

*CRASH AVOIDANCE: NEW OPPORTUNITIES FOR BEHAVIOR ANALYSIS*

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The application of behavior analysis to reduce injuries and deaths resulting from motor vehicle crashes is not a new idea. Behavior analysis has been used with much success to promote vehicle safety belt use (e.g., Geller, 1988; Streff & Geller, 1986), and increasing vehicle safety belt use has been shown to reduce dramatically the trauma inflicted on crash-involved vehicle occupants (Streff, Wagenaar, & Schultz, 1990). Another approach to reducing the number of injuries caused by motor vehicle crashes is to change behaviors relevant to the prevention of vehicle crashes. Behavior analysis has been applied with some success to affect precursors to vehicle crashes, most notably the prevention of alcohol-impaired driving (e.g., see review by Geller & Lehman, 1989) and speeding (e.g., Van Houten et al., 1985; Van Houten & Van Houten, 1987). However, behavior analysis has been underused in the examination and modification of numerous other behaviors relevant to vehicle crash avoidance.

There is some evidence in the traffic safety literature (albeit dated and based on small data samples) that modification of behaviors antecedent to a crash may be effective in reducing crash frequency and severity (e.g., Joscelyn & Jones, 1980; Lohman, Leggett, Stewart, & Campbell, 1976). These studies found improper turning, following too closely, running through a traffic control, driving left of center, and speeding behaviors to be particularly hazardous and thus deserving of special efforts to reduce their occurrence. Our research team

at The University of Michigan Transportation Research Institute recently completed a study for the National Highway Traffic Safety Administration (NHTSA) examining police crash reports from 11 states to determine those behavioral factors most frequently reported by police to have caused vehicle crashes (Streff, Schultz, & Molnar, 1990).

A data set for analysis was created based on data from police crash reports from each of the 11 states (supplied by NHTSA). These police crash reports were generated by officers after they examined the crash sites and interviewed relevant witnesses. Few of the crashes were investigated by specially trained crash investigation teams. The 11 states were selected because each had detailed police reports with descriptions of behaviors contributing to the crashes. States not included in the final data set either had no description of crash-contributing behaviors or the state's crash data were not available from NHTSA.

The procedure used to record crash data and the types of data recorded per crash varied among states. Prior to analyzing the data, we generated uniform descriptions of the behaviors recorded in the original reports. For many categories, detailed behavioral descriptions were classified under a broader behavioral class. For example, most states had only a single category of "speeding." However, if a given state had separate categories describing drivers who were speeding in a school zone, speeding in a construction zone, or speeding in other areas, each of these categorizations was classified together as "speeding" in our data set. This ensured comparability of data across states.

Our data set documented 1,868,142 crashes, including a total of 3,421,258 motor vehicles and involving all levels of injury severity (i.e., from those resulting in only property damage through those resulting in a death). This data set is by far the most comprehensive crash data set yet examined

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Table 1  
 Unsafe Driving Acts from Police Crash Reports

Unsafe driving act	Frequency	% of UDA total
Failure to yield	292,243	19.3
Speeding	256,266	16.9
Following too close	155,845	10.3
Driver inattention	99,439	6.6
Careless driving	88,131	5.8
Disregard traffic signal	76,021	5.0
Alcohol/drugs	48,493	3.2
Improper turn	45,373	3.0
Failure to control vehicle	43,013	2.8
Improper backing	33,375	2.2
Improper passing	23,895	1.6
Improper lane use	23,575	1.6
Improper lane change	22,240	1.5
Driving left of center	18,832	1.2
Improper lookout	8,255	0.5
Wrong way	3,785	0.2
Improper signal	3,196	0.2
Other driver behavior	270,927	17.9
Total	1,512,904	100.0

to explore driving behaviors contributing to crashes. Behaviors that caused the crash (referred to as unsafe driving acts or UDAs) were recorded by police for 55.7% of the vehicles. In over 79% of these cases, police recorded only one crash-related behavior. Table 1 shows the behaviors included in the data set and the percentage of crashes caused by each behavior in crashes in which only one unsafe behavior had been identified as contributing to the crash. As shown, three behaviors accounted for 46.5% of the cases (failure to yield, 19.3%; speeding, 16.9%; and following too closely, 10.3%). It is noteworthy that this table also shows a significant proportion of crashes involving "other driver behaviors," driver inattention, and careless driving (totalling 30.3% of the cases).

The weakness of this evaluation is that it relied completely upon police reports of UDAs that usually were not observed directly by the officer. Instead, UDAs were inferred from physical evidence at the crash site and from interviews with the persons involved in the crash and others who may have witnessed the crash. Although these data were certainly collected in a less rigorous manner than be-

havior analysts would prefer, they do point out significant research directions for applied behavior analysis.

