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an analysis of motorcycle accidents with recommendations for licensing and operation

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AN ANALYSIS OF MOTORCYCLE ACCIDENTS WITH RECOMMENDATIONS FOR LICENSING AND OPERATION

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ABSTRACT

Motorcycle accidents officially reported as occurring in North Carolina in 1968 were analyzed to determine the circumstances surrounding the crashes, and on the basis of the analyses recommendations are made for licensing and vehicle operation.

Altogether, 935 accident reports were examined. Two main accident categories were set up for analysis: multivehicle and single vehicle.

About two-thirds of the accidents were multivehicle, and almost all such accidents involved a motorcycle and an automobile. Moreover, in 62 percent of multivehicle accidents, the driver of the car was at fault. Most often the car was making a left turn in front of the motorcycle when the accident occurred. Next in frequency, the car pulled out in front of the motorcycle. When the motorcyclist was at fault—in only 29 percent of multivehicle accidents—he was most likely "following too closely". In about nine percent of the multivehicle accidents, culpability did not clearly lie with one party or the other.

Rounding curves was the maneuver most frequently associated with single vehicle accidents, which accounted for approximately one-third of all motorcycle accidents. Loss of control was also caused by an animal, pedestrian, or bicycle darting into the street or by gravel or oil slicks in the road. Sometimes loss of control occurred when the motorcyclist was trying to avoid a car. There were very few instances when the motorcyclist was clearly at fault in a single vehicle accident; yet note should be made of the fact that the majority of single vehicle accidents occurred under the most predictable of the situations described—that is, in adapting to roadway curvature. Exuberant or incautious behavior on the part of the cyclist accounted for single vehicle accidents in a few instances, but only three cyclists were found to be drunk.

Passengers figured prominently in the motorcycle accident picture. In fact, passengers were present in nearly 12 percent of all motorcycle accidents and in almost 30 percent of fatal accidents. Passengers were also more likely to be present in single vehicle accidents than in multivehicle accidents.

Fatalities occurred in 2.89 percent of all motorcycle accidents. Daytime fatalities were more likely to be multivehicle and nighttime fatalities were more likely to be single vehicle. Passengers were present in almost 30 percent of fatal accidents, suggesting that passengers markedly increase the likelihood of a fatality should an accident occur.

In making recommendations, one factor is overriding: the data analyses indicate that the three major accident-causing situations are amenable to countermeasures.

1) *Public Information.* Through mass communications, motorists and motorcyclists alike may become mutually aware. Motorists can be encouraged to look out for motorcyclists; motorcyclists can be informed of ways to increase their visibility.

2) *Special Licensing.* Guidelines for proper operation of motorcycles can be disseminated, and certain skills can be emphasized and required. Licensing of motorcyclists should include tests of maneuverability, particularly in the execution of curves.

3) *Passengers.* Carrying passengers can be discouraged or even prohibited.

In summary, the analyses indicate that a number of things can be done that are likely to reduce the incidence of motorcycle accidents.

INTRODUCTION

The use of motorcycles on the public highways has increased steadily over recent years. Concomitant with this increase is a growing concern about the safety hazards posed by these machines. Clearly, in any collision with an automobile a motorcyclist is at a disadvantage independent of the question of fault. Because motorcycles pose such a threat to the safety of the rider, anything that can be done to reduce the frequency of their involvement in accidents should be worthwhile. To determine what factors might be associated with motorcycle accidents, this study examined a sample of accident reports describing crashes involving motorcycles.

METHOD

Copies of the written accident reports were obtained for all motorcycle accidents reported to the North Carolina Department of Motor Vehicles as occurring in North Carolina in 1968. These accident reports are the official documents filled out by the investigating officer. Each report was examined to determine the circumstances surrounding the crash, including the maneuvers involved. Note was made of whether the crash occurred during daylight, dusk or dawn, or at night. It was also noted whether there were passengers present and whether a fatality occurred. Because motorcycle crashes almost always involve injury, there was no category for property damage only.

