ATTENTION

The enclosed report is a reprint of the original technical report which has recently gone out of print. Its content does not differ in any way from the original report. The format differs slightly due to time restrictions in the reprinting process.

We hope that this report will fulfill your interests. We appreciate your continued concern in highway safety.

ABSTRACT

This report attempts to characterize the conditions which prevail when motorcycle accidents occur. In order to carry out this characterization, all single vehicle motorcycle accidents (N=706) and all car-motorcycle accidents (N=1418) which occurred in North Carolina in 1972 were investigated. Tabular presentations provide comparison between motorcycle accidents and similar passenger car accidents.

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ACKNOWLEDGMENTS

Grateful appreciation is expressed to Kathryn F. Garren and Robert K. Wood for handling the computer programming required for this study.

I. INTRODUCTION

Throughout the 1960's and into the 1970's, North Carolina has seen a tremendous growth in the number of motorcycles registered in the state. Between 1969 and 1972 passenger car registrations increased from 1,966,690 to 2,303,629, a rise of 17.1 percent. But during the same interval, 1969 to 1972, motorcycle registration increased from 29,249 to 59,631, a rise of 103.9 percent (Figure 1).

Between 1969 and 1972 passenger car deaths increased from 1,438 to 1,496; for motorcycles the corresponding figures were 40 and 69, an increase of 72.5 percent (Figure 2).

With the fuel shortage now upon us, the popularity of motorcycles may increase even more rapidly than in the past. More cyclists will take to the roads and highways, and consequently motorcycles will account for a larger share of motor vehicle fatalities.

In an attempt to reduce the deaths and injuries which added motorcycle mileage seems destined to create, old questions concerning motorcycle safety and motorcycle operation have taken a new significance. Driver education administrators and instructors ask if their

programs should be enlarged to provide training in correct motorcycle operation. These same administrators and instructors want to know what defensive driving techniques they should now be teaching to passenger car drivers which would reduce the probability of car-cycle accidents.

To date some forty states (in addition to Washington, D.C. and Puerto Rico) have special licensing procedures for the operators of motorcycles. In North Carolina, the recipient of a standard driver's license is entitled to operate a motorcycle on the streets and highways of the state without ever having demonstrated whether or not he or she can ride a motorcycle.

Should driver education turn its efforts to motorcycle instruction? If the state decides to require a special license for motorcycle operators, what questions should be asked of potential cycle operators? Such questions are broad, complex, and filled with value judgments which go well beyond the field of highway safety.

The present study is an attempt to answer more basic questions: when, where, and why do motorcycle accidents occur? Only after these basic questions are answered can the more particular questions from professionals in driver education and driver licensing be addressed.

II. PROCEDURE

In order to adequately describe motorcycle accidents in North Carolina the Highway Safety Research Center's (HSRC) vehicle-oriented and accident-oriented files for 1972 were scanned. The vehicle file contains information on some 219,714 vehicles involved in accidents in 1972. A total of 2,410 vehicles on file are motorcycles. For purposes of this study motorcycles were defined as follows:

Motorcycle.

Motorcycle	2,229
Motorscooter	69
Other Motorbike	112
Total	2,410

Of 2,410 motorcycles involved in accidents, 706 (29.3%) were involved in single vehicle accidents, and 1,418 (58.8%) collided with a single passenger car. The remaining 286 motorcycles (11.9%) were involved in some other type of accident, e.g. a cycle-truck accident or a cycle-cycle accident.

It seems reasonable to speculate that single vehicle accidents for motorcycles are under-represented. The reason is straightforward. In order for an accident to be reported to the North Carolina Department of Motor Vehicles (and to be recorded subsequently on HSRC data tapes) personal injury and/or $200 worth of property damage has usually occurred.

It is relatively more difficult for a motorcycle than a passenger car to sustain $200 worth of damage. On those occasions when a motorcycle does sustain as much as $200 worth of damage it seems likely that the driver will receive some level of injury.

In short, it is likely that motorcycles are having many minor accidents which result in little if any injury and which go unreported. Because of this problem in reporting it is assumed that single vehicle motorcycle accidents reported herein are not only under-represented, but those which are reported are biased toward more serious accidents. All tables which contain "single vehicle motorcycle accident" columns should be read with this bias in mind.

In order that the types and frequencies of motorcycle accidents might be put in perspective, information on passenger car accidents was also tabulated. In some cases direct comparisons between motorcycle accidents and passenger car accidents are appropriate; in other cases the relationships between these two types of accidents may be of only passing interest. For the purposes of this study, passenger cars were defined as follows:

Passenger Car.

Passenger Car	188,742
Taxicab	908
Passenger Car and House Trailer	160
Passenger Car and Trailer	363
Total	190,173

Of 190,173 passenger cars involved in accidents, 28,654 (15.1%) were involved in single vehicle accidents. The balance of the accident-involved passenger cars (84.9%) were in some other type of multi-vehicle accident.

