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**National Highway
Traffic Safety
Administration**

Vehicle Familiarity and Safety

OFFICE OF VEHICLE
SAFETY RESEARCH
Crash Avoidance Research Division

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16. Abstract

A literature review and accident data analyses were conducted to examine the relationship between vehicle familiarity and safety. The information from these diverse sources was consistent in suggesting that drivers of passenger cars and motorcycles are having safety problems adjusting to unfamiliar vehicles. This problem was not caused by low total driver experience but by inexperience with the accident-involved vehicle. Estimates were made of the extent of this problem and recommendations were suggested to better understand the causes of the problem and identify possible countermeasures.

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METRIC CONVERSION FACTORS

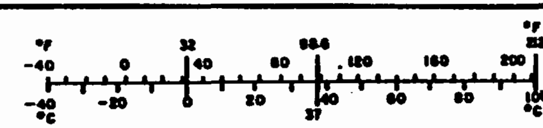
Approximate Conversions to Metric Measures

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 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights 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	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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VEHICLE FAMILIARITY AND SAFETY

BACKGROUND

All drivers encounter problems associated with their inexperience behind the wheel at various times in their driving careers. The most common inexperience problems occur when first learning to drive. New drivers need to learn rules of the road, how to detect and avoid traffic hazards, how their car operates, and how it responds under different environmental conditions. Until the driver's skills and knowledge are well learned, mistakes are likely to occur. These mistakes can lead to accidents.

In addition to new drivers, those who have been driving for many years can also encounter inexperience problems anytime they operate an unfamiliar car. The skills learned in a familiar car may not be the exact ones required in an unfamiliar car. In this case, drivers must learn new skills just as when they first learned to drive. Unlike the new driver, the experienced driver may have even more difficulty adjusting to the vehicle because the habits acquired previously may interfere with the new skills required. The characteristics of the unfamiliar vehicle are not what the driver expects based on past experience. This interference problem becomes particularly critical in an emergency situation where quick and accurate responses are needed. Here, the unfamiliar driver tends to reflexively revert to previously learned responses, which may be inappropriate for the vehicle being used. The result could be an accident.

More specifically, unfamiliar cars can lead to safety problems because drivers may not be sensitive to the vehicle's handling, braking, and acceleration reponses. A maneuver that can be routinely performed in a familiar car could result in overcorrection of steering, locked brakes, or a too slow acceleration in an unfamiliar car. For example, if a car drifts onto the road shoulder, the driver who may have no trouble bringing a familiar car back on the road may oversteer an unfamiliar car and lose control.

Unfamiliar cars can also create problems because hand- and foot-operated controls are not located where drivers expect them to be or do not operate as expected. In unfamiliar cars, the driver's attention may be distracted from the roadway while searching for or attempting to actuate hand-operated controls. Confusion and distraction can also result from inadvertent operation of unfamiliar controls. For some controls, such as the horn and wipers, drivers may not be able to find and operate them as rapidly as needed. Unfamiliarity problems with foot controls can result because the spacing between pedals and size of pedals vary from car to car. In an emergency stop, the extra milliseconds an unfamiliar driver may take to find the brake pedal can mean the difference between a close call and an actual accident. In some cars, it is even possible that an unfamiliar driver could miss the brake pedal completely.

Several research studies have been conducted in the past to investigate the extent and nature of vehicle unfamiliarity problems. Some examined the general relationship between unfamiliarity and accidents. Others explored how the specific factors of control unfamiliarity and vehicle response unfamiliarity might affect safety. Various methodologies have been employed, including accident case analyses, experimental studies, and surveys. In addition, a recent analysis has been conducted of the data in the NHTSA National Accident Sampling System. The findings of these diverse studies, which are described below, strongly suggest that vehicle unfamiliarity plays a significant role in accident causation.

THE ASSOCIATION BETWEEN VEHICLE FAMILIARITY AND ACCIDENTS

One of the earliest studies examining the general relationship between unfamiliarity and crashes was conducted by Fell and Mudrowsky in a 1969 unpublished paper. They analyzed 342 accidents investigated by the Cornell Aeronautical Laboratories (CAL) in a study sponsored by the Automobile Manufacturers Association. Of these accidents, 93 (27 percent) involved drivers who had been driving the accident involved vehicle less than one month. Twenty-four of the 93 (25 percent) had borrowed the vehicle. The report recommended that certain vehicle features be standardized to help reduce the unfamiliarity problem, including hand-operated controls, the distance from the accelerator to the brake pedal, and the range of allowable engine horsepower.

A larger number of the accidents investigated by CAL were analyzed by Fell, et al. (1973) and compared to a control group of drivers who were stopped at road blocks in the same geographic area as the accident investigations. The accident sample included 802 drivers involved in 434 accidents. Driving experience was obtained from 606 of these drivers and vehicle familiarity from 539.* The control group of 400 drivers served as a measure of the expected levels of experience and vehicle familiarity in the general population. The analysis found that 106 out of the 539 accident-involved drivers (or about 20 percent) reported less than one month familiarity with the vehicle. This compares to 55 out of 400 control group drivers (or 14 percent) who reported less than one month vehicle familiarity. Less than six months familiarity was reported by 41 percent of the accident group, but only 34 percent of the control group. The differences in the amount of vehicle familiarity for the two groups was statistically significant. The analysis also found that the accident-involved driver had significantly less driving experience than those in the control group. The report recommended that further studies should be conducted to uncover the reasons for the unfamiliarity and inexperience effects.

Because motorcycles are less forgiving of operator error than automobiles, vehicle unfamiliarity problems have been hypothesized as a significant contributor to motorcycle crashes. The most thorough and up-to-date motorcycle accident study is by Hurt, Ouellet, and Thom (1981). Their study

*Based on personal communications with the senior author, the large number of unknowns were not thought to have introduced any biases in the findings because most of the unknowns were for accidents investigated before the authors started their data collection.

analyzed data based on in-depth investigations of motorcycle accidents in California. Figure 1 and Table 1 show the data comparing rider familiarity with the accident-involved cycle to total riding experience*. These data indicate that, although the median total riding experience in this accident sample was almost three years, the median experience on the specific motorcycle involved in the accident was less than five months. Thus, although these accident victims were experienced in riding motorcycles, they were not very familiar with the particular cycle involved in the crash.

The Hurt study also collected data on rider experience from a sample of motorcyclists passing the locations of the accidents investigated. Both total experience and experience on the observed motorcycle were obtained. Table 2 compares the exposure data with the accident data. The Table shows that drivers with less than three months accident vehicle experience are overrepresented relative to the percent of drivers in the exposure sample with less than three months experience on the observed cycle. Drivers with low total experience are also overrepresented. In order to compare the relative effects of these factors, the ratio of vehicle specific experience percent to total experience percent was computed. This analysis found no real differences in this ratio between the accident and exposure samples, thus suggesting no higher risk for riders of unfamiliar cycles. However, because data were missing from about 74% of the exposure sample, these data should be interpreted somewhat cautiously.