Motorcycle accidents were divided into multivehicle and single vehicle crashes. For the former, culpability was determined by examination of the accident report rather than by whether or not the investigating officer arrested anyone. In most instances it was clear from the report who had the right of way and whether the accident could have been avoided by reasonably prudent action on the part of either driver. Culpability was much more difficult to determine in the case of single vehicle accidents. Of a total of 305 single vehicle accidents, there were 39 in which an arrest was made and in which the motorcyclist appeared to be clearly at fault. In a number of cases, the motorcyclist's culpability was not clear and in most of these instances the investigating officer did not arrest him. There were, however, a few instances in which an arrest was made, although it appeared that the motorcyclist was not clearly at fault. There were also some arrests for offenses not directly related to the motorcycle crash, such as failure to report an accident, failure to wear safety helmet, or failure to carry liability insurance. Thus, because of the ambiguity concerning fault in single vehicle accidents, descriptive percentages are given, but statistical tests were not run on these accidents by culpability.

RESULTS

A total of 936 motorcycle accidents were officially reported to the North Carolina Department of Motor Vehicles as having occurred in North Carolina during 1968. One of these reports was illegible, leaving a total of 935 that were analyzed.

Type of Accident by Culpability and Time of Day. Table 1 shows the breakdown of these reports according to number of vehicles involved, culpability, and time of day. As can be seen, most motorcycle accidents occur during daylight hours when it would be expected that exposure would be greatest. Sixty-seven percent, or two-thirds, of the accidents were multivehicle. Almost all of these involved a motorcycle and an automobile. In sixty-two percent of the multivehicle accidents the driver of the automobile was at fault. Such situations included the car turning in front of the motorcycle, the car pulling out into the motorcycle, or the car engaging in some other maneuver without seeing the motorcycle (see Table A in Appendix).

Table 1. Total accidents: Type of accident by culpability and time of day

		Day	Dawn/ Dusk	Night	Total
Multivehicle:					
Car at Fault:	Frequency	306	22	64	392
	Row %	78.06	5.61	16.33	100.00
	Column %	63.62	66.67	55.17	62.22
Motorcycle at Fault:	Frequency	136	9	39	184
	Row %	73.91	4.89	21.20	100.00
	Column %	28.27	27.27	33.62	29.21
Culpability Unclear:	Frequency	39	2	13	54
	Row %	72.22	3.70	24.08	100.00
	Column %	8.11	6.06	11.21	8.57
Subtotal:	Frequency	481	33	116	630
	Row %	76.35	5.24	18.41	100.00
	Column %	72.77	60.00	52.97	67.38
Single Vehicle:					
Subtotal:	Frequency	180	22	103	305
	Row %	59.02	7.21	33.77	100.00
	Column %	27.23	40.00	47.03	32.62
Total:	Frequency	661	55	219	935
	Row %	70.70	5.88	23.42	100.00
	Column %	100.00	100.00	100.00	100.00

The motorcyclist was at fault in 29 percent of multivehicle accidents. The largest category for these motorcycle-at-fault accidents was "following too closely." Most of the other situations involved inappropriate behavior on the part of the motorcyclist, such as passing on the right or running a red light (see Table B in Appendix).

In almost nine percent of multivehicle accidents, culpability did not clearly lie with one party or the other. In some instances, neither party had clearly committed an offense (e.g., a car swerved to miss a small boy on a bicycle and a motorcycle could not avoid hitting the car when it entered his lane). In a few instances both parties had clearly violated the law. The largest group in the unclear culpability category concerned a car or motorcycle turning while the other vehicle was passing (see Table C in Appendix).