It would be useful for behavior analysts to work with police officers who complete crash reports and help them determine the specific, quantifiable UDAs causing vehicle crashes. Unfortunately, current police crash investigation and reporting procedures do not generally include the degree of rigor needed for a comprehensive behavior analysis. This is not surprising, because currently most police spend very few of their training hours learning the skills necessary to conduct valid and reliable crash investigations (D. Smith, Lieutenant, Michigan State Police, personal communication, November 28, 1990).

Behavior analysts could work with police departments to help officers observe and define UDAs more precisely. Recall that over 30% of the UDAs reported by police were "other driver behavior," driver inattention, and careless driving. Indeed, this training to improve precision in behavioral observation and reporting could be accompanied by systematic evaluations of the interobserver reliability of officers' crash reports. Such reliability estimates would help not only to evaluate the effectiveness of the training programs, but would also help behavior analysts and others to assess the quality of crash data for program development and evaluation.

In addition to improved training in behavioral observation and reporting skills, crash data quality and the utility of crash data for use by behavior analysts could be improved substantially by the development of more objective, standardized crash reporting forms. Opportunities for behavior analysts to contribute to the development of standardized crash report forms are likely to increase in the near future as more police agencies begin using portable or lap-top computers for generating reports in the field.

Although there appears to be a great deal of consistency among analyses of crash data on UDAs that contribute most to crashes (i.e., speed, failure to yield, following too closely), more information is needed on the prevalence of these UDAs among

the noncrash-involved population. These data will assist in determining the relative riskiness of these behaviors (i.e., crashes per occurrence of the UDA in the general driving population). Although the simple frequency of these behaviors as they contribute to crashes is important, a relative risk analysis would help establish more accurate priorities regarding what behaviors should be targeted for change. This information would prove invaluable in efforts to understand and subsequently change drivers' behavior.

There is also value in examining how hazardous precrash UDAs covary. It may be the case that there are specific combinations of UDAs that are particularly hazardous. Behavioral covariance has been observed previously among safety behaviors (e.g., Fricker & Larsen, 1990; Ludwig & Geller, 1991), and behavioral covariance should be examined empirically among UDAs. Such studies can contribute significantly to the understanding of crash causation and the development of cost-effective crash avoidance programs. The interrelationships between unsafe and safe driving behaviors is best analyzed through direct behavioral observation, the foundation of applied behavior analysis.

## REFERENCES

- Fricker, J. D., & Larsen, R. J. (1990). Safety belts and turn signals: Driver disposition and the law. *Transportation Research Record*, **1210**, 47-52.
- Geller, E. S. (1988). A behavioral science approach to transportation safety. *Bulletin of the New York Academy of Medicine*, **64**, 632-661.
- Geller, E. S., & Lehman, G. R. (1989). Drinking-driving intervention strategies: A person-situation-behavior framework. In M. D. Laurence, J. R. Snortum, & F. E. Zimring (Eds.), *The social control of drinking and driving* (pp. 297-320). Chicago: University of Chicago Press.
- Joscelyn, K. B., & Jones, R. K. (1980). *Police enforcement procedures for unsafe driving actions. Volume I: Summary* (Report No. DOT HS-805 743). Washington, DC: National Highway Traffic Safety Administration.
- Lohman, L. S., Leggett, E. C., Stewart, J. R., & Campbell, B. J. (1976). *Identification of unsafe driving actions and related countermeasures* (Report No. DOT HS-803 064). Washington, DC: National Highway Traffic Safety Administration.
- Ludwig, T. D., & Geller, E. S. (1991). Improving the driving practices of pizza deliverers: Response generalization and moderating effects of driving history. *Journal of Applied Behavior Analysis*, **24**, 31-44.
- Streff, F. M., & Geller, E. S. (1986). Strategies for motivating safety belt use: The application of behavior analysis. *Health Education Research: Theory and Practice*, **1**, 47-59.
- Streff, F. M., Schultz, R. H., & Molnar, L. J. (1990). *Analysis of speed and other unsafe driving acts* (Report No. UMTRI-90-11). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- Streff, F. M., Wagenaar, A. C., & Schultz, R. H. (1990). Reductions in police-reported injuries associated with Michigan's safety belt law. *Journal of Safety Research*, **21**, 9-18.
- Van Houten, R., Rolider, A., Nau, P. A., Friedman, R., Becker, M., Chaldovsky, I., & Scherer, M. (1985). Large scale reductions in speeding and accidents in Canada and Israel: A behavioral ecological perspective. *Journal of Applied Behavior Analysis*, **18**, 87-93.
- Van Houten, R., & Van Houten, F. (1987). The effects of a specific prompting sign on speed reduction. *Accident Analysis and Prevention*, **19**, 115-117.

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