The one accident investigation study which has data of comparable quality on unfamiliarity in passenger vehicles was the Indiana University Tri-Level Study of Accident Causation (Treat et al., 1979). From 1972-1977, the researchers at Indiana University investigated the extent and nature of the role of human, vehicular, and environmental factors in traffic crashes. Monroe County, Indiana, was the site for the three levels of investigation that were conducted: analyses of 13,568 police reports; on-scene investigations of 2,258 accidents; and in-depth investigations of 420 crashes by a multidisciplinary team. This study is one of the most comprehensive investigations of passenger vehicle accident causal factors.

The in-depth level data confirm the findings of the Fell studies and serves as a meaningful comparison to the Hurt motorcycle study. In comparison to the 57 percent of the accident-involved motorcycle riders that had less than six months familiarity with the cycle, the Indiana study found that 34 percent**

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* About 5% and 9% of the riders had unknown levels of vehicle familiarity and rider experience, respectively. These unknowns were eliminated in the calculation of the adjusted and cumulative percents.

** About 8% of the drivers had unknown levels of vehicle familiarity and were assumed to be proportionately distributed among the various familiarity levels for analysis purposes.

of the passenger car drivers had less than six months familiarity with the accident vehicle (Table 3). Accident vehicle familiarity for these vehicle types is compared in Figure 2. It shows that vehicle familiarity among accident drivers/riders increases at the same rate for both vehicle types, although unfamiliar motorcyclists represent a higher proportion of accident victims than car drivers. This difference is probably due to the less forgiving nature of motorcycle accidents.

Another measure of vehicle familiarity collected by Indiana is the total miles the driver had been driving the accident vehicle. These data are presented in Table 4, which shows that drivers who have driven the accident vehicle only 500 miles or less represent 12 percent of the accident-involved drivers; drivers with less than 1,000 miles familiarity with the vehicle represent 17 percent of the accident-involved drivers; and drivers with less than only 2,000 miles on the vehicle comprise about a quarter of the total accident-involved drivers. These relatively high percentages at such low mileages are strong evidence of the role of vehicle unfamiliarity in crashes.

Similar evidence is found in the National Accident Sampling System (NASS) collected by NHTSA. Unlike the Indiana data, these data are collected based on a nationwide sample of all accidents. The data are obtained from police accident reports and driver interviews. In NASS, the accident vehicle mileage variable was listed as unknown for 30-35% of the drivers. For analysis purposes, the unknowns were not counted and assumed to be proportionally distributed among the various categories. Table 5 shows the 1979 and 1980 NASS data describing the number of miles the driver had driven the accident vehicle. These data show even higher percentages of unfamiliar drivers in crashes than the Indiana data. For example, drivers with less than 1,000 miles familiarity with the vehicle represent about 21-24 percent of the accident-involved drivers. These high percentages add further support to the hypothesis relating vehicle unfamiliarity to accidents.

In order to determine whether the drivers who were unfamiliar with the vehicle also had little total driving experience, the Indiana data on accident vehicle experience and total driving experience is compared in Figure 3. Table 6 lists the total driving experience, in months, of the accident-involved drivers. These data show that only 2 percent of the accident-involved drivers had less than six months total driving experience. In contrast, 34 percent of the accident drivers had less than six months familiarity with the accident vehicle. This comparison suggests that many of these accident-involved drivers are not just having the skill acquisition problems of new, inexperienced drivers. They are experienced drivers who are having difficulty adjusting to an unfamiliar vehicle.

In another analysis of the relation between vehicle unfamiliarity and driving experience, a cross tabulation was performed on these variables using the 1979-1980 NASS data base (Table 7). The table shows that for all levels of driving experience, the lower the degree of vehicle familiarity, the higher the proportion of accident-involved drivers. For example in 1979, 24 percent of the accident-involved drivers who had 2-6 months total driving experience had between 551 and 1050 miles familiarity with the vehicle. At the next lower level of vehicle familiarity (less than 550 miles), this proportion was

10 percent higher (i.e., 34 percent). Table 7 also compares drivers' first 1050 miles experience with the accident vehicle to five times more experience (1051-5050 miles). These comparisons also show that at each level of total driving experience, there was a greater proportion of accident-involved drivers at the lower degree of vehicle familiarity. Thus, the influence of vehicle familiarity on accident risk is to some extent independent of the driver's total driving experience. However, the data show that the two factors are not completely independent. The percentage of accident-involved, unfamiliar drivers is much greater for the group with low total driving experience than for the older, more experienced drivers. Thus, the combination of vehicle inexperience and general driving experience has a larger effect on accidents than either factor alone.

Another factor that could possibly account for the high proportion of unfamiliar drivers in accidents is driver age. Figure 4, based on the Indiana data, shows how the proportion of accident drivers in each age group changes as a function of vehicle familiarity level, in months. Less than 6 months vehicle familiarity is compared to 6-12 months familiarity and the first year familiarity is compared to each of the next two years. In each age group (except the 45-54 year olds in the 3-year comparison), a higher proportion of drivers were in the lower familiarity categories. Thus, vehicle familiarity appears to be a problem for all age groups. The differences in the percentages are greatest for the younger age groups, which indicates that the problem of adjusting to an unfamiliar vehicle may be harder for younger drivers. These data along with NASS data suggest that a synergistic effect of age, experience, and vehicle unfamiliarity may act to increase the likelihood of accidents more than each factor by itself.

The NASS and Indiana Tri-Level data do not take into account the exposure of drivers to the risk of accident involvement in unfamiliar cars. Measurement of the exposure to risk can help to distinguish whether drivers become involved in accidents because they frequently operate unfamiliar cars or because driving unfamiliar vehicles is inherently dangerous. Exposure to risk is measured by comparing the percent of drivers in unfamiliar cars who are involved in accidents to the percent of unfamiliar drivers in the general driving population. Although the study by Fell et al. (1973) made this comparison with data obtained from accident and no accident samples, no general population, vehicle familiarity information is available that is directly comparable to the accident data from the Indiana Tri-Level Study and NASS.