III. RESULTS

Driver Characteristics and Injury

In 1972, as in previous years, motorcycle accidents involved primarily the young. Over 90 percent of all motorcycle accidents were recorded by operators under 35 years of age. In the case of single vehicle motorcycle accidents, 27.8 percent were associated with teenagers. Thirty-eight percent of all the motorcycle operators involved in car-cycle accidents were teenagers (Table 1).

If a passenger car was involved in a single vehicle accident, the odds were 3 to 1 that the driver was a male. If a passenger car was involved in a collision with a motorcycle, the odds were 3 to 2 that the driver of the passenger car was a male. In the case of motorcycles, regardless of accident type, the driver was nearly always a male--97 or 98 percent of the time (Table 2).

Single vehicle accidents involving passenger cars had a fairly high association with alcohol. According to police officers' accident reports, 25.9 percent of the drivers of passenger cars involved in single vehicle accidents had been drinking prior to the accident. A total of 11.1 percent were thought to have consumed sufficient alcohol to have impaired their driving ability. The corresponding alcohol percentages for motorcyclists involved in single vehicle accidents were: 13.6 percent drinking, 4.1 percent impaired. For car-cycle accidents, alcohol

seems to have been much less of a problem that it was in single vehicle crashes (Table 3).

Other types of physical impairment seem to have been less common. Illness, fatigue, sleep, and other physical ailments were relatively rare. However, in the case of single vehicle passenger car accidents one of these four categories was reported 6.6 percent of the time (Table 4).

Over half of all cyclists involved in single vehicle accidents sustained a serious or fatal (A or K) injury. For drivers of passenger cars involved in single vehicle accidents, one in five was seriously injured or killed. Again, it should be remembered that many minor single vehicle motorcycle accidents go unreported, and thereby the injury figures associated with cyclists in this type of accident may be artificially inflated.

In car-cycle accidents, the cyclist almost always came away second best. Some 2.1 percent of the cyclists involved in car-cycle accidents were killed. The corresponding number for passenger car drivers was 0.1 percent. While almost 4 out of 5 cyclists involved in a car-cycle accident sustained at least some injury, more than 95 out of 100 passenger car drivers involved in a car-cycle collision left the accident unharmed (Table 5).

Accident Environment

In North Carolina, motorcycle accidents were a seasonal phenomenon. During the six months between April and September, 76.0 percent of all single vehicle motorcycle accidents occurred. During the same time period, 69.6 percent of all car-cycle accidents occurred (Table 6).

For both motorcycles and passenger cars, traffic accidents were associated with weekend driving. (Table 7).

While 43.9 percent of all single vehicle passenger car accidents occurred during daylight conditions, 64.4 percent of all single vehicle motorcycle accidents occurred during daylight. Fully three-fourths of all car-cycle accidents occurred during daylight. And only 10.3 percent of car-cycle accidents occurred on dark, unlighted roads (Table 8).

While passenger cars continued to operate during inclement weather, it seems that motorcycles reduced operation. This phenomenon was reflected in the fact that approximately 95 out of 100 single vehicle motorcycle accidents occurred during clear or cloudy weather. For passenger cars involved in single vehicle accidents the ratio was closer to 75 out of 100 (Table 9).

If road condition is considered rather than weather condition, it can be seen that more than 9 out of 10 single vehicle motorcycle accidents occurred on dry pavement. For passenger cars the ratio was nearly 7 out of 10 (Table 10).

Motorcycles are less stable vehicles than automobiles. For this reason it is often assumed that motorcycles are relatively more likely to be involved in an accident on a curve than are passenger cars. This was not the case. Some 42.7 percent of the single vehicle accidents involving motorcycles occurred on curves; 44.4 percent of the single vehicle accidents involving passenger cars occurred on curves (Table 11).

Because of the inherent instability of a two-wheeled vehicle (compared to a four-wheeled vehicle) the road surface on which a motorcycle is traveling may significantly affect the probability of an accident. While 56.6 percent of the single vehicle accidents involving passenger cars occurred on smooth asphalt and 32.2 percent occurred on course asphalt, the corresponding figures for motorcycles were 51.4 and 40.2 percent, respectively. Since accident involvement for motorcycles on coarse asphalt roadways was relatively higher than that of passenger cars, it is tempting to conclude that coarse asphalt may be a treacherous surface for a cyclist to negotiate. But without knowing the relative exposure of cars and motorcycles to the various road surfaces, it is not possible to know whether coarse asphalt is an accident producing surface or whether cyclists ride relatively more often on coarse asphalt roads (Table 12).

Road defects (e.g. holes, ruts, soft shoulders) generally have a low association with motor vehicle accidents. For example, only 7.8 percent of all single vehicle passenger car accidents were associated

with a road defect, and only 3.5 percent of all car-cycle accidents were associated with a road defect. Motorcycles involved in single vehicle accidents, however, were more likely to be associated with road defects than were passenger cars. Altogether, 12.9 percent of single vehicle motorcycle accidents were associated with road defects. By far the most serious road defect for cyclists was "loose materials on the road surface." This categorization was associated with 6.8 percent of all single vehicle cycle accidents (Table 13).

