of all drivers. First time and less than monthly driving the road describes the experience of 29 percent of the unfamiliar drivers but only 17 percent of all drivers. Drivers with a month or less experience driving the type of vehicle involved in the accident account for 5.5 percent of the unfamiliar drivers but less than one percent of all drivers. Alcohol is identified as a contributing factor in the accident for 10 percent of the unfamiliar drivers but only 5 percent of all drivers.

It should also be noted that the drivers with unknown familiarity are included in the all drivers group and that drivers with unknown familiarity are overrepresented in the first time driving the road, young female, and 2-6 months experience with the vehicle-type groups.

Even though unfamiliar drivers are overrepresented in each of these five high-risk driver categories, driver familiarity per se may still be an important factor influencing the accident rate. In an attempt to evaluate this possibility without the appropriate multivariate exposure data, an upper bound on the influence of the other factors is assumed. Suppose that each of the other factors, if present, was the sole source of the accident. If, after removing the accidents involving unfamiliar drivers where these factors are present, unfamiliar drivers are still overrepresented when compared to the share of all driving (VMT) performed by this group, then driver familiarity would be established as an important factor influencing accidents.

On the other hand, if removing the accidents where these factors are present results in no over representation, then it is still possible that driver familiarity is an important factor in the accident, but there is doubt. Table 12 presents the results of this analysis. Of 4,174 accident-involved drivers, 124 or 3.0 percent were unfamiliar with the vehicle and were not considered high-risk based on age, sex, license status, frequency of driving the road, driving experience with the class of vehicle, or alcohol involvement. This share, 3.0 percent, is roughly twice the best-estimate share (1.5 percent) of VMT where the driver is unfamiliar with the vehicle, and is slightly higher than even the high-estimate of the share of driving by this group. So, we conclude that driver familiarity with the vehicle is an important factor which influences accident rates beyond the effects of the high-risk factors which are correlated with drivers who are unfamiliar with the vehicle.

TABLE 7
DRIVER AGE-SEX BY DRIVER FAMILIARITY
(PERCENT OF TOTAL DRIVERS FOR EACH GROUP)

SEX AND AGE OF DRIVER	UNFAMILIAR DRIVERS	FAMILIAR DRIVERS	ALL DRIVERS	UNKNOWN FAMILIARITY
Male				
< 26	53	41	43	44
26-55	35	43	42	43
>55	12	16	15	13
Total	100	100	100	100
Female				
< 26	56	33	47	59
26-55	38	52	41	33
>55	6	15	12	8
Total	100	100	100	100
Both Sexes				
< 26	54	38	44	50
26-55	36	46	42	39
>55	10	16	14	11
Total	100	100	100	100

SOURCE: 1981 NASS inflated to U.S. totals

TABLE 8
EXPERIENCE DRIVING THE ROAD BY DRIVER FAMILIARITY
(PERCENT OF TOTAL DRIVERS FOR EACH GROUP)

FREQUENCY DRIVING THE ROAD	UNFAMILIAR DRIVERS	FAMILIAR DRIVERS	ALL DRIVERS	UNKNOWN FAMILIARITY
First Time	13	5	6	12
Less Than Monthly	16	11	11	10
Monthly	8	11	10	6
Weekly	28	24	25	31
Daily	34	50	48	41
	100	100	100	100

SOURCE: 1981 NASS inflated to U.S. totals

TABLE 9
MONTHS DRIVING EXPERIENCE WITH PASSENGER CARS BY DRIVER FAMILIARITY (PERCENT OF TOTAL DRIVERS FOR EACH GROUP)

MONTHS DRIVING EXPERIENCE	UNFAMILIAR DRIVERS	FAMILIAR DRIVERS	ALL DRIVERS	UNKNOWN FAMILIARITY
1	5.5	.3	.7	.3
2	.6	.1	.3	1.7
3	.9	.3	.5	2.9
4-6	5.9	1.8	2.3	3.6
7-12	3.4	2.4	2.4	2.5
12-24	5.8	6.3	6.6	10.6
24-60	15.3	11.8	12.1	12.7
GT-60	62.6	77.1	75.0	65.7
	100.0	100.0	100.0	100.0

SOURCE: 1981 NASS inflated to U.S. totals

TABLE 10
LICENSE STATUS OF DRIVER FAMILIARITY
(PERCENT OF TOTAL DRIVERS FOR EACH GROUP)

LICENSE STATUS	UNFAMILIAR DRIVERS	FAMILIAR DRIVERS	ALL DRIVERS	UNKNOWN FAMILIARITY
Learner's Permit	1	0	0	1
Valid License	88	97	95	93
Other	11	3	5	6
	100	100	100	100