Thirty-three percent of all motorcycle accidents involved no other vehicle. Most of the accidents occurred while the motorcyclist was maneuvering curves—a factor that figured in almost 28 percent of all single vehicle motorcycle accidents. Another major category was loss of control caused by an animal, pedestrian, or bicycle darting into the street, or loss of control caused by gravel or an oil slick in the road. In a number of cases the motorcyclist lost control while trying to avoid a car. This category is of particular interest because of the large number of multivehicle accidents caused by the automobile driver failing to see the motorcyclist. Mechanical failure figured in a number of other accidents. There were relatively few instances where the motorcyclist was clearly at fault (39 out of 305, or less than 13 percent). These cases usually involved speeding or going too fast for conditions. In a few cases the motorcyclist was clearly "acting up" with his vehicle, and in only three instances was he found to be drunk. (Table D in the Appendix provides more complete information on single vehicle crashes.)

Type of Accident by Time of Day. Table 2 presents data for type of accident by time of day. Compared with multivehicle accidents, the single vehicle accident is overrepresented in the daytime figures ($X^2 = 30.79$, 2 df, $p < .001$). It may be that the motorcycle is relatively more difficult to detect during daylight hours, while at night it is more easily seen because of its lights. Such a hypothesis would be supported by the fact that in multivehicle accidents the automobile drivers frequently reported that they did not see the motorcycle. On the other hand, the single vehicle accident may be more likely to occur at night because of the increased difficulty in detecting many of the hazards common to motorcyclists, such as objects in the road. It may be noted that for passenger car accidents the same day-night differences are observed for single and multivehicle crashes.

Table 2. Total accidents by type of accident and time of day

		Day	Dawn/ Dusk	Night	Total
Multivehicle:	Frequency	481	33	116	630
	Row %	76.35	5.24	18.41	100.00
	Column %	72.77	60.00	52.97	67.38
Single Vehicle:	Frequency	180	22	103	305
	Row %	59.02	7.21	33.77	100.00
	Column %	27.23	40.00	47.03	32.62
Total:	Frequency	661	55	219	935
	Row %	70.70	5.88	23.42	100.00
	Column %	100.00	100.00	100.00	100.00

$X^2 = 30.79$, 2 df, $p < .001$.

Multivehicle Culpability by Time of Day. Table 3 presents comparisons of culpability by time of accident for multivehicle accidents. Although most multivehicle accidents are the fault of the automobile driver, there are no significant differences according to the time of day that the accident occurs. For daytime, nighttime, dawn or dusk, the fault lies with the driver of the automobile in close to 60 percent of multivehicle accidents.

Passengers. In a total of 112, or almost 12 percent, of the accidents, there was at least one passenger present. In most instances, there was only one passenger, but in two cases there were two, and in one instance there were three passengers in addition to the driver (who was arrested for overloading his vehicle).

When passenger accidents are examined by type of accident and time of occurrence (see Table 4), there are no significant differences. The distribution of passenger accidents between day and night is about the same for single and multivehicle events.

Table 5 shows the total number of accidents by presence of passengers and by time of accident. There were no significant differences between the proportion of daytime accidents that included a passenger and the corresponding proportion for nighttime accidents. Tables 6 and 7 show the same comparisons for single and multivehicle accidents. Again there are no significant differences.

Table 8 shows the presence of passengers by type of accident. Passengers are present in almost 12 percent of all motorcycle accidents but in only slightly more than 10 percent of multivehicle accidents and in more than 15 percent of single vehicle accidents, a difference that is statistically significant ($X^2 = 5.01$, 1 df, $p < .05$).

Table 3. Multivehicle accidents, culpability by time of day

		Day	Dawn/ Dusk	Night	Total
Car at Fault:	Frequency	306	22	64	392
	Row %	78.06	5.61	16.33	100.00
	Column %	63.62	66.67	55.17	62.22
Motorcycle at Fault:	Frequency	136	9	39	184
	Row %	73.91	4.89	21.20	100.00
	Column %	28.27	27.27	33.62	29.21
Culpability Unclear:	Frequency	39	2	13	54
	Row %	72.22	3.70	24.08	100.00
	Column %	8.11	6.06	11.21	8.57
TOTAL:	Frequency	481	33	116	630
	Row %	76.35	5.24	18.41	100.00
	Column %	100.00	100.00	100.00	100.00