Multi-vehicle accidents tend to occur at intersections. Car-cycle accidents are no exception. Over half (53.0 percent) of all car-cycle accidents occurred at the intersection of two roads. Interestingly enough, 25.4 percent of all single vehicle cycle accidents occurred at the intersection of two roads. Why so many single vehicle accidents should have occurred at intersections is open to debate. Perhaps these accidents can be related to the low visibility of cycles and last minute attempts by the cyclist to avoid a crash. Perhaps these accidents were attempts by cyclists to correct for motorists' mistakes (Table 14).

A total of 53.0 percent of all car-cycle accidents occurred at intersections. However, 66.3 percent of all car-cycle accidents occurred where no traffic control device (e.g. stop sign, stop and go signal, etc.) was present. It is obvious that many car-cycle accidents are occurring at intersections with no traffic control present (Table 15).

Generally speaking, car-cycle accidents occur in business and residential areas where the speed limit is 35 mph or less. Single vehicle accidents involving either motorcycles or passenger cars usually occur in open country where the speed limit is somewhat higher (Tables 16 and 17).

Vehicle Condition and Operation

In car-cycle accidents, motorcycles were cited for vehicle defects 2.3 percent of the time and passenger cars 1.7 percent of the time. In single vehicle accidents, motorcycles were cited for vehicle defects 5.0 percent of the time and passenger cars 12.2 percent of the time (Table 18).

As has been stated before, motorcycles are less stable than four wheeled vehicles. When single vehicle accidents were considered, it was observed that passenger cars skidded out of control immediately prior to the accident in 6.4 percent of the recorded cases while the corresponding percentage for motorcycles was 2.4. Again, it can be speculated that many minor skidding accidents sustained by cyclists never came to the attention of police officers.

Both motorcycles and passenger cars seemed to be involved in numerous single vehicle accidents due to evasive actions taken to avoid other wheeled vehicles. Some 9.9 percent of all single vehicle motorcycle accidents fell in this category; for passenger cars the percentage was 3.6 (Table 19).

In over 9 out of 10 single vehicle accidents, the vehicle (motorcycle or passenger car) was going straight ahead. In car-cycle accidents, the motorcycle was going straight ahead in 77.8 percent of the cases. The passenger car was making a left turn in 44.3 percent of the cases (Table 20).

Single vehicle accidents involving motorcycles tended to occur at lower speeds than single vehicle accidents involving passenger cars. In car-cycle accidents it appeared that motorcycles were moving at higher speeds prior to the accident than were passenger cars, but it should be remembered that the passenger car involved in a car-cycle accident was often turning left and was therefore going at a very low rate of speed (or standing still) immediately prior to the accident (Table 21).

Passenger car drivers were more apt to be cited for violations at the time of an accident than were motorcyclists. In single vehicle accidents, motorcyclists committed one or more violations in 31.7 percent of the cases; motorists committed one or more violations in 59.4 percent of the cases (Table 21).

The most common violation associated with single vehicle accidents (motorcycles and passenger cars) was speeding. In car-cycle accidents, the most common violation for cyclists was also speeding. For passenger cars involved in car-cycle accidents, three types of violations predominated: failure to yield right of way, improper turning, and failure to see if movement could be made in safety. Together, these three cate-

gories accounted for more than 3 out of 4 violations committed by passenger car drivers involved in car-cycle accidents (Table 22).

Car-Cycle Accidents

Almost 9 out of 10 car-cycle accidents were associated with at least one violation--either by the motorcyclist, the motorist, or both. Most frequently (49.7 percent of the time), the motorist was cited for one violation while the cyclist was error free. In 29.0 percent of the cases, the cyclist committed one violation while the motorist was error free (Table 24).

In 27.4 percent of all car-cycle crashes, both vehicles were going straight ahead. In 38.6 percent of these crashes the motorcycle was going straight ahead, but the passenger car was turning left. In 4.8 percent of the cases the car was turning left as the motorcycle attempted to pass. Clearly, left-turning motorists are a source of considerable danger to cyclists (Table 25).

Neither alcohol nor physical impairment played a major role in car-cycle crashes. Police officers' reports indicated that in 85.9 percent of all car-cycle crashes neither the motorist nor the cyclist had been drinking. In 86.1 percent of all car-cycle crashes the physical status of the motorist and cyclist was normal (Tables 26 and 27).

The last table in this section reiterates a point which has already been made--car-cycle crashes are extremely hazardous to cyclists. In 2.1 percent of the cases the cyclist died; in 44.7 percent of the cases he was seriously injured (Table 28).