SOURCE: 1981 NASS inflated to U.S. totals

TABLE 11
ALCOHOL INVOLVEMENT BY DRIVER FAMILIARITY
(PERCENT OF TOTAL DRIVERS FOR EACH GROUP)

ALCOHOL INVOLVEMENT	UNFAMILIAR DRIVERS	FAMILIAR DRIVERS	ALL DRIVERS	UNKNOWN FAMILIARITY
Yes	10	5	5	6
No	90	95	95	94
	100	100	100	100

SOURCE: 1981 NASS inflated to U.S. totals

TABLE 12
ESTIMATING THE LOWER BOUND ON THE SHARE OF UNFAMILIAR DRIVER ACCIDENT INVOLVEMENTS

	Accident Involved Drivers (Percent of Grand Total)		
	UNFAMILIAR	FAMILIAR	TOTAL
LOW RISK*	124 (3.0)	2103 (50.4)	2227 (53.4)
HIGH RISK	229 (5.5)	1718 (41.1)	1947 (46.6)
TOTAL	353 (8.5)	3821 (91.5)	4174 (100.0)

*Low Risk = All males over 26 who drive the road monthly or more frequently; and who have a valid driver's license; and have more than one month experience driving cars; and who were not involved in alcohol-related accidents; together with all females with the same four characteristics.

High Risk = All other accident involved drivers.

SOURCE: 1981 NASS

4.0 CONTRIBUTING FACTORS

In this section, we attempt to identify other factors which may contribute to accidents when drivers are unfamiliar with the vehicle. Unlike the factors considered in the previous section, these factors are not obviously associated with high risk. Probably the most obvious factor to examine is the make of the auto. Unusual vehicle performance or control layout might make a specific auto-make more likely to be involved in accidents with an unfamiliar driver. Table 13 shows driver familiarity by vehicle make. No make of car appears to be over represented.

Similar analyses were performed for 27 other factors which are recorded for NASS accidents. Table 14 lists the factors examined which were not over or underrepresented by five percentage points or more. A difference of five percentage points or more is significant at roughly the 95 percent confidence level.

Table 15 presents the factors where one or more levels of a factor was over or underrepresented by five percentage points or more. This should be interpreted simply as an indication that the factor may contribute to accidents along with driver familiarity with the accident vehicle. These factors do not suggest a typical scenario for accidents involving drivers who are unfamiliar with the accident vehicle.

TABLE 13
MAKES OF CARS BY DRIVER FAMILIARITY
(PERCENT OF TOTAL DRIVERS FOR EACH GROUP)

MAKE (CODE)	UNFAMILIAR DRIVERS	FAMILIAR DRIVERS	ALL DRIVERS	UNKNOWN FAMILIARITY
AMC (1)	1.6	3.3	2.7	1.9
Chrylser (6)	.4	1.7	1.5	1.5
Dodge (7)	3.8	4.1	3.8	3.4
Imperial (8)	*	0.1	0.1	*
Plymouth (9)	8.2	6.1	6.4	6.5
Ford (12)	16.0	16.1	15.9	15.7
Lincoln (13)	1.0	1.0	0.9	0.6
Mercury (14)	5.2	4.3	4.2	3.8
Buick (18)	7.7	7.5	7.6	7.8
Cadillac (19)	2.0	2.4	3.1	4.7
Chevrolet (20)	23.1	23.5	23.1	22.3
Oldsmobile (21)	8.5	7.1	8.1	9.9
Pontiac (22)	7.3	7.5	7.7	8.0
Other Domestic (29)	*	0.2	0.3	0.4
Volkswagen (30)	2.0	2.6	2.8	3.3
Audi (32)	0.1	0.2	0.3	0.3
BMW (34)	0.1	*	0.1	0.2
Datsun (35)	2.5	3.0	2.4	1.4
Fiat (36)	*	0.4	0.5	0.7
Honda (37)	0.1	1.6	1.2	0.6
Mazda (41)	1.4	0.8	0.7	0.5
Mercedes (42)	*	0.5	0.5	0.4
MG (43)	*	0.3	0.2	0.1
Peugot (44)	0.1	0.1	*	*
Porsch (45)	*	*	*	0.1
Renault (46)	*	*	0.2	0.4
Saab (47)	*	0.1	0.1	0.2
Subaru (48)	2.4	1.1	0.9	0.2
Toyata (49)	4.2	3.7	3.8	3.9
Triumph (50)	0.2	0.3	0.2	0.1
Volvo (51)	1.3	0.3	0.5	0.7
	100.0	100.0	100.0	100.0