$X^2 = 3.44$, 4 df, P = NS

Table 4. Passenger accidents: Type of accident by time of day

		Day	Night	Total
Multivehicle:	Frequency	45	20	65
	Row %	69.23	30.77	100.00
	Column %	60.81	52.63	58.04
Single Vehicle:	Frequency	29	18	47
	Row %	61.70	38.30	100.00
	Column %	39.19	47.37	41.96
Total:	Frequency	74	38	112
	Row %	66.07	33.93	100.00
	Column %	100.00	100.00	100.00

$X^2 = .690$, 1 df, P = NS

Table 5. Total accidents: Presence of passengers by time of day

		Day	Night	Total
Multivehicle:	Frequency	74	38	112
	Row %	66.07	33.93	100.00
	Column %	11.20	13.87	11.98
Single Vehicle:	Frequency	587	236	823
	Row %	71.32	28.68	100.00
	Column %	88.80	86.13	88.02
Total:	Frequency	661	274	935
	Row %	70.70	29.30	100.00
	Column %	100.00	100.00	100.00

$X^2 = 1.31$, 1 df, P = NS

Table 6. Single vehicle accidents: Presence of passengers by time of day

		Day	Night	Total
Passengers:	Frequency	29	18	47
	Row %	61.70	38.30	100.00
	Column %	16.11	14.40	15.41
No Passengers:	Frequency	151	107	258
	Row %	58.53	41.47	100.00
	Column %	83.89	85.60	84.59
Total:	Frequency	180	125	305
	Row %	59.02	40.98	100.00
	Column %	100.00	100.00	100.00

Fisher's $p_f = .405$, P = NS.

Table 7. Multivehicle accidents: Presence of passengers by time of day

		Day	Night	Total
Passengers:	Frequency	45	20	65
	Row %	69.23	30.77	100.00
	Column %	9.36	13.42	10.32
No Passengers:	Frequency	436	129	565
	Row %	77.17	22.83	100.00
	Column %	90.64	86.58	89.68
Total:	Frequency	481	149	630
	Row %	76.35	23.65	100.00
	Column %	100.00	100.00	100.00

$X^2 = 2.034$, 1 df, P = NS

Table 8. Total accidents: Type of accident by presence of passengers

		Passengers	No Passengers	Total
Single Vehicle:	Frequency	47	258	305
	Row %	15.41	84.59	100.00
	Column %	41.96	31.35	32.62
Multivehicle:	Frequency	65	565	630
	Row %	10.32	89.68	100.00
	Column %	58.04	68.65	67.38
Total:	Frequency	112	823	935
	Row %	11.98	88.02	100.00
	Column %	100.00	100.00	100.00

$\chi^2 = 5.05$, 1 df, $p < .05$

Fatalities. Only 27 accidents involved fatalities. Table 9 presents the distribution of these fatal accidents by day-night and by type of accident. The daytime fatalities are much more likely to be multivehicle, while the nighttime fatalities are more likely to be single vehicle ($X^2 = 5.63$, 1 df, $p < .02$). For multivehicle fatalities, shown in Table 10, the nighttime accidents were more likely to be considered the fault of the motorcyclist than the daytime accidents. Indeed, there were no nighttime multivehicle fatalities in which the automobile driver was considered at fault (Fisher's $p < .01$).

Table 9. Fatal accidents: Type of accident by time of day

		Day	Night	Total
Multivehicle:	Frequency	13	4	17
	Row %	76.47	23.53	100.00
	Column %	81.25	36.36	62.96
Single Vehicle:	Frequency	3	7	10
	Row %	30.00	70.00	100.00
	Column %	18.75	63.64	37.04
Total:	Frequency	16	11	27
	Row %	59.26	40.74	100.00
	Column %	100.00	100.00	100.00

$X^2 = 5.63$, 1 df, $p < .02$.