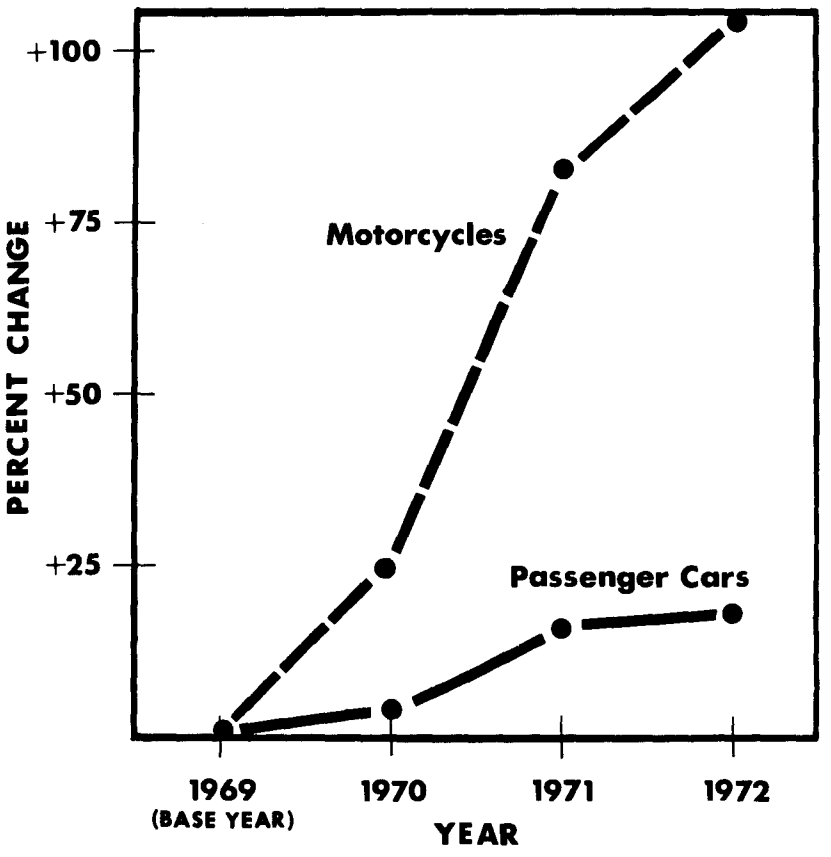

Figure 1. Percent change in motorcycle and passenger car registrations by year.

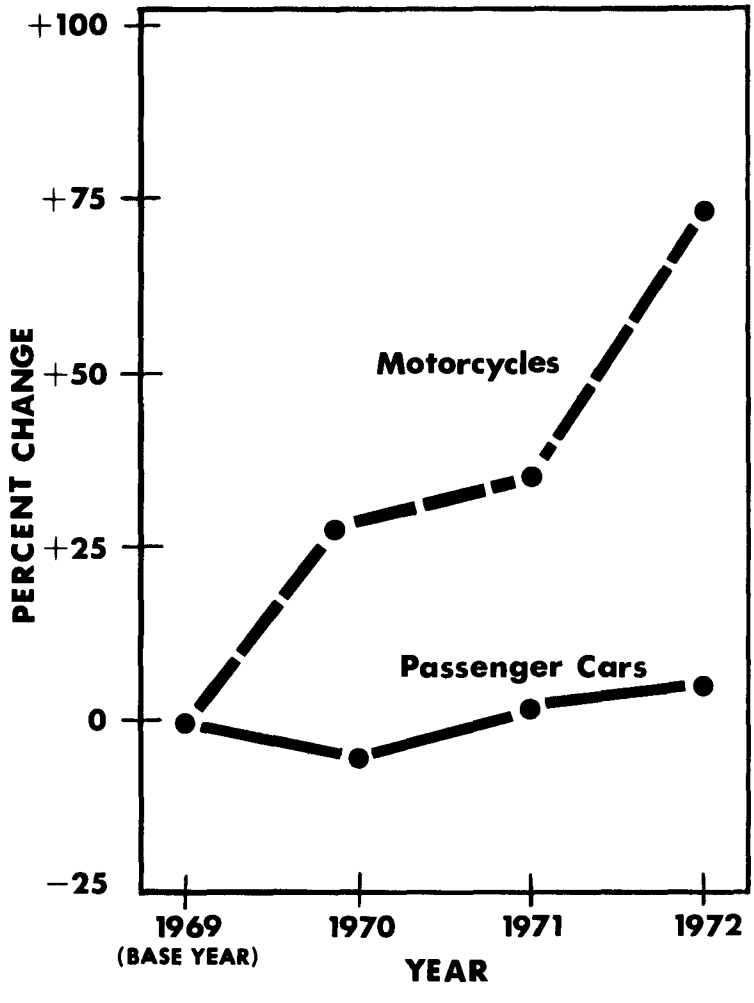

Figure 2. Percent change in motorcycle and passenger car fatalities by year.

Table 1. Motorcycle and passenger car accidents by age of vehicle operator.