*Less than 0.1%

SOURCE: 1981 NASS inflated to U.S. totals

TABLE 14
FACTORS NOT OVER OR UNDER REPRESENTED IN ACCIDENTS INVOLVING UNFAMILIAR DRIVERS

1. Registration of Vehicle
2. Rollover Involvement
3. Driver Education
4. Restriction of Roadway at Scene
5. Roadway Alignment
6. Roadway Profile
7. Access Control
8. Direction of Travel Flow
9. Atmospheric Conditions
10. Urban/Rural
11. Roadway Surface Condition
12. Speed Limit
13. Trafficway Division and Median Type
14. Reckless Driving Violation Charged
15. Speeding Violation Charged
16. Unknown Violation Charged
17. Previous Suspensions and Revocations
18. DWI Violation Charged

TABLE 15
FACTORS WITH LEVELS WHICH ARE OVER/UNDER REPRESENTED WITH UNFAMILIAR DRIVERS

	FACTOR	LEVEL	UNFAMILIAR	FAMILIAR
1.	Number of Occupants	1	53.7	66.8
		2	25.2	22.2
		3+	21.1	11.0
2.	Body Type	2-door Sedan	46.6	51.4
		4-door Sedan	28.1	28.1
		3-5-door Sedan	8.8	11.0
		Station Wagon	15.0	8.1
		Other	1.4	1.4
3.	Roadway Surface Type	Concrete	6.0	12.9
		Bitummus	92.3	85.4
		Other	1.7	1.7
4.	Shoulder Presence	None	50.2	56.5
		One or Two	49.8	43.5
5.	Roadway Function Class	Principle Artery	38.2	40.2
		Minor Attery	28.0	22.9
		Urban Collector	4.6	9.3
		Rural Collector	12.7	9.7
		Local	16.5	17.9
6.	Relation to Junction	Non-Junction	44.8	36.3
		3-leg Intersection	9.6	8.9
		4-leg Intersection	19.8	23.2
		>4-leg Intersection	1.3	0.4
		Intersection-related	10.8	17.9
		Other	14.0	13.3
7.	Number of Travel Lanes	1	4.8	4.5
		2	53.9	54.8
		3	17.8	11.4
		4	17.0	16.9
		5+	6.5	12.4
8.	Other violation Charged (not covered in 14, 15, 16, or 18 of Table 14)	No	71.5	81.4
		Yes	28.5	8.6
9.	Previous Accidents	0	81.1	75.8
		1+	18.9	24.2

SOURCE: 1981 NASS inflated to U.S. totals

5.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The best estimate of the share of all passenger car VMT in 1981 where the driver had less than 150 miles experience driving the car is 1.5 percent. NASS for 1981 reports 8.9 percent of the accident-involved drivers of passenger cars had less than 150 miles experience with the vehicle. Thus, this category of driver is about six times more likely to be involved in an accident, per mile, than the average driver.

The NASS data on passenger cars were examined to be sure that this result was not caused by reporting bias. Roughly 37 percent of the accident-involved drivers had no reported experience with the accident vehicle. If all of these drivers had more than 150 miles experience, then unfamiliar drivers would still be about 3.5 times more likely to be involved in an accident than the average driver. No over- or underreporting of unfamiliar drivers was observed for any PSU, indicating the result is not a systematic coding error. The injury severities of familiar and unfamiliar drivers were compared to see if unfamiliar drivers report less serious accidents more often than familiar drivers. Unfamiliar drivers report more "possible injury" accidents but otherwise the accidents they report are not less serious than those reported by familiar drivers.

Unfamiliar drivers of passenger cars are overrepresented in a number of high-risk factors which could be responsible for the over representation of these drivers in 1981 NASS accidents involving a passenger car. Young male drivers, drivers who drive the road where the accident occurred less than monthly, drivers with less than a month experience driving passenger cars, drivers with invalid licenses, and drivers in accidents where alcohol was identified as a contributing factor are all overrepresented in the unfamiliar driver group. However, if all of the accidents involving these "high-risk" factors are eliminated, unfamiliar drivers still account for about three percent of all accident-involved drivers which is higher than most estimates of the share of VMT by unfamiliar drivers. So, familiarity with the car is an important factor affecting accident risk.