Table 10. Multivehicle fatalities: Culpability by time of day

		Day	Night	Total
Car at Fault:	Frequency	11	0	11
	Row %	100.00	0	100.00
	Column %	84.62	0	64.71
Cycle at Fault:	Frequency	2	4	6
	Row %	33.33	66.67	100.00
	Column %	15.38	100.00	35.29
Total:	Frequency	13	4	17
	Row %	76.47	23.53	100.00
	Column %	100.00	100.00	100.00

Fisher's $p_f < .01$.

When fatal motorcycle accidents are examined according to their proportion of total day and nighttime accidents (Table 11), no significant differences are detected. Fatal accidents constitute 2.42 percent of all daytime accidents, compared with 4.01 percent of all nighttime accidents. For single vehicle motorcycle accidents, fatal crashes constitute 1.67 percent of daytime crashes and 5.60 percent of nighttime crashes ($X^2 = 3.60$, 1 df, $.05 < p < .10$, Table 12). While this difference is not statistically significant at .05, it suggests that single vehicle crashes occurring at night may be more serious than such crashes occurring during daylight hours. For multivehicle accidents, fatalities represent 2.70 percent of daytime crashes and 2.68 percent of nighttime crashes, or virtually identical proportions (Table 13).

Table 11. Total accidents: Severity by time of day

		Day	Night	Total
Fatal:	Frequency	16	11	27
	Row %	59.26	40.74	100.00
	Column %	2.42	4.01	2.89
Non Fatal:	Frequency	645	263	908
	Row %	71.04	28.96	100.00
	Column %	97.58	95.99	97.11
Total:	Frequency	661	274	935
	Row %	70.70	29.30	100.00
	Column %	100.00	100.00	100.00

$X^2 = 1.76$, 1 df, P = NS

Table 12. Single vehicle accidents: Severity by time of day

		Day	Night	Total
Fatal:	Frequency	3	7	10
	Row %	30.00	70.00	100.00
	Column %	1.67	5.60	3.28
Not Fatal:	Frequency	177	118	295
	Row %	60.00	40.00	100.00
	Column %	98.33	94.40	96.72
Total:	Frequency	180	125	305
	Row %	59.02	40.98	100.00
	Column %	100.00	100.00	100.00

$X^2 = 3.60$, 1 df, $p = 180 > .05 > .10$ ($X^2 = 3.84$, $p = .05$).

Table 13. Multivehicle accidents: Severity by time of day

		Day	Night	Total
Fatal:	Frequency	13	4	17
	Row %	76.47	23.53	100.00
	Column %	2.70	2.68	2.70
Non Fatal:	Frequency	468	145	613
	Row %	76.35	23.65	100.00
	Column %	97.30	97.32	97.30
Total:	Frequency	481	149	630
	Row %	76.35	23.65	100.00
	Column %	100.00	100.00	100.00

$X^2 = 0.00$, 1 df, P = NS

Table 14 shows total accidents by whether a fatality occurred and by type of accident. Fatalities occurred in 2.89 percent of all motorcycle accidents, in 2.70 percent of multivehicle accidents, and in 3.28 percent of single vehicle accidents. These differences are not statistically significant.

Table 14. Total accidents: Type of accident by fatality

		Yes	No	Total
Single Vehicle:	Frequency	10	295	305
	Row %	3.28	96.72	100.00
	Column %	37.04	32.49	32.62
Multivehicle:	Frequency	17	613	630
	Row %	2.70	97.30	100.00
	Column %	62.96	67.51	67.38
Total:	Frequency	27	908	935
	Row %	2.89	97.11	100.00
	Column %	100.00	100.00	100.00

$X^2 = .25$, 1 df, P = NS

Fatalities and Passengers. The association between the presence of passengers and seriousness of the accident is shown in Table 15. It can be seen that passengers were present in almost 12 percent of all motorcycle accidents, and almost 30 percent of fatal accidents (X^2 = 8.22, 1 df, p < .01). Because the presence of a passenger doubles the candidates for a fatality, the analysis was run again to include driver fatalities only. Table 16 shows these results which are significant (X^2 = 5.67, 1 df, p < .02). It appears that passengers not only increase the likelihood of a fatality occurring in the event of an accident but also increase the likelihood of a driver fatality should an accident occur.