Data that approximates the desired exposure information were obtained from the 1977 Nationwide Personal Transportation Study (NPTS), sponsored by the Department of Transportation. This was a national survey to provide comprehensive data on travel patterns and included information on the full range of trips and travel made in the U.S. along with related socioeconomic characteristics of the tripmakers. The survey was based on a probability sample of 24,466 households in each of the 50 states and the District of Columbia. This data base contains information on the miles driven since ownership or other acquisition (e.g. rental, lease, company-owned, etc.) for all vehicles in the households surveyed. Since the mileage is based on all vehicles owned or operated on a regular basis by "households" rather than by individual drivers, the NPTS data may underestimate the actual level of vehicle unfamiliarity for individual household drivers. Because the NPTS survey occurred during the time between the Indiana study and the 1979-1980 NASS data collection, changes in vehicle ownership patterns over the years may affect the comparability of the data. Nevertheless, since the NPTS data was the best available exposure measure of vehicle familiarity, it was used to help approximate the relative risk of unfamiliar drivers in accidents.

Table 8 shows the NPTS data on vehicle unfamiliarity for miles of household ownership of vehicles. Figure 5 compares this NPTS data to vehicle unfamiliarity among the accident populations in the NASS and Indiana studies.

The graph shows that unfamiliar drivers are involved in a greater proportion of accidents than would be expected based on the vehicle usage levels of the NPTS driving population. For example, vehicles owned by households and driven less than 1,000 miles comprise about 12 percent of the NPTS vehicle population. In comparison, about 17-23 percent of the accident-involved drivers have less than 1,000 miles experience with the vehicles. In other words, these drivers are approximately 1-1/2 to 2 times more likely to be involved in crashes than would be expected based on the exposure of the drivers in the NPTS sample to unfamiliar cars. Drivers having less than 500 miles familiarity with their vehicle are about 2 to 3 times more likely to become involved in a crash than would be expected.

The Role of Unfamiliarity in Accidents

The above analyses of accident data do not reveal the reasons for the effect of vehicle unfamiliarity on accidents. Because the Indiana Tri-Level Study attempted to identify the causal factors of accidents, their findings were reviewed to determine if vehicle unfamiliarity was identified as a cause and, if so, what was the nature of the unfamiliarity problem.

The category of vehicle unfamiliarity was one of many specific causal factors that the Indiana team looked for in each accident investigated. It was defined as "...a lack of driving time in a particular vehicle. Borrowed, rented, or owned vehicles driven for less than 6 months are considered unfamiliar to the driver. Characteristics such as different locations of controls and accessories, different transmissions, different size vehicles, different power outputs, etc. could all contribute to an accident situation. If the handling aspects of the involved vehicle generated responses different than anticipated during the accident sequence, then vehicle unfamiliarity should be considered as a potential factor."

Based on the above definition, the Indiana study identified unfamiliarity as a definite causal factor in .2 percent of the accidents investigated on-site and in-depth; it was identified as a probable cause in .7 percent of the on-site investigations and 1 percent of the in-depth cases. This was the seventh most frequent cause in the human condition or state subgroups of causes following such factors as alcohol impairment, other drug impairment, and fatigue.

These percentages are lower than might be expected from the data on percent of unfamiliar drivers in crashes. These low values may, in part, be attributed to the difficulty of detecting the subtle effects of vehicle unfamiliarity on driver performance. Because the investigators at Indiana had to rely on driver interviews for much of the pre-crash accident reconstruction, many vehicle unfamiliarity problems may have been missed. An accident-involved driver may not be fully aware of the problems caused by unfamiliarity. For example, the extra tenths of a second to hit the brake pedal may not even be noticed. The time the driver was distracted while trying to operate an unfamiliar control may not be remembered after the shock of the crash and thus, may not have been recorded by the investigation. In fact, the researchers were very conservative in their assessment of causes. For 20 percent of the accidents studied in-depth, no definite causes were identified. Given these limitations, the numbers Indiana attributed to vehicle unfamiliarity as a causal factor should be taken as conservative estimates and can be viewed as an indication that the problem does exist.

One clue concerning why vehicle unfamiliarity can cause accidents comes from an analysis performed by Indiana on the relationship between this factor and other accident causes. The results found that unfamiliarity with the vehicle was associated with accidents where maintaining adequate directional control could have prevented the crash. It was also associated with excessive speed and improper evasive action. The association with excessive speed is not easily explainable although the Indiana study hypothesizes that it might reflect an attitude of testing the limit of the new vehicle, misperception of speed, or driver age. The other factors suggest a problem with adjusting to an unfamiliar steering response.

Another analysis performed by Indiana examined the relationship between vehicle familiarity and environmental causal factors. The results found that vehicle unfamiliarity increases the likelihood of an accident due to road design problems (e.g., country roads which are unexpectedly narrow) and slick roads. Indiana hypothesized that both environmental factors require a quick response from the driver in order to avoid an accident. Since vehicle unfamiliarity is likely to make a quick, correct response very difficult, an accident is more likely to result. Again, unfamiliar or unexpected vehicle handling characteristics are suggested as the culprit.

In order to determine whether the unfamiliarity problem is associated with new vehicles or older models, the NASS data on odometer readings was examined. Table 9 compares new vehicles (less than 6500 odometer miles) to old vehicles (over 6500 odometer miles) for drivers who had relatively few miles experience with the accident-involved vehicle. These data show that almost all of the accidents were occurring in relatively old cars, regardless of driver familiarity. Unfortunately, the NASS data base does not contain information to indicate whether these older models had been borrowed, rented, recently purchased, or stolen. Such information would be helpful in explaining why these accidents are happening and how to prevent them.

Another factor that was examined in an attempt to provide information on the nature of the unfamiliarity problem was driver sex. The NASS data was analyzed to compare the vehicle familiarity of male and female drivers. Averaging the data from 1979 and 1980 NASS showed that about 22 percent of both men and women had less than 1,000 miles vehicle familiarity. Thus, these accident data indicate that men and women have similar difficulties with vehicle familiarity. However, the analysis does not compare accident rates based on relevant exposure data (which are unavailable). A comparison of rates might show that men and women have a different risk of involvement in unfamiliar vehicles.

Because some of the unfamiliar cars may have been rented or borrowed, they may have been driven on an unfamiliar road as well. On an unfamiliar route, drivers can become confused or distracted looking for road signs or may miss a curve or road hazard that they did not expect. If this is the case, then it will be difficult to determine if drivers are at higher risk because of the unfamiliar vehicle or the unfamiliar route. The Indiana data were examined to determine the relationship between route experience and accident vehicle experience. A chi square analysis (chi square = 30.2, 36 degrees of freedom, significance = .74) showed that the two measures were not statistically associated with one another, thus suggesting that the level of vehicle familiarity does not depend on how frequently the accident route was traveled by the driver.

In summary, a number of accident investigation studies clearly show vehicle unfamiliarity to be an important contributing factor to accidents. Unfamiliarity with the vehicle may increase a driver's risk of accident involvement 2-3 times. Available accident data do not make clear why vehicle unfamiliarity is linked to accidents and what countermeasures would help prevent these accidents. The limited evidence available points to vehicle handling as one possible source of the problem.