	Single Vehicle Accidents		Car-Cycle Accidents	
Age	Motorcycles	Passenger Cars	Motorcycle	Passenger Cars
Under 16 years of age	1.7	0.4	4.2	0.1
16 years	4.8	6.9	6.5	3.0
17 years	6.7	6.7	8.5	4.5
18 or 19 years	14.6	15.8	18.8	7.8
20 thru 24 years	34.0	26.6	32.6	17.8
25 thru 34 years	27.9	20.0	19.0	19.0
35 thru 44 years	7.5	9.2	5.9	14.8
45 thru 54 years	1.6	5.9	2.1	12.6
55 thru 64 years	0.7	3.3	1.4	10.4
65 thru 74 years	0.0	1.3	0.2	5.5
75 years and older	0.0	0.4	0.0	1.8
Not stated	0.6	3.3	0.8	2.8
Total	100.1	99.8	100.0	100.1
N	706	30495	1418	1418

Table 2. Motorcycle and passenger car accidents by sex of vehicle operator.

	Single Vehicle Accidents		Car-Cycle Accidents	
Sex	Motorcycles	Passenger Cars	Motorcycles	Passenger Cars
Male	97.2	76.4	98.6	60.6
Female	2.8	23.6	1.4	39.4
Total	100.0	100.0	100.0	100.0
N	704	29549	1408	1379

Table 3. Motorcycle and passenger car accidents by sobriety of vehicle operator.

	Single Vehicle Accidents		Car-Cycle Accidents	
Sobriety	Motorcycles	Passenger Cars	Motorcycles	Passenger Cars
Had not been drinking	81.9	67.4	92.2	91.3
Drinking - ability impaired	4.1	11.1	0.8	2.6
Drinking - ability impairment not known	9.5	14.8	3.6	2.1
Not stated	4.5	6.7	3.5	4.1
Total	100.0	100.0	100.1	100.1
N	706	30495	1418	1418

Table 4. Motorcycle and passenger car accidents by physical condition of vehicle operator.

Physical Condition	Single Vehicle Accidents		Car-Cycle Accidents	
	Motorcycles	Passenger Cars	Motorcycles	Passenger Cars
Ill	0.1	0.4	0.0	0.0
Fatigued	0.3	1.4	0.1	0.2
Asleep	0.0	2.7	0.0	0.0
Other physical impairment	1.1	2.1	0.2	0.7
Restriction on license not complied with	0.3	0.1	0.1	0.1
Normal	86.0	79.0	90.0	92.0
Condition not known	10.9	12.5	8.0	3.7
Not stated	1.4	1.9	1.7	3.4
Total	100.1	100.1	100.1	100.1
N	706	30495	1418	1418

Table 5. Motorcycle and passenger car accidents by degree of injury sustained by vehicle operators.

	Single Vehicle Accidents		Car-Cycle Accidents	
Degree of Injury	Motorcycles	Passenger Cars	Motorcycles	Passenger Cars
Fatal	1.3	1.2	2.1	0.1
A	53.4	17.5	44.7	1.7
B	25.6	7.9	20.8	1.0
C	8.5	6.3	10.7	1.5
Not injured	11.2	67.0	21.8	95.8
Total	100.0	99.9	100.1	100.1
N	706	30409	1381	1381

Table 6. Motorcycle and passenger car accidents by month.

	Single Vehicle Accidents		
Month	Motorcycles	Passenger Cars	Car-Cycle Accidents
January	2.7	8.1	3.0
February	3.0	7.6	3.9
March	3.8	7.6	5.6
April	10.5	7.9	10.9
May	10.3	8.9	11.2
June	15.7	8.0	12.4
July	12.5	8.7	12.9
August	16.4	7.5	12.6
September	10.6	8.4	9.9
October	7.4	8.7	7.7
November	4.0	9.0	5.1
December	3.1	9.6	4.6
Total	100.0	100.0	99.8
N	706	30495	1418

Table 7. Motorcycle and passenger car accidents by day of week.

	Single Vehicle Accidents		
Day of Week	Motorcycles	Passenger Cars	Car-Cycle Accidents
Monday	10.5	10.9	11.7
Tuesday	11.6	10.5	13.5
Wednesday	12.6	10.2	11.4
Thursday	12.7	11.3	15.0
Friday	12.2	14.9	15.0
Saturday	20.3	23.1	17.1
Sunday	20.1	19.0	16.2
Total	100.0	99.9	99.9
N	706	30495	1418

Table 8. Motorcycle and passenger car accidents by light condition.

	Single Vehicle Accidents		
Light Condition	Motorcycles	Passenger Cars	Car-Cycle Accidents
Daylight	64.4	43.9	75.4
Dusk	4.8	2.6	3.3
Dawn	0.1	1.8	0.1
Darkness - road lighted	10.4	12.1	10.9
Darkness - road not lighted	20.3	39.9	10.3
Total	100.0	100.3	100.0
N	705	30363	1418

Table 9. Motorcycle and passenger car accidents by weather conditions.

Weather	Single Vehicle Accidents		Car-Cycle Accidents
	Motorcycles	Passenger Cars	
Clear	78.3	56.0	78.6
Cloudy	16.9	17.4	15.9
Raining	3.8	22.8	4.9
Snowing	0.0	1.2	0.1
Fog	0.6	2.0	0.5
Sleet or hail	0.0	0.1	0.0
Not stated	0.4	0.4	0.0
Total	100.0	99.9	100.0
N	706	30495	1418

Table 10. Motorcycle and passenger car accidents by road condition.

