

How Effective Are Daytime Motorcycle Headlight Laws?

A Response to Zador's Criticism

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Zador rejects the substantive conclusion of my study of motorcycle daytime headlight laws¹ on the basis of alleged methodological problems and flawed assumptions underlying the research. Since several of Zador's comments are concerned with statistical biases, the original data were reanalyzed to conform with his recommendations. This procedure will permit an empirical assessment of Zador's methodological concerns and will provide some pertinent additional evidence on the effectiveness of daytime headlight laws.

Zador juxtaposes the findings of my study with those presented by Hurt, *et al.*² The comparison of these studies is problematic in two respects. Hurt's data pertain to injured and uninjured motorcyclists in California, while my study is exclusively based on fatal motorcycle crashes occurring nationwide. But a more important difference between the studies is that the research by Hurt, *et al.*, is concerned with the effectiveness of motorcycle daytime headlight *operation* among other topics, while my study tries to determine the effectiveness of daytime headlight *laws*. This distinction is important since studies of the effect of legislation should be concerned with results attributable to the laws, that is, differential headlight use between states with and without the legislation. The latter distinction is not acknowledged by Zador who falsely claims that my "analysis was based on the assumption that headlights are never in use during the day in states without use laws." On the contrary, the paper refers to two studies which report that daytime headlight use was in fact higher in states with than without the legislation (see Muller,¹ p 1139). Therefore, Zador's concerns with voluntary headlight use in states without the laws is of no consequence for the study.

However, Zador's comments on biases resulting from the method of data aggregation and analysis may be of greater consequence. To determine their significance, the data were rearranged and reanalyzed (see Table 1). In accordance with Zador's suggestions, the data were subdivided into consistent groups of states with headlight laws effective throughout 1975 to 1980 (14 states) and states without those laws (33 states). To remove a potential downward bias, fatalities occurring at dawn and dusk were excluded from the analysis. In addition, the data are presented for each year, and the association between lighting condition and collision type was tested for homogeneity across states for each of the 12 sub-groups. The homogeneity test using log-odds ratios is described by Fleiss³ (p 166) and in Appendix B of my paper¹ (p 1141).

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The results of the reanalysis are as follows: First, all 12 homogeneity tests are statistically insignificant at the .05 level suggesting that the association between lighting condition and collision type did not vary substantially. Second, restricting the analysis to a consistent number of states within each group of states and removing the dawn and dusk fatalities from the night data are of no major consequence. The difference in the per cent of fatal motorvehicle collisions in Table 3 of my article was 1.3 per cent for the daytime and .5 per cent for the non-daytime comparison. The corresponding differences found in Table 1 are 1.4 per cent and .2 per cent, respectively. Third, although the differences in the proportions of fatal multi-vehicle collisions vary between the two groups of states by year, none of the differences is statistically significant at the .05 level (see z tests). Fourth, the aggregation of data across years is permissible since the proportion of fatal multi-vehicle collisions does not vary substantially from year to year. Thus, the comparison presented in the bottom row of Table 1 is of particular interest for the substantive interpretation of the findings.

The last point of Zador's comment is concerned with the power of the statistical test. Zador points out that a fatality reduction of 230 or a difference of 2.6 per cent points between states with and without laws would have only a 50 per cent chance of being detected as statistically significant. This may appear to be an unreasonably low power for discriminating between proportions when they are in fact representing different populations. Yet, according to Cohen's⁴ criterion, a Type I error is about four times as serious as a Type II error. Since the Type I error was set at .05 in my original analysis the Type II error should be set at .2, which implies a power of 80 per cent might be acceptable. Moreover, since the direction was predicted, the power of the statistical test detecting a 2.6 per cent difference is about 85 per cent. Therefore, the number of observations for comparing states with and without headlight laws is large enough to detect differences of this size when in fact they exist.

To arrive at a substantive conclusion based on the findings presented in Table 1, let us assume that the differences between states with and without headlight laws at daytime are in fact a result of the legislation. Then, the laws would have been effective in preventing 114 fatal multi-vehicle collisions for the period of study, which translates into 19 fatalities per year distributed over 14 states with the laws. Since the null hypothesis cannot be rejected, it must be cautioned that this is a liberal interpretation which suggests marginal effectiveness of the laws, not substantial fatality reductions.

Therefore, the reanalysis of the data is consistent with the conclusion that daytime headlight use laws are either ineffective or marginally effective in preventing motorcycle multi-vehicle collision fatalities which is also the conclusion of my previous article.¹

DIFFERENT VIEWS

TABLE 1—Per Cent of Multi-Vehicle Motorcycle Collision Fatalities by States' Legal Status, Lighting Condition, and Year

Year	DAY					NIGHT				
	With Law ¹		Without Law ²		z _d	With Law ¹		Without Law ²		z _n
	%	n	%	n		%	n	%	n	
1975	70.2	399	71.3	783	-.39	48.0	383	53.1	701	-1.58
1976	64.4	463	67.4	749	-1.09	54.8	454	50.3	704	1.52
1977	66.1	549	67.2	918	-.43	52.4	574	51.2	927	.45
1978	67.0	606	64.9	1091	.87	54.3	630	51.7	992	1.01
1979	63.2	620	67.0	1019	-1.57	50.5	735	52.2	1167	-.73
1980	64.1	663	65.4	1104	-.55	48.5	746	51.2	1249	-1.17
1975-80	65.6	3300	67.0	5664	-1.35	51.4	3522	51.6	5740	-.24

Note: Fatalities at dawn and dusk are excluded.

¹Includes states with daytime headlight laws effective from 1975-80. The states are Arkansas, Florida, Georgia, Illinois, Indiana, Maine, Montana, New York, North Carolina, Oregon, South Carolina, Washington, Wisconsin, Wyoming.

²Includes all states not mentioned in footnote 1 plus the District of Columbia, but excludes California, Minnesota, Tennessee and West Virginia.

REFERENCES

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