Table 15. Total accidents: Severity by presence of passengers

		Passengers	No Passengers	Total
No Fatality:	Frequency	104	804	908
	Row %	11.45	88.55	100.00
	Column %	92.86	97.69	97.11
Fatality:	Frequency	8	19	27
	Row %	29.63	70.37	100.00
	Column %	7.14	2.31	2.89
Total:	Frequency	112	823	935
	Row %	11.98	88.02	100.00
	Column %	100.00	100.00	100.00

X^2 = 8.22, 1 df, p < .01.

Table 16. Total accidents: Driver fatality by presence of passengers

		Passengers	No Passengers	Total
Driver Fatality:	Frequency	105	804	909
	Row %	11.55	88.45	100.00
	Column %	93.75	97.69	97.22
Driver Fatality:	Frequency	7	19	26
	Row %	26.92	73.08	100.00
	Column %	6.25	2.31	2.78
Total:	Frequency	112	823	935
	Row %	11.98	88.02	100.00
	Column %	100.00	100.00	100.00

= 5.665, 1 df, p < .02.

DISCUSSION

Clearly, the major threat to the motorcyclist is the automobile operator who does not see him. Sixty-two percent of multivehicle accidents and 42 percent of all motorcycle accidents (both single vehicle and multivehicle), were the fault of the automobile driver. In most instances, the driver reported he did not see the motorcycle. Since the automobile driver is at fault, it may appear at first glance that there is little the motorcyclist can do. However, a greater awareness on the part of the motorcyclist that the automobile driver is unlikely to see him may be of help in at least two ways:

1. The motorcycle driver can allow himself greater range in maneuvering and keep a constant eye out for the other driver. He can also make use of a rear view mirror (although at high speeds such a mirror may be less helpful because of vibration.)

2. The motorcycle driver can take measures to increase his own visibility:

    a. Burn headlights and taillights at all times the vehicle is in operation *day and night.*

    b. Wear reflectorized helmet, gloves, and vest.

    c. Use turn signals if available, in addition to hand signals.

    d. Use a horn as a warning device.

Multivehicle accidents in which the motorcyclist is at fault usually involve violations of rules of the road. Following too closely accounts for the largest portion of these accidents, underscoring the importance of the motorcyclist's knowing how much distance he needs in which to stop the vehicle. Single vehicle accidents usually involve loss of control caused by exceeding the capabilities of the vehicle and/or driver or by obstructions or impairments in the road (an animal darting into the road or an oil slick on the pavement). While it is difficult for the motorcyclist to control the actions of animals or pedestrians, there are certain precautions he can take. Factors mentioned earlier to increase visibility would apply here, including the use of a horn. Beyond measures aimed at increasing his visibility, the motorcyclist could also make a point of maintaining surveillance over a broad area, not only of the highway but also of landscape adjoining the highway so that dangerous situations might be anticipated more readily. Such surveillance might possibly be of help in the case of gravel or oil slicks.

Passengers appear to figure more heavily in single vehicle accidents than in multivehicle accidents. More than 15 percent of single vehicle accidents involved a motorcycle passenger compared with less than 11 percent of multivehicle accidents. This is not surprising because a motorcycle is controlled to a large extent through body movement, and a passenger is likely to confound this kind of control. Passengers also figured heavily in accidents associated with blowouts. While passengers were present in about 12 percent of all accidents, they were present in 60 percent of accidents caused by blowouts. It appears that tires should be inspected carefully before passengers are added to the load.

Although mechanical failures accounted for only slightly more than six percent of all single vehicle accidents, nevertheless it appears that this kind of accident is more amenable to preventive measures than most. Such problems as kick stands that drop while the vehicle is in motion, brakes that lock, wheels that come off, throttles that stick, transmissions that lock, drive chains that break, tires that fail and so forth, could probably be drastically reduced with regular and conscientious maintenance.