What could be done to reduce this accident risk? Probably the simplest countemeasure is to inform unfamiliar drivers of their increased risk. Table 1 indicates that roughly half of the VMT by unfamiliar drivers is in rental cars. The other half is in newly-purchased new or used cars.* So this information could be provided to car rental agencies and automobile dealers for further dissemination to renters or buyers. A simple statement could be read: "The risk of accidents to drivers who are unacquainted with their car is **six times** higher than average. We suggest you fully acquaint yourself with the controls of this car in the parking lot and that you exercise caution as you familiarize yourself with the braking, steering, and acceleration characteristics of this car."

Table 16 presents a rough estimate of the cost of this reading to rental agencies and dealers and compares this cost to the costs of accidents by drivers who are unfamiliar with their cars. Based on the assumptions in this table, if 0.4 percent or more of the accidents involving unfamiliar drivers could be avoided by the reading, then the reading would be cost-effective.

It seems likely that the reading would be at least this effective because it is delivered to part of the target population of drivers (new owners and renters) just before they are at risk. However, it is not delivered to non-owner drivers of newly-purchased cars, and NASS provides no information on the relationship between the car driver and the owner.** Without this information there is no way to be **certain** that the reading would be delivered to the accident-involved unfamiliar drivers. Table 17 presents a question which would reveal this relationship and could be included in a NASS special study.

*Note that in newly-purchased cars, the owner is responsible for only about one third of the VMT by unfamiliar drivers. Other household members and people borrowing the car drive the other two thirds.

**Though the reading is not delivered to new drivers either, Table 10 indicates only one percent of the unfamiliar drivers are driving under learner's permits and Table 9 indicates that only about seven percent of unfamiliar drivers have less than four months experience with passenger cars.

A poster could provide much of the information of the reading and would cost the car dealers and rental agencies much less to implement. It would probably be effective enough to warrant its implementation while the NASS data on the relationship between the car owner and accident involved driver is being collected. Thus, a strategy which could be implemented immediately is to send posters to car rental agencies and car dealers and to collect information on the relation between the driver and owner of the accident vehicle. This new information would permit a more accurate identification of the target population and a more cost-effective countermeasure.

TABLE 16
COST-EFFECTIVENESS OF THE CAUTIONARY STATEMENT COUNTERMEASURE

1.	Assume a one minute/reading	
2.	Total car sales in 1981 (#3 in Table 1)	18,245,000
3.	Total car rentals in 1981 (from Table 1 #11 * #12/150)	98,234,000
4.	Assume $15/hr. labor rate	
5.	Cost to car dealers = (#1 * #2 * #4/60) =	$4,561,250
6.	Cost to rental agencies = (#1 * #3 * #4/60) =	$24,558,380
7.	Total cost of reading in 1981 (#5 + #6) =	$29,119,630
8.	Total accident cost in 1980(A)	$57.2 x 10^9
9.	Fraction of accidents involving unfamiliar drivers (From 1981 NASS Inflated to U.S. Totals)	.14
10.	Total cost of accidents involving unfamiliar drivers (#8 * #9)	$7.94 x 10^9
11.	Break-even percent effectiveness, (#7 / #10) (percent of accidents avoided because of the reading cost equals accident cost savings)	0.4%

(A) Economic Cost to Society of Motor Vehicle Accidents, NHTSA, January 1983, DOT-HS-806-342

TABLE 17
AN ADDITION TO NASS WHICH WOULD REVEAL THE RELATION BETWEEN VEHICLE OWNER AND DRIVER

What is the relation between the vehicle driver and the vehicle owner?