	Single Vehicle Accidents		
Road Condition	Motorcycles	Passenger Cars	Car-Cycle Accidents
Dry	91.4	67.8	91.7
Wet	7.4	30.1	6.9
Oily	0.7	0.1	0.1
Muddy	0.1	0.3	0.1
Snowy	0.1	1.0	0.1
Icy	0.1	0.8	1.1
Total	99.8	100.1	100.0
N	700	30358	1418

Table 11. Motorcycle and passenger car accidents by road character.

	Single Vehicle Accidents		
Road Character	Motorcycles	Passenger Cars	Car-Cycle Accidents
Straight road - level	41.1	37.4	61.5
Straight road - hillcrest	3.0	3.2	5.4
Straight road - on grade	12.0	13.9	18.1
Sharp curve - level	13.0	11.7	1.7
Sharp curve - hillcrest	1.1	1.5	0.5
Sharp curve - on grade	10.2	8.8	1.8
Other curve - level	9.6	12.5	4.9
Other curve - hillcrest	1.7	1.4	0.9
Other curve - on grade	7.1	8.5	3.6
Not stated	1.1	0.9	1.6
Total	99.9	99.8	100.0
N	706	30495	1418

Table 12. Motorcycle and passenger car accidents by road construction.

	Single Vehicle Accidents		
Road Construction	Motorcycles	Passenger Cars	Car-Cycle Accidents
Concrete	4.0	5.2	4.2
Smooth asphalt	51.4	56.6	63.5
Coarse asphalt	40.2	32.2	28.8
Gravel	1.6	1.9	1.2
Dirt or sand	2.0	3.1	1.6
Other	0.3	0.2	0.1
Not stated	0.6	0.7	0.6
Total	100.1	99.9	100.0
N	706	30495	1418

Table 13. Motorcycle and passenger car accidents by road defects.

Road Defects	Single Vehicle Accidents		Car-Cycle Accidents
	Motorcycles	Passenger Cars	
Loose material on surface	6.8	1.9	1.3
Holes; deep ruts	1.6	0.4	0.1
Low shoulders	1.6	1.7	0.4
Soft shoulders	0.6	2.2	0.2
Other defects	1.0	0.7	0.4
Road under construction	1.3	0.9	1.1
No defects	86.5	91.4	96.1
Not stated	0.7	0.8	0.5
Total	100.1	100.0	100.1
N	706	30495	1418

Table 14. Motorcycle and passenger car accidents by roadway feature.

	Single Vehicle Accidents		
Roadway Feature	Motorcycles	Passenger Cars	Car-Cycle Accidents
Bridge or underpass	1.6	3.6	0.3
Driveway	6.4	4.7	26.5
Alley intersection	0.4	0.1	0.3
Intersection of two roadways	25.4	17.3	53.0
Non-intersection median crossover	0.8	0.5	1.1
End or beginning of divided highway	0.4	0.3	0.0
Not stated	65.0	73.7	18.9
Total	100.0	100.2	100.1
N	706	30495	1418

Table 15. Motorcycle and passenger car accidents by traffic control.

	Single Vehicle Accidents		
Traffic Control	Motorcycles	Passenger Cars	Car-Cycle Accidents
Stop sign	8.9	5.5	20.5
Yield sign	0.3	0.3	0.6
Stop and go signal	3.3	1.4	10.4
Flashing signal	0.3	0.2	0.6
Railroad crossing	0.0	0.3	0.0
Officer	0.0	0.0	0.2
Other device	1.8	2.9	1.3
No control present	85.4	89.3	66.3
Total	100.0	99.9	99.9
N	706	30495	1418

Table 16. Motorcycle and passenger car accidents by locality.

	Single Vehicle Accidents		
Locality	Motorcycles	Passenger Cars	Car-Cycle Accidents
Business	12.3	6.5	29.9
Residential	29.7	21.7	37.0
School or playground	0.8	0.5	1.6
Open country	57.1	71.3	31.5
Total	99.9	100.0	100.0
N	706	30495	1418

Table 17. Motorcycle and passenger car accidents by posted speed.

	Single Vehicle Accidents		
Posted Speed	Motorcycle	Passenger Cars	Car-Cycle Accidents
20 mph	1.9	0.9	2.8
25 or 30	4.4	2.0	4.5
35 or 40	30.5	20.9	45.0
45 or 50	12.9	8.5	16.9
55	41.2	52.4	20.1
60	6.9	11.3	4.3
65	1.9	3.1	0.2
Not stated	0.3	.9	6.1
Total	100.0	100.0	99.9
N	682	29414	1418

Table 18. Motorcycle and passenger car accidents by vehicle condition.