RECOMMENDATIONS

Licensing Procedures

Special testing should be required for a license to operate a motorcycle. Such testing should include maneuvering turns and curves, particularly left hand curves. Since so many motorcycle crashes take place under circumstances beyond the control of the motorcyclist, some consideration should be given to requiring evidence of ability to handle the vehicle in an emergency situation, e.g., stopping the cycle quickly, leaving the roadway safely, and perhaps maneuvering the vehicle over a special test course that requires a fairly high degree of proficiency in handling turns and curves around obstacles.

Although mastery of information is no guarantee that the information will be used, nevertheless testing should also cover knowledge of the special problems concerning operation of a motorcycle. For example, information should be made available that would make it very clear to the motorcyclist that he is much less likely to be seen by other drivers than if he were operating an automobile. Information regarding stopping distances should be provided, preferably by the manufacturer. Stopping distance will vary from one kind of machine to another, as well as from one rider to another and on different road types and conditions. Information should be made available regarding the special hazards associated with passengers. Not only do tires become a critical factor, but the overall handling of the machine is changed drastically.

Operating Procedures

Not only should helmets be required, but consideration should be given to the possibility of requiring any or all of the following:

1. Use of headlights and taillights at all times the motorcycle is in operation, *day and night.* It may be appropriate to consider a requirement that all new motorcycles have an ignition interlock so that all lights would come on after the motorcycle is started.

2. Use of reflectorized and highly visible gloves, vest, and helmet.

3. Use of turn signals, as well as hand signals where practical.

4. Use of a horn to make the presence of the motorcycle known to other drivers.

It should be strongly emphasized that such measures concern more than just the protection of the motorcyclist. They are also designed to protect the automobile driver from becoming involved in a collision with a vehicle of low visibility.

The question of passengers and the hazards associated with their presence should be investigated further to see whether any special restrictions might be desirable.

Informing the Driving Public

Because 42 percent of all motorcycle accidents (and 62 percent of multivehicle motorcycle accidents) involve an automobile driver that failed to see the motorcycle, it would be appropriate to take steps to educate the driving public of the problems associated with sharing the highway with the motorcyclist.

APPENDIX

Table A. Multivehicle accidents, car at fault: Circumstances contributing to crash by time of day

		Day	Dawn/ Dusk/ Night	Total
Car Turned in Front of Motorcycle:	Frequency	139	43	182
	Row %	76.37	23.63	100.00
	Column %	45.43	50.00	46.43
Car Pulled Out Into Motorcycle:	Frequency	104	21	125
	Row %	83.20	16.80	100.00
	Column %	33.99	24.42	31.89
Car Maneuvered w/o Seeing Cycle:	Frequency	46	17	63
	Row %	73.02	26.98	100.00
	Column %	15.03	19.77	16.07
Car Saw Cycle But Did Not Avoid It:	Frequency	11	2	13
	Row %	84.62	15.38	100.00
	Column %	3.59	2.32	3.32
Miscellaneous:	Frequency	6	3	9
	Row %	66.67	33.33	100.00
	Column %	1.96	3.49	2.29
Total:	Frequency	306	86	392
	Row %	78.06	21.94	100.00
	Column %	100.00	100.00	100.00

8. Multivehicle accidents, motorcycle at fault: Circumstances contributing to crash by time of day

		Day	Dawn/ Dusk/ Night	Total
ng too Closely:	Frequency	51	15	66
	Row %	77.27	22.73	100.00
	Column %	37.50	31.25	35.87
toplight Intersection:	Frequency	19	6	25
	Row %	76.00	24.00	100.00
	Column %	13.97	12.50	13.58
into Wrong Lane:	Frequency	15	6	21
	Row %	71.43	28.57	100.00
	Column %	11.03	12.50	11.41
roper Passing:	Frequency	12	7	19
	Row %	63.16	36.84	100.00
	Column %	8.82	14.58	10.33
t Control:	Frequency	12	7	19
	Row %	63.16	36.84	100.00
	Column %	8.82	14.58	10.33
into Car, Car had	Frequency	13	1	14
ight of Way:	Row %	92.86	7.14	100.00
	Column %	9.56	2.08	7.61
proper Turn:	Frequency	7	2	9
	Row %	77.78	22.22	100.00
	Column %	5.15	4.17	4.89
chanical Failure:	Frequency	3	2	5
	Row %	60.00	40.00	100.00
	Column %	2.21	4.17	2.72
iscellaneous:	Frequency	4	2	6
	Row %	66.67	33.33	100.00
	Column %	2.94	4.17	3.26
otal:	Frequency	136	48	184
	Row %	73.91	26.09	100.00
	Column %	100.00	100.00	100.00