The Effects of Vehicle Unfamiliarity on Driver Performance

Because of the difficulty of using accident investigation data to identify why vehicle unfamiliarity causes safety problems, researchers have employed survey and experimental methodologies. A number of these studies were reviewed to determine whether their findings support the results of the accident data analyses and to help identify countermeasures.

In order to quantify the performance penalty associated with finding hand-operated controls in unfamiliar cars, Malone, et al. (1972) conducted an experiment using automobile mockups. On the average, the subjects took three times longer to find controls in unfamiliar configurations than in familiar ones. The distraction caused by this difficulty in finding controls could lead to safety problems if encountered while driving.

In an experiment to quantify the time to operate horn controls in unfamiliar cars, Essex Corporation (1974) measured driver response to a number of different horn control configurations. Significant differences in response times were found. The median first trial reaction time to a rim blow horn, stalk-mounted horn, and center-of-wheel-located horn were 29 seconds, 9.6 seconds and .62 seconds, respectively. The average times for the stalk and rim horns would have been even higher had the experimenters not imposed a 30-second upper limit on subject response time. Because the horn is often used to warn drivers or pedestrians of a potential collision, the rapid operation of the horn is important to driver safety.

The researchers also conducted a survey of 400 drivers to investigate whether these experimental findings could be supported by real-world experiences of drivers. The horn configurations were rank ordered based on the percentage of respondents who had experienced problems. This ranking closely corresponded to the ranking based on simple reaction time. Thus, these two sets of data lend support to the notion that long horn operating times measured experimentally reflect the problems drivers are experiencing in the real world.

Another survey of control operability problems was conducted by Mourant et al. (1977). This survey focused on fingertip reach controls. Of the 405 drivers in the sample, 99 reported 143 problems of finding controls, and 177 reported 250 problems of inadvertent operation. Many of these problems were caused by unfamiliarity with the control configuration and habit interference.

In a study of driver experiences with a variety of automotive design characteristics, Burger, et al. (1977) surveyed 10,000 drivers with a mail questionnaire. Of the 3,500 responses, 83 percent had driven an unfamiliar car. Of this group, only 41 percent stated that they had not been confused by the location and operation of vehicle controls. "Better hand controls" was the fifth most frequently recommended design improvement following "better rearview mirrors", "defog other windows", "reduced windshield glare", and "better vision from vehicle."

Although no study has specifically addressed driver brake response time in unfamiliar cars, research has shown that some pedal geometry designs can impair driver performance. For example, a number of studies have found that the vertical and lateral separation between automobile foot pedals can influence brake response time. (Glass and Suggs 1977, Glaser and Halcomb 1980). These findings suggest that response time can increase when drivers used to the "feel" of the pedal geometry in one car are exposed to an unfamiliar car having a different pedal geometry.

Almost all of the experimental investigations of driver response to vehicle handling characteristics have used subjects who were trained to be familiar with the car. One study which specifically attempted to assess the influence of unfamiliar vehicle handling characteristics on driver performance was conducted by Rice et al. (1976). In this study a large group of representative drivers was observed as they drove a course that contained a number of maneuvering tasks. Some of the subjects were selected because they normally drove a vehicle similar to one of the test vehicles. The performance of this group was compared to that of subjects unfamiliar with the test vehicle. The results showed that vehicle familiarity had no influence on the mean time to complete the course. However, the familiar drivers had less variability in course completion times and were thus considered to be more consistent in their performance than the unfamiliar group. In terms of the overall maneuver failure rate, the two groups were not significantly different. However, in the wet surface maneuver, the unfamiliar group performed worse than the familiar group. The lack of major differences between groups suggests that driver performance measured experimentally is not severely degraded by vehicle unfamiliarity. However, a few differences in performance were found and they suggest that under real-world conditions when quick, reflexive responses are required, the safety of some drivers may be adversely affected by vehicle unfamiliarity. Additional testing with different levels of vehicle familiarity and careful selection of subjects, driving tasks and performance measures would be needed to confirm this hypothesis.

CONCLUSIONS AND RECOMMENDATIONS

Data derived from in-depth accident investigations as well as national accident statistics are consistent in suggesting that unfamiliar drivers are overrepresented in accidents and that this problem is a small but serious aspect of highway safety. Unfamiliar passenger car drivers (those with less than 1,000 miles experience in the vehicle) account for about 17-24% of all drivers in crashes. Those with less than 500 miles represent about 12-17% of all accident-involved drivers. Unfamiliar drivers are as much as 2-3 times more likely to be involved in a crash than familiar drivers. Unfamiliar motorcycle riders also have a high risk of accident involvement. For both vehicle types, the problem does not appear to be caused by low total driving/riding experience. Most of the unfamiliar riders/drivers have much longer total experience than experience with the accident-involved vehicle. The data suggest that many motor vehicle operators are having difficulty adapting to unfamiliar vehicles. In the case of very young or novice drivers, their limited overall driving experience may interact with limited vehicle familiarity to contribute to accident causation.

Existing accident data do not clearly show the specific causes for this adaptation problem. Unfamiliar vehicle handling and braking characteristics have been identified as possible factors causing drivers to lose control of the vehicle. Experimental studies have shown that unfamiliar vehicle controls can also lead to unsafe driver performance. However, until a better understanding of the reasons for unfamiliar vehicle accidents is achieved, specific countermeasures cannot be identified.

In order to achieve a clearer understanding of this problem, it is important to obtain additional data from accident studies, exposure surveys and experimental investigations. The most relevant accident information on vehicle familiarity appears to be vehicle experience in miles driven, which should contain as few "unknowns" as possible. Also, information on whether the car was new, borrowed, rented, stolen, etc., is needed. Comparable exposure data is needed to overcome some of the limitations in the NPTS data base. Experimental studies of unfamiliar driver performance with respect to pedel geometry and vehicle dynamics would provide a better understanding of the possible reasons for the potential link between unfamiliarity and accidents. Once such data have been obtained and analyzed, they will provide the basis for the development of the countermeasures.