Vehicle Condition	Single Vehicle Accidents		Car-Cycle Accidents	
	Motorcycles	Passenger Cars	Motorcycles	Passenger Cars
Defective brakes	1.0	1.8	0.6	0.3
Defective headlights	0.3	0.1	0.5	0.1
Defective rear lights	0.0	0.0	0.3	0.4
Defective steering	0.7	0.9	0.0	0.0
Defective tires	1.7	8.3	0.2	0.6
Other defects	1.3	1.1	0.7	0.3
Not known if defective	18.4	15.4	17.4	15.0
No defects detected	74.1	71.5	78.5	80.9
Not stated	2.5	1.0	1.8	2.4
Total	100.0	100.1	100.0	100.0
N	706	30495	1418	1418

Table 19. Motorcycle and passenger car accidents by miscellaneous action.

Miscellaneous Action	Single Vehicle Accidents		Car-Cycle
	Motorcycles	Passenger Cars	Accidents
Avoiding pedestrian	0.0	0.1	(Cannot be determined from HSRC file.)
Avoiding other wheeled vehicle (excluding tricycle and other child's toys)	9.9	3.6	
Avoiding fixed object	0.1	0.1	
Avoiding animal	2.1	0.7	
Fire or mechanical failure	0.1	0.2	
Fell from vehicle	1.4	0.2	
Driverless moving vehicle	0.0	0.3	
Skidded out of control	2.4	6.4	
Pushing or towing vehicle (do not include trailer)	0.0	0.2	
Not stated	83.9	88.2	
Total	99.9	100.0	
N	706	30495	

Table 20. Motorcycle and passenger car accidents by vehicle maneuver.

	Single Vehicle Accidents		Car-Cycle Accidents	
Vehicle Maneuver	Motorcycles	Passenger Cars	Motorcycles	Passenger Cars
Going straight ahead	91.1	92.8	77.8	39.4
Changing lanes or merging	0.6	0.4	1.1	1.0
Passing	1.4	2.4	6.5	2.5
Making right turn	2.7	1.3	1.7	4.0
Making left turn	1.7	1.7	6.6	44.3
Making U turn	0.4	0.1	0.9	0.6
Backing	0.1	0.4	0.4	1.3
Slowing or stopping	1.7	0.8	1.1	2.1
Starting in a roadway	0.3	0.0	3.8	4.6
Parking	0.0	0.0	0.0	0.0
Leaving parked position	0.0	0.1	0.3	0.4
All others	0.0	0.1	0.0	0.0
Total	100.0	100.1	100.2	100.2
N	706	30495	1267	1267

Table 21. Motorcycle and passenger car accidents by approximate speed before accident.

Approximate Speed (Before Accident)	Single Vehicle Accidents		Car-Cycle Accidents	
	Motorcycles	Passenger Cars	Motorcycles	Passenger Cars
0 thru 9 mph	1.0	0.6	9.9	30.1
10 thru 19 mph	4.8	1.9	12.2	26.8
20 thru 29 mph	10.8	4.6	16.6	13.0
30 thru 39 mph	23.1	12.4	27.5	9.4
40 thru 49 mph	20.4	18.3	14.2	6.5
50 thru 59 mph	18.3	28.0	6.5	3.3
60 thru 69 mph	7.5	15.2	1.2	0.8
70 thru 79 mph	3.3	6.4	0.1	0.1
80 mph and over	0.6	3.5	0.1	0.1
Not stated	10.3	9.0	11.6	9.9
Total	100.1	99.9	99.9	100.0
N	706	30495	1418	1418

Table 22. Motorcycle and passenger car accidents by number of violations.

	Single Vehicle Accidents		Car-Cycle Accidents	
Violations	Motorcycles	Passenger Cars	Motorcycles	Passenger Cars
0	68.3	40.7	62.4	41.9
1	27.8	48.7	34.7	55.5
2	3.5	9.0	2.5	2.4
3+	0.4	1.7	0.3	0.1
Total	100.0	100.1	99.9	99.9
N	706	30495	1418	1418

Table 23. Motorcycle and passenger car accidents by type of violations.

	Single Vehicle Accidents		Car-Cycle Accidents	
Violations	Motorcycles	Passenger Cars	Motorcycles	Passenger Cars
Speeding below 65 mph	42.7	33.6	21.7	4.9
Speeding 65 to 75 mph	7.1	8.0	0.2	0.6
Speeding 75+ mph	4.3	6.6	0.2	0.1
Failed to yield right of way	0.8	0.5	14.8	41.1
Drove left of center	13.7	19.5	10.4	3.9
Improper overtaking	2.7	1.1	13.0	3.0
Passed stop sign	2.4	2.6	2.6	0.8
Disregarded traffic signal	0.0	0.3	1.7	0.9
Followed too closely	1.2	0.3	11.6	1.7
Made improper turn	1.6	0.5	4.3	11.9
Improper or no signal	0.0	0.1	1.0	1.9
Improper parking location	0.0	0.0	0.3	0.1
Under the influence of alcohol	8.2	10.2	1.2	2.2
Reckless driving	7.8	8.5	2.3	0.2
Racing	0.0	0.1	0.0	0.0
Failed to see if movement could be made in safety	3.5	2.6	10.6	24.7
Passing on curve	0.0	0.0	0.0	0.0
Passing on hill	0.0	0.0	0.0	0.0
Passed stopped school bus	0.0	0.0	0.0	0.0
Improper lights	0.0	0.0	1.2	0.1
Improper brakes	0.0	0.5	0.3	0.2
Other improper driving	3.9	4.9	2.4	1.5
Total	99.9	99.9	99.8	99.8
N	255	21835	576	863

Table 24. Number of violations committed by drivers of passenger cars versus number of violations committed by drivers of motorcycles.

