

UTC Project Information	
Project Title	MPC-521 – Evaluating Relationships between Perception-Reaction Times, Emergency Deceleration Rates, and Crash Outcomes using Naturalistic Driving Data
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Funding Agencies	USDOT, Research and Innovative Technology Administration
Agency ID or Contract Number	DTRT13-G-UTC38
Project Cost	\$75,000
Start and End Dates	September 30, 2013 to September 30, 2018
Project Duration	September 30, 2013 to September 30, 2018
Brief Description of Research Project	<p>Perception-reaction time (PRT) and deceleration rate are two critical factors in stopping sight distance (SSD). Since SSD is a critical design criterion (it controls vertical curve design and horizontal sightline offsets), the values of PRT and deceleration rate used in design have large impacts on both the safety and costs of the roadway system. PRT and deceleration rates are also used in crash reconstruction, which can impact the outcomes of lawsuits and tort liability.</p> <p>Current <i>American Association of State Highway and Transportation Officials</i> (AASHTO) SSD guidance related to PRT and deceleration rate is provided in <i>A Policy on Geometric Design of Highways and Streets</i> (herein referred to as the Green Book) (1). These values are based on 90th percentile PRT and 10th percentile deceleration rate values from experiments that were completed in Texas in the mid 1990's (2). However, these experiments lacked real-world distractions that drivers are subject to, were limited in the age range and abilities of drivers, did not test a wide variety of initial speeds and lighting conditions that may impact PRT and deceleration rates, and did not account for potential correlations between the PRT and deceleration rates. Thus, the values from these experiments may not be applicable in real-world scenarios.</p> <p>Recent research has used driving simulators and naturalistic data from the 100-car naturalistic driving study to evaluate PRT (3, 4). However, the sample sizes and conditions accounted for were limited. Also, the relationship between PRT and deceleration rate was not accounted for.</p>

Little research has been done that evaluates average emergency deceleration rates.

The *Strategic Highway Research Program 2* (SHRP2) recently implemented a multi-year naturalistic driving study (NDS) data collection effort that included over 3,400 drivers across the United States in an effort to address the role of driver performance and behavior in traffic safety. This effort developed a database that researchers can use to assess driver characteristics and behaviors. This is a potential source that could be used to assess and develop models of the relationships between PRT and emergency deceleration rates. Given that data are available for crashes and near crashes, evaluation of the differences in PRT and deceleration rates for crash and near crash events may also reveal interesting differences that can be used to prevent crashes in the future.

There are likely multiple factors that influence the relationship between PRT and deceleration rate. The deceleration rate a person is likely to select (i.e., the intensity of brake application) in braking situations is likely to depend on the level of risk the driver perceives. Thus, there is potential that PRT has a direct impact on emergency deceleration rates. Large values of PRT may occur due to inattentiveness, yet the driver may brake harder due to an impending collision when compared to a shorter PRT for the same situation. Conversely, attentive drivers with long PRT may have low deceleration rates if they judge the conflict to be low risk (i.e., there is little urgency for either PRT or braking). Thus, high PRT may be associated with high deceleration rates when drivers are inattentive while attentive drivers are likely to have low PRT and high deceleration rates (for high risk situations) and high PRT and low deceleration rates for low risk situations.

Understanding the relationship between PRT and deceleration rate can improve transportation engineers understanding of human factors related to SSD, leading to improved design guidance and safer roadways. It could also improve crash reconstruction and the ability to determine what happened at crashes. Therefore, a study is needed to evaluate 1) the differences in PRT and deceleration rates between crash and near crash events and 2) the relationship between PRT and deceleration rates. The results of this research could be used by transportation agencies to improve design guidance. The results could also be used in crash reconstruction and for developing policies aimed at reducing the number and severity of crashes that occur on and near the roadway.

<p>Describe Implementation of Research Outcomes (or why not implemented)</p> <p>Place Any Photos Here</p>	<ol style="list-style-type: none"> 1) Evaluate the differences in PRT and emergency deceleration rates between crash and near crash events. 2) Determine the strength of correlations between PRT and emergency deceleration. Also, determine if there is a causal relationship between PRT and emergency deceleration rates and, if so, what the relationship is. 3) Develop a method and equations for predicting the PRT and deceleration rate for drivers that can be used for design and for crash reconstruction.
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>This research could identify relationships between PRT and deceleration rates that have not been previously investigated. Understanding these relationships could improve design guidance and safety for the transportation network. Also, understanding differences in PRT and deceleration rates between crashes and near crashes could be used to develop policies to improve the safety of the users of the transportation system. The results of the analysis will be used to develop equations for predicting PRT and deceleration rates that can be in design and for crash reconstruction.</p>
<p>Web Links</p> <ul style="list-style-type: none"> • Reports • Project Website 	<p>https://www.ugpti.org/resources/reports/details.php?id=896</p>