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TABLE 1 - MOTORCYCLE RIDER EXPERIENCE AND VEHICLE FAMILIARITY*

Months	ACCIDENT VEHICLE EXPERIENCE Absolute Freq	Adjusted Freq (%)	Cumulative Freq (%)	TOTAL STREET RIDING EXPERIENCE Absolute Freq	Adjusted Freq (%)	Cumulative Freq (%)
0.	129	15.1	15.1	37	4.5	4.5
1.	106	12.4	27.5	29	3.5	8.1
2.	71	8.3	35.8	27	3.3	11.4
3.	62	7.3	43.0	18	2.2	13.6
4.	38	4.4	47.5	14	1.7	15.3
5.	30	3.5	51.0	7	0.9	16.1
6.	55	6.4	57.4	24	2.9	19.1
7-12.	136	15.9	73.3	83	10.1	29.2
13-18.	64	7.6	80.9	35	4.3	33.5
19-24.	48	5.2	86.1	72	8.8	42.3
25+.	89	13.9	100	161	57.7	100

* Source: Hurt _et al_, 1981

TABLE 2 - MOTORCYCLE RIDER STREET BIKE EXPERIENCE*

Known Experience (Months)	Exposure Data: Total Experience	Exposure Data: On Observed Motorcycle	Accident Data: Total Experience	Accident Data: On Accident Motorcycle
0-1	25 (4.1%)**	99 (16.2%)	66 (8.1%)	235 (27.5%)
2-3	22 (3.6%)	60 (9.8%)	45 (5.5%)	133 (15.6%)
4-6	37 (6.1%)	88 (14.4%)	45 (5.5%)	123 (14.3%)
TOTAL for 6 Months	84 (13.7%)	247 (40.4%)	156 (19.1%)	491 (57.4%)
7-12	64 (10.5%)	141 (23.0%)	83 (10.1%)	136 (15.9%)
13-24	86 (14.1%)	105 (17.2%)	107 (13.1%)	112 (13.1%)
25-36	46 (7.5%)	37 (6.1%)	93 (11.4%)	63 (7.4%)
37-48	49 (8.0%)	25 (4.1%)	64 (7.8%)	26 (3.0%)
48+	282 (46.1%)	56 (9.2%)	315 (38.5%)	27 (3.2%)
TOTAL	611	611	818	855

* Source: Hurt, et. al., 1981.

** All percentages are adjusted to eliminate unknowns

TABLE 3 - DRIVER EXPERIENCE IN ACCIDENT VEHICLE
(Counts of Drivers by Months*)

Months	Absolute Freq	Adjusted Freq (%)	Cumulative Freq (%)	Months	Absolute Freq	Adjusted Freq (%)	Cumulative Freq (%)
1.	70	10	10	13-18.	57	9	64
2.	34	5	15				
3.	39	6	21	19-24.	80	11	75
4.	30	4	26				
5.	30	4	30	25-36.	81	11	86
6.	28	4	34				
7.	25	4	38	36+	88	14	100
8.	23	3	41				
9.	16	2	44				
10.	13	2	46				
11.	12	2	47	TOTAL -	657		
12.	49	7	55	MISSING -	49		

*Source: Indiana University Tri-Level Study

TABLE 4 - DRIVER EXPERIENCE IN ACCIDENT VEHICLE
(Counts of Drivers by Miles*)

Miles	Absolute Freq	Adjusted Freq (%)	Cumulative Freq (%)
0-150.	34	5	5
151-500.	46	7	12
501-1000.	32	5	17
1001-2000.	46	7	24
2001-3000.	32	4	28
3001-4000.	31	5	33
4001-5000.	35	5	38
5001-6000	25	4	42
6001-7000.	21	3	45
7001-8000.	38	6	51
8001-9000.	14	2	53
9000+.	315	47	100

TOTAL - 669
MISSING - 49

*Source: Indiana University Tri-Level Study

TABLE 5 - DRIVER FAMILIARITY WITH ACCIDENT VEHICLES--MILES*

Miles	% of Drivers In Accidents 1979	Cumulative %	% of Drivers In Accidents 1980	Cumulative %
0-150	8.8	8.8	9.9	9.9
151-550	8.3	17.1	6.2	16.1
551-1,050	7.1	24.2	5.2	21.3
1,051-2,050	6.7	30.1	4.8	26.1
2,051-3,050	4.6	34.7	4.1	30.2
3,051-4,050	3.3	38.0	2.8	33.0
4,051-5,050	4.5	42.5	6.3	39.3
5,051-6,050	1.4	43.5	1.8	41.1
6,051-7,050	1.3	45.2	1.0	42.1
7,051-8,050	3.7	48.7	2.4	44.5
8,051-9,050	.6	49.5	1.4	45.9
9,051-10,050	5.9	55.4	6.9	52.8
10,051+	43.8	100.0	47.2	100.0

*Source: NASS 1979, 1980

TABLE 6 - DRIVER EXPERIENCE--MONTHS*

Months Experience	Absolute Freq	Adjusted Freq (%)	Cumulative Freq (%)
2.	3	0	0
3.	5	1	1
4.	5	1	2
5.	1	0	2
6.	2	0	2
7.	2	0	3
8.	4	1	3
9.	3	0	4
10.	2	0	4
11.	2	0	4
12.	9	1	6
13-18.	25	3	9
19-24.	42	6	15
25-36.	58	9	24
37-84.	177	26	50
85+.	340	50	100

TOTAL - 679
MISSING - 45

*Source: Indiana University Tri-Level Study

TABLE 7 - PERCENTAGE OF ACCIDENT DRIVERS HAVING VARIOUS DEGREES OF VEHICLE FAMILIARITY VERSUS MONTHS TOTAL DRIVING EXPERIENCE*

	ACCIDENT VEHICLE FAMILIARITY**			
Months Total Experience	0-550 (Miles)	551-1,050 (Miles)	0-1,050 (Miles)	1,051-5,050 (Miles)
-1979-				
0-1	92	0	92	7
2-6	34	24	58	36
7-12	32	13	45	29
13-24	20	14	34	35
25-36	16	9	25	21
37-48	29	4	33	19
49-60	15	6	21	25
-1980-				
0-1	100	0	100	0
2-6	46	20	66	27
7-12	34	13	47	36
13-24	22	6	28	24
25-36	22	4	26	23
37-48	18	16	34	24
49-60	25	3	28	31

*Source - NASS 1979, 1980

**Percentages do not add to 100% because the higher mileage categories are not included

TABLE 8 - RECENTLY ACQUIRED HOUSEHOLD PASSENGER CARS--
MILES DRIVEN IN HOUSEHOLD*

VEHICLE MILEAGE IN HOUSEHOLD	% OF TOTAL CARS OWNED AND OPERATED BY HOUSEHOLDS**	CUMULATIVE %
0-150	1.5	1.5
151-500	3.8	5.3
501-1,000	5.7	11.0
1,001-2,000	8.3	19.3
2,001-3,000	6.6	25.9
3,001-4,000	5,3	31.2
4,001-5,000	7.9	39.1
5,001-6,000	5.6	44.7
6,001-7,000	3.7	48.4
7,001-8,000	6.4	54.8
8,001-9,000	2.4	57.2

*Source - Nationwide Personal Transportation Survey (1977), FHWA
**Percentages calculated after eliminating unknowns

TABLE 9 - PERCENT OF ACCIDENT-INVOLVED DRIVERS IN NEW VERSUS OLD CARS WITH VARIOUS ACCIDENT VEHICLE FAMILIARITY LEVELS*

MILES DRIVEN ACCIDENT VEHICLES \ ODOMETER READING	(NEW) UNDER 6,500 MILES	(OLD) OVER 6,500 MILES
0-149	14	86
150-549	16	84
550-1,049	10	90
1,050-2,049	16	84
2,050-3,049	20	80
3,050-4,049	12	88