1. Driver is owner.
2. Driver is in owner's household.
3. Driver is employee of owner.
4. Driver is friend of owner.
5. Driver rents the vehicle from owner.
6. Driver stole the vehicle from owner.
7. Other.

```
1                DATA F1;
2                SET NASS81.DRIVER;

NOTE:  DATA SET WORK.F1 HAS 9523 OBSERVATIONS AND 47 VARIABLES. 372 OBS/TRK.
NOTE:  THE DATA STATEMENT USED 0.89 SECONDS AND 184K.

3                DATA F2;
4                SET NASS81.OCCUPANT;
5                IF OCC_ROLE NE 1 THEN DELETE;

NOTE:  DATA SET WORK.F2 HAS 9420 OBSERVATIONS AND 73 VARIABLES. 291 OBS/TRK.
NOTE:  THE DATA STATEMENT USED 1.32 SECONDS AND 192K.

6                DATA F3;
7                MERGE F1(IN=R)F2(IN=B);
8                BY PSU CASE_NO VEH_NO;
9                IF R & B;

NOTE:  DATA SET WORK.F3 HAS 9420 OBSERVATIONS AND 111 VARIABLES.  186 OBS/TRK.
NOTE:  THE DATA STATEMENT USED 2.13 SECONDS AND 188K.

10               DATA F4;
11               SET NASS81.VEHICLE;
12               IF BODY_TYP<10;

NOTE:  DATA SET WORK.F4 HAS 6693 OBSERVATIONS AND 78 VARIABLES. 219 OBS/TRK.
NOTE:  THE DATA STATEMENT USED 0.58 SECONDS AND 192K.

13               DATA F5;
14               MERGE F3(IN=INE)F4(IN=INO);
15               BY PSU CASE_NO VEH_NO;
16               IF INE & INO;

NOTE:  DATA SET WORK.F5 HAS 6629 OBSERVATIONS AND 180 VARIABLES. 108 OBS/TRK.
NOTE:  THE DATA STATEMENT USED 2.51 SECONDS AND 204K.

17               DATA F6;
18               MERGE F5(IN=F) NASS81.ACCIDENT(IN=A);
19               BY PSU CASE_NO;
20               IF F & A;

NOTE:  DATA SET WORK.F6 HAS 6629 OBSERVATIONS AND 237 VARIABLES. 81 OBS/TRK.
NOTE:  THE DATA STATEMENT USED 2.66 SECONDS AND 258K.

30               DATA INEXP EXP UNK;
31               SET F6;
32               MLG=9;
33               IF MILEAGE=1 THEN MGL=1;
34               IF 1<MILEAGE<=997 THEN MLG=2;
35               IF MLG=1 THEN OUTPUT INEXP;
36               IF MLG=2 THEN OUTPUT EXP;
37               IF MLG=9 THEN OUTPUT UNK;

NOTE:  DATA SET WORK.INEXP HAS 374 OBSERVATIONS AND 238 VARIABLES. 81 OBS/TRK.
NOTE:  DATA SET WORK.EXP HAS 3844 OBSERVATIONS AND 238 VARIABLES. 81 OBS/TRK.
NOTE:  DATA SET WORK.UNK HAS 2411 OBSERVATIONS AND 238 VARIABLES. 81 OBS/TRK.
NOTE:  THE DATA STATEMENT USED 1.69 SECONDS AND 208K.
```

APPENDIX B
DETERMINING THE SIGNIFICANCE OF A DIFFERENCE IN PROPORTION OF DRIVERS IN A LEVEL OF A FACTOR

Let:

P_A = fraction of involved unfamiliar drivers in a level

P_B = fraction of involved familiar drivers in a level

P = overall fraction in the level

$n' = n_A n_B/(n_A + n_B) = 340.8$

n_A = number of unfamiliar drivers = 374

n_B = number of familiar drivers = 3844

Experimental Statistics by M. G. Natrella provides an equation for estimating the chi square for the difference between P_A and P_B:

$$X^2 = (n' \left|P_A - P_B\right| - 1/2)^2/(n' P(1-P))$$

note that $P(1-P) \leq 1/4$ so:

$$X^2 \geq (340.8 \left|P_A - P_B\right| - 1/2)^2/340.8 * .25)$$

Since $X^2 = 3.84$ for 1 degree of freedom at the 95 percent confidence level:

$$3.84 \geq (340.8 \left|P_A - P_B\right| - 1/2)^2/(340.8 * .25)$$

Solving for $\left|P_A - P_B\right|$ yields

$$\left|P_A - P_B\right| \leq (1/2 + \sqrt{3.84 * 340.8 * .25})/340.8$$

$$\left|P_A - P_B\right| \leq .05454$$

So, a difference in the raw sample data of more than 5.5 percentage points is certainly significant at the 95 percent confidence level. However, in NASS serious accidents are sampled more frequently than less serious accidents and the weights used to produce the U.S. totals reflect this weighting. Further, the weights depend on the primary sampling unit (PSU). In order for this 5.5 percentage point difference to hold for the inflated NASS data, familiar or unfamiliar drivers should not be overrepresented in any PSU or in any level of accident injury severity. Tables 3 and 4 show that this is true.

If the true proportion in the full sample (P) is less than 50 percent, the differences of less than 5 1/2 percentage points could be significant. For example, if P = 0.1, then differences of 3.3 percentage points are significant. Multiple testing tends to lower the signficance level, however, and since many tests are performed in this anlaysis, only differences considerably above the nominal level should be considered signficant in the final analysis. For simplicity, differences of more than five percentage points are identified and discussed in this report and are interpreted as statistically significant at roughly the 95 percent confidence level.