Table C. Multivehicle accidents, culpability unclear: Circumstances contributing to crash by time of day

		Day	Dawn/ Dusk/ Night	Total
Car Turning, cycle passing or cycle turning, car passing:	Frequency	16	2	18
	Row %	88.89	11.11	100.00
	Column %	41.02	13.33	33.33
Complex Situation Cycle Hit Car:	Frequency	11	4	15
	Row %	73.33	26.67	100.00
	Column %	28.21	26.67	27.78
Complex Situation Car Hit Cycle:	Frequency	3	2	5
	Row %	60.00	40.00	100.00
	Column %	7.69	13.33	9.26
Head on in Center of Road:	Frequency	2	2	3
	Row %	50.00	50.00	100.00
	Column %	5.13	13.33	7.40
Intersection Traffic Light:	Frequency	2	1	3
	Row %	66.67	33.33	100.00
	Column %	5.13	6.67	5.56
Two Cycles Lost Control:	Frequency	1	2	3
	Row %	33.33	66.67	100.00
	Column %	2.56	13.33	5.56
Miscellaneous:	Frequency	4	2	6
	Row %	66.67	33.33	100.00
	Column %	10.26	13.34	11.11
Total:	Frequency	39	15	54
	Row %	72.22	27.78	100.00
	Column %	100.00	100.00	100.00

Table D. Single vehicle accidents: Circumstances contributing to crash by time of day

		Day	Dawn/ Dusk/ Night	Total
aking Turn or Curve:	Frequency	46	39	85
	Row %	54.12	45.88	100.00
	Column %	25.56	31.20	27.87
ost Control:	Frequency	23	20	43
	Row %	53.49	46.51	100.00
	Column %	12.78	16.00	14.10
nimal in Road:	Frequency	22	14	36
	Row %	61.11	38.89	100.00
	Column %	12.22	11.20	11.80
t Something in Road:	Frequency	24	11	35
	Row %	68.57	31.43	100.00
	Column %	13.33	8.80	11.47
voiding Car:	Frequency	15	9	24
	Row %	62.50	37.50	100.00
	Column %	8.33	7.20	7.87
chanical Failure:	Frequency	7	6	13
	Row %	53.85	46.15	100.00
	Column %	3.89	4.80	4.26
t Curb or Median:	Frequency	4	6	10
	Row %	40.00	60.00	100.00
	Column %	2.22	4.80	3.28
n Off Road:	Frequency	7	3	10
	Row %	70.00	30.00	100.00
	Column %	3.89	2.40	3.28
destrian:	Frequency	4	3	7
	Row %	57.14	42.86	100.00
	Column %	2.22	2.40	2.30
owout:	Frequency	6	0	6
	Row %	100.00	0	100.00
	Column %	3.33	0	1.97
t Bicycle:	Frequency	2	1	3
	Row %	66.67	33.33	100.00
	Column %	1.11	.80	.98

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(Table D continued)

		Day	Dawn/ Dusk/ Night	Total
Driving Under the Influence	Frequency	1	2	3
	Row %	33.33	66.67	100.00
	Column %	.56	1.60	.98
Miscellaneous	Frequency	19	11	30
	Row %	63.33	36.67	100.00
	Column %	10.56	8.80	9.84
Total	Frequency	180	125	305
	Row %	59.02	40.98	100.00
	Column %	100.00	100.00	100.00

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