*Source - NASS 1979, 1980 Combined

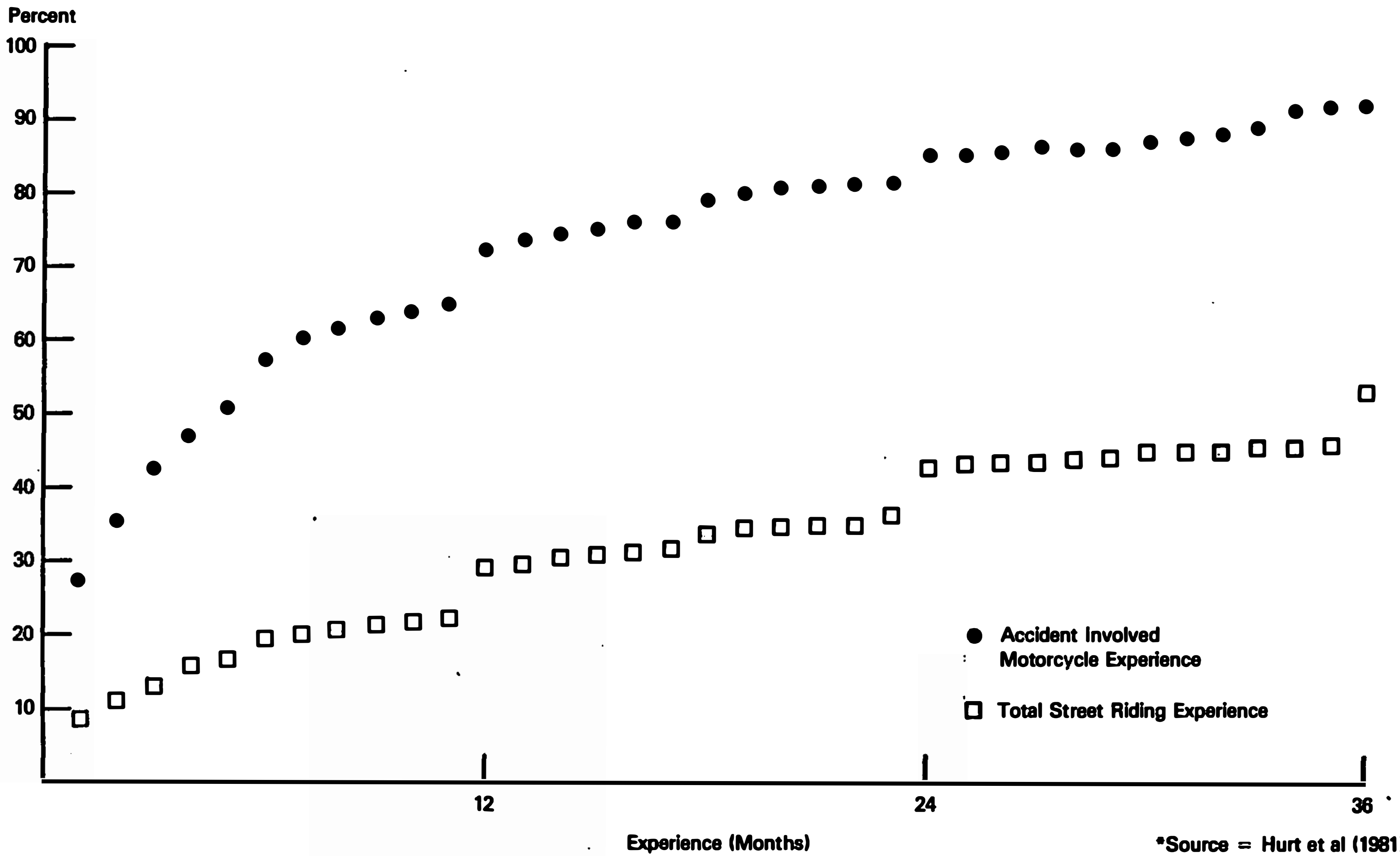

Figure 1: The cumulative percent of accident-involved motorcycle operators as a function of accident vehicle experience and total street riding experience*