Passenger Car Violations	Motorcycle Violations 0	1	2	3	
0	10.3	29.0	2.3	0.3	41.9
1	49.7	5.6	0.2		55.5
2	2.3	0.1			2.4
3	0.1				0.1
	62.4	34.7	2.5	0.3	99.9

N = 1418

Table 25. Passenger car maneuver at time of accident versus motorcycle maneuver at time of accident.

Car's Maneuver	Cycle's Maneuver: Straight	Lane Change	Passing	Right Turn	Left Turn	U Turn	Backing	Slowing-Stopping	Starting	Leaving Parking Space	
Straight	27.4	0.7	0.4	1.0	4.4	0.7	0.4	0.6	3.6	0.2	39.4
Lane Change	0.9	0.1									1.0
Passing	0.3		0.2	0.1	1.7	0.2					2.5
Right Turn	2.4	0.1	1.0	0.1	0.1				0.2	0.1	4.0
Left Turn	38.6		4.8	0.4	0.3			0.2			44.3
U Turn	0.6										0.6
Backing	1.3										1.3
Slowing-Stopping	1.4	0.2	0.1	0.1	0.1			0.2			2.1
Starting	4.5							0.1			4.6
Leaving Parking Space	0.4										0.4
	77.8	1.1	6.5	1.7	6.6	0.9	0.4	1.1	3.8	0.3	100.2

N = 1267

Table 26. Sobriety of drivers of passenger cars versus sobriety of motorcycle operators.

Sobriety of Passenger Car Driver	Sobriety of Motorcycle Operator: Not Drinking	Drinking - Impaired	Drinking - Impairment Not Known	Not Stated	
Not Drinking	85.9	0.7	3.0	1.7	91.3
Drinking - Impaired	2.0		0.1	0.5	2.6
Drinking - Impairment Not Known	1.5		0.4	0.2	2.1
Not Stated	2.8	0.1	0.1	1.1	4.1
	92.2	0.8	3.6	3.5	100.1

N = 1418

Table 27. Physical condition of drivers of passenger cars versus physical condition of motorcycle operators.

Physical Condition of Passenger Car Driver	Physical Condition of Motorcycle Operator: Fatigued	Other Physical Impairment	Restriction On License Not Complied With	Normal	Condition Not Known	Not Stated	
Fatigued				0.1		0.1	0.2
Other Physical Impairment				0.6		0.1	0.7
Restriction On License Not Complied With				0.1			0.1
Normal		0.2	0.1	86.1	4.8	0.8	92.0
Condition Not Known	0.1			0.8	2.7	0.1	3.7
Not Stated				2.3	0.5	0.6	3.4
	0.1	0.2	0.1	90.0	8.0	1.7	100.1

N = 1418

Table 28. Injuries sustained by driver of passenger car versus injuries sustained by motorcycle operator.

Injuries To Passenger Car Driver	Injuries to Motorcycle Operator: None	C	B	A	Killed	
None	20.1	10.7	20.6	42.9	1.5	95.8
C	0.5		0.1	0.8	0.1	1.5
B	0.2		0.1	0.6	0.1	1.0
A	0.9			0.4	0.4	1.7
Killed	0.1					0.1
	21.8	10.7	20.8	44.7	2.1	100.1

N = 1381

IV. CONCLUSION

Whenever motorcycles share the road with passenger cars, a potentially dangerous situation exists.

(1) When cars and motorcycles collide the cyclist nearly always sustains a more severe injury than the motorist. Motorcycles are by their very nature lightweight and almost totally devoid of protective armor. It only stands to reason that the driver of a massive vehicle, wrapped in a cocoon of steel, should fare better in a crash than a cyclist.

(2) Motorcycles are small in size, and to date they make up only a small proportion of vehicles on the road. For at least these two reasons, motorcycles are often overlooked and ignored in traffic. Either the motorcycle is not seen, or it is misperceived.

It seems that very little can be accomplished to protect a cyclist once he has become involved in an accident. Protective clothing, helmets, etc. help, but these countermeasures are paltry indeed when compared to the crash phase safety devices built into passenger cars--seat belts and shoulder harnesses, high pentration resistant windshields, side door beams, etc. If motorcycle injuries and fatalities are to be reduced, countermeasures must be preventive rather than preserving.

Education programs for cyclists and motorists alike would certainly seem in order. Driver education programs should be expanded to provide

instruction in operation of the motorcycle. Licensure to operate a motorcycle should be based on evaluation of an applicant's knowledge and skill concerning motorcycles rather than the current practice of allowing all holders of an operator's license to use a motorcycle on the highway.