MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 17-338 (project 521) | December 2017

Evaluating Relationships Between Perception-Reaction Times, Emergency Deceleration Rates, and Crash Outcomes Using Naturalistic Driving Data

the ISSUE

Perception-reaction times (PRT) and deceleration rates are critical components in the design of highways and streets. This research aims to improve understanding of PRT and deceleration rates using naturalistic driving data. Previous research has been limited to controlled experimental conditions (i.e., test track or driving simulators) and may not reflect real-world conditions.

the RESEARCH

This research had several objectives, including 1) evaluating differences in PRT and deceleration rates between crash and near-crash events, 2) assessing correlation between PRT and deceleration rate, 3) determine if there is a causal relationship between PRT and deceleration rate (and what it is), and 4) develop predictive models for PRT and deceleration rate that can be used for roadway design and crash reconstruction. These objectives were met by applying multiple statistical analysis techniques to the SHRP2 naturalistic driving data.

The analysis results indicated that crash events were associated with longer PRT values and lower deceleration rates. The Pearson correlation between PRT and deceleration rate was low. However, PRT was a causal factor of deceleration rate in both crash and near-crash events. In crash events, longer PRT values were associated with lower deceleration rates. In near-crash events, longer PRT values were associated with higher deceleration rates.

Regression models for crash reconstruction were estimated using panel and quantile regression methods. Applications of these models for both purposes are illustrated and discussed. The results for design applications are compared with existing AASHTO design guidance.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

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North Dakota State University
South Dakota State University
University of Colorado Denver
University of Denver
University of Utah
Utah State University
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Project Title

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the FINDINGS

There were significant differences in reaction times between crash and near crash events. Differences in deceleration rates may be due to truncation of deceleration rates at the time of impact for crash events. Thus, evidence showing differences in deceleration rates is limited.

Pearson correlation between reaction time and deceleration was weak. However, statistically significant relationships were found using Directed Causal Graphs. For crashes, longer reaction times were associated with lower deceleration rates. In near crashes, longer reaction times were associated with greater deceleration rates.

When using the regression models for crash reconstruction, it was shown that the mean values for PRT and Avg_Decel can be predicted using the regression models. It was also shown that confidence intervals can be constructed using the mean values, root mean squared error, and a lognormal distribution.

the IMPACT

The results provide real-world information that can be used in highway design, crash reconstruction, and potential guidance for developing driver assistance technologies. In particular, the results provide improved understanding for parameters impacting stopping sight distance (a key highway design criterion).
The results also provide insight into how reaction times and deceleration rates change based on the vehicles speed, which is lacking in current the published literature.

For more information on this project, download the entire report at www.ugpti.org/resources/reports/details.php?id=896

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.