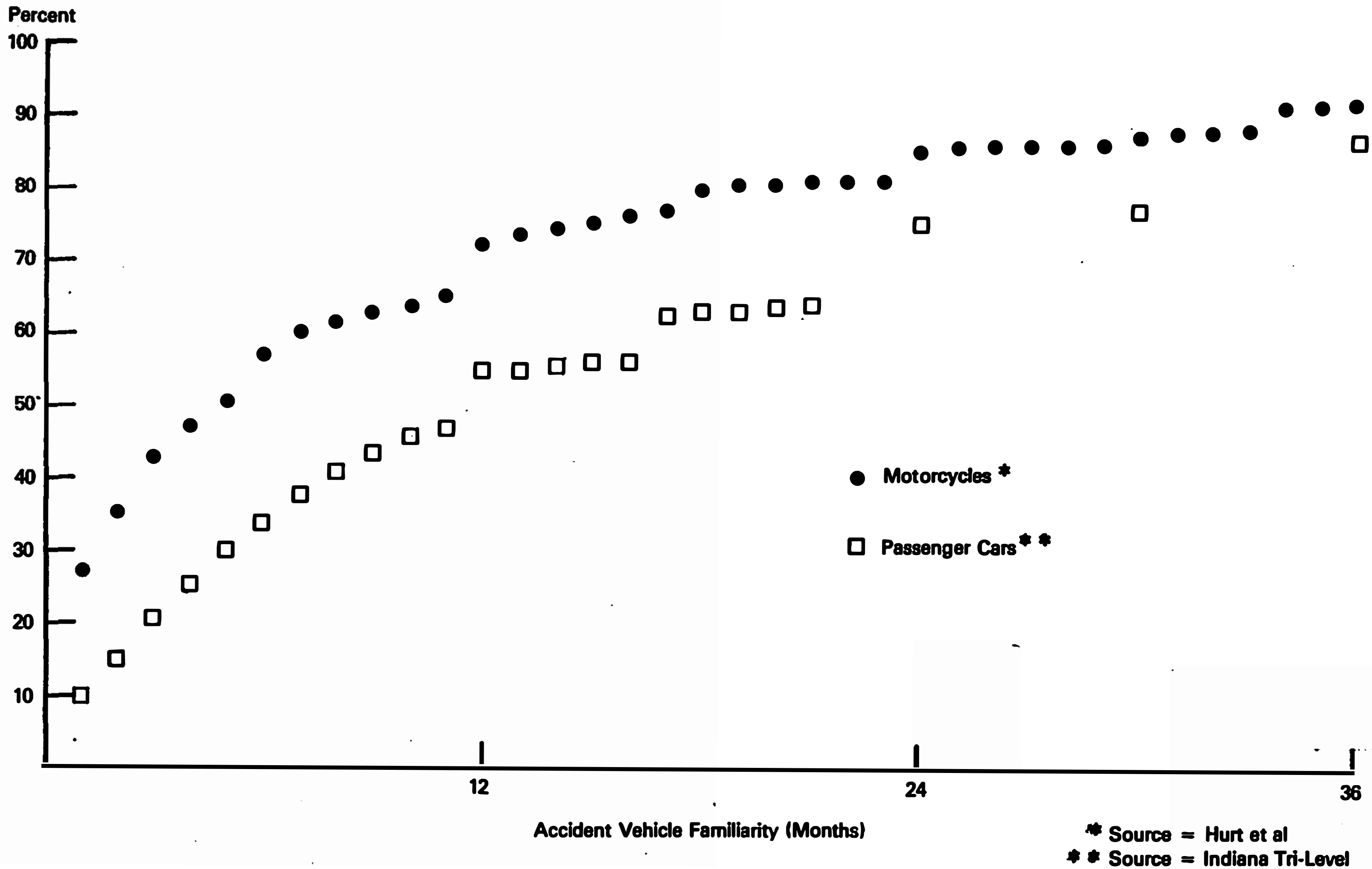

Figure 2: The cumulative percent of accident-involved motorcycle operators and automobile drivers as a function of accident vehicle familiarity

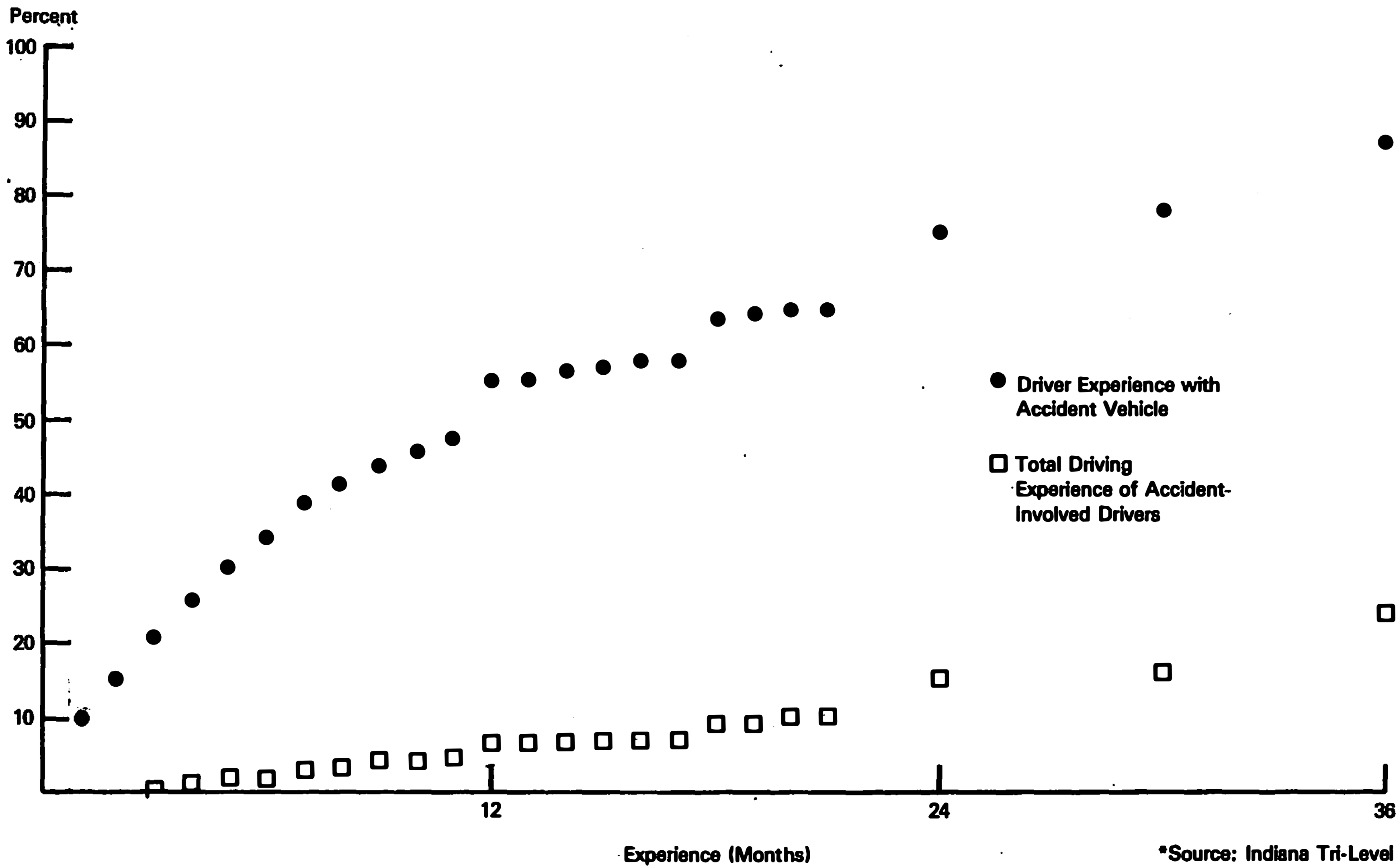

Figure 3: The cumulative percent of accident-involved drivers as a function of accident vehicle experience and total driving experience*

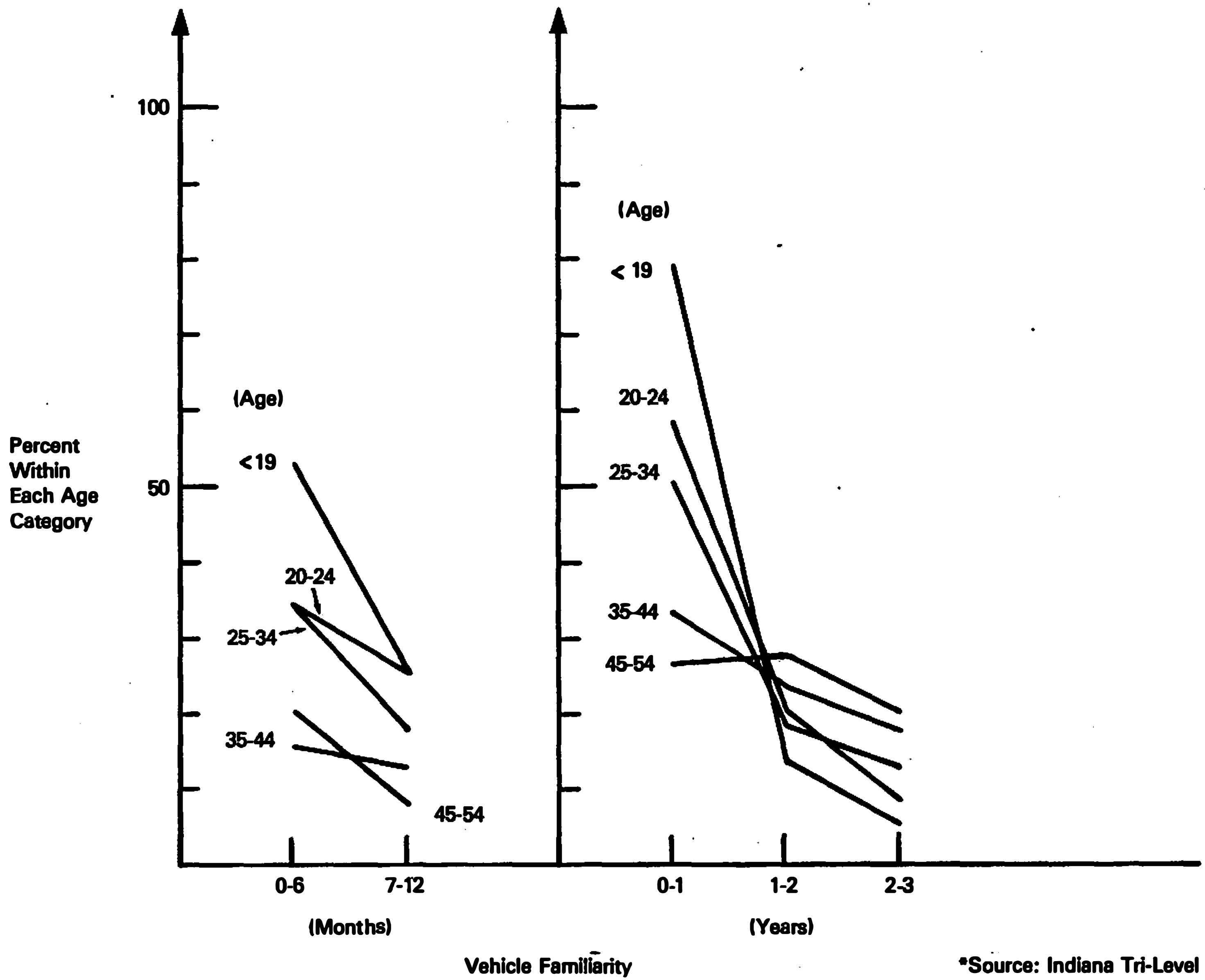

Figure 4: The percent of accident-involved drivers as a function of age and vehicle familiarity*

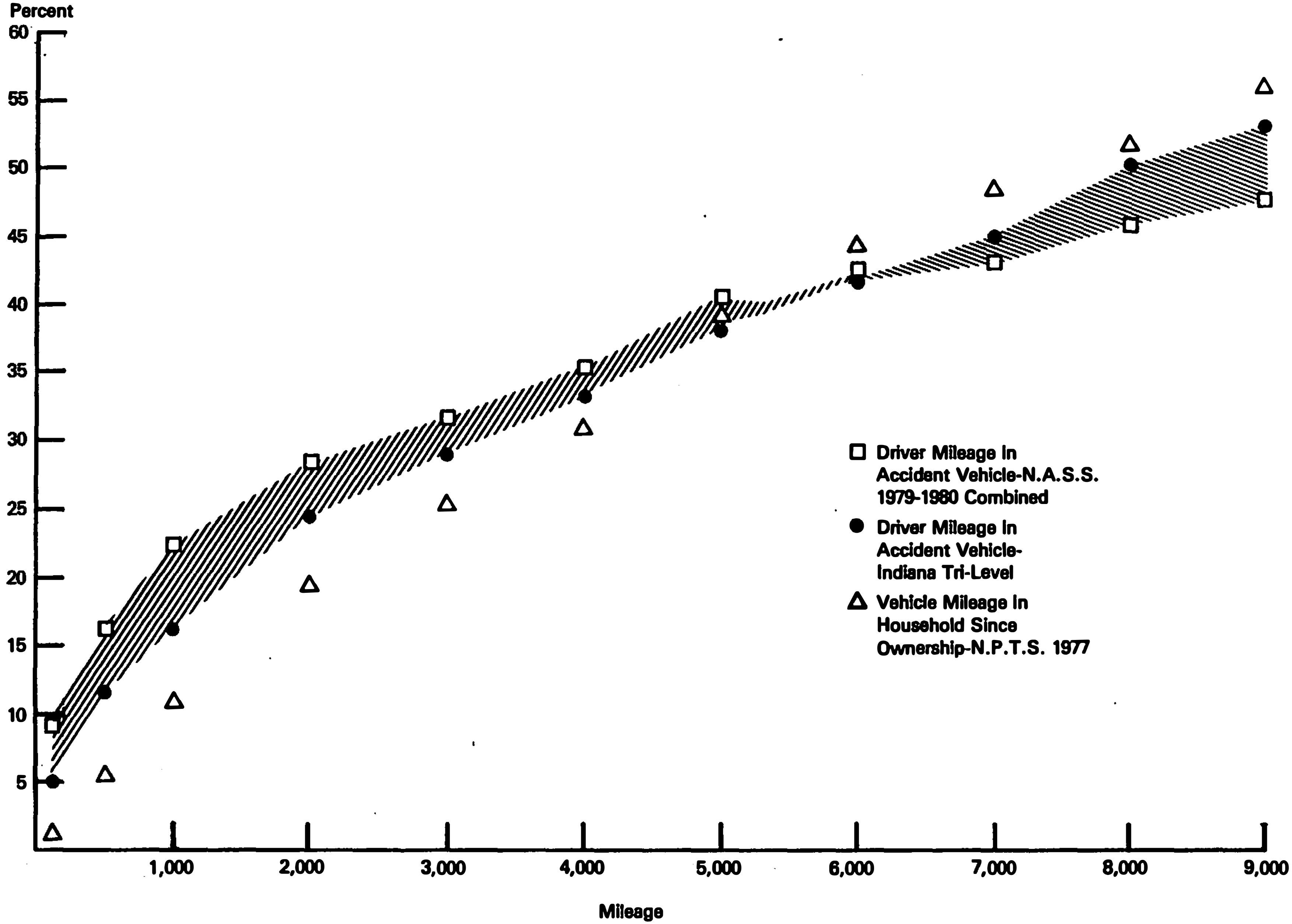

Figure 5: The cumulative percent of accident-involved drivers as a function of vehicle familiarity compared to the cumulative percent of vehicles in households as a function of mileage since ownership.