Crash Factors in Intersection-Related Crashes: An On-Scene Perspective
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Crash Factors in Intersection-Related Crashes: An On-Scene Perspective

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16. Abstract

Crashes often occur at intersections because these are the locations where two or more roads cross each other and activities such as turning left, crossing over, and turning right have the potential for conflicts resulting in crashes. In order to understand the crash scenarios at intersections, this study examines general characteristics of motor vehicle traffic crashes at intersections by analyzing the association of the critical reason with several crash factors such as driver’s sex and age, traffic control device, critical pre-crash event, and atmospheric condition. The National Motor Vehicle Crash Causation Survey data collected at crash scenes between 2005 and 2007 is used in statistical analyses such as descriptive analysis, generalized logit model, and configural frequency analysis.

Descriptive statistics are first used to highlight characteristics of the intersection-related crashes. The results from this analysis provide guidelines for in-depth analysis. Close associations of crash factors with critical reasons of an event that made the crash imminent are revealed through the analysis of generalized logit model. Subsequently, the configural frequency analysis is used to identify patterns of driver-attributed critical reasons in the intersection-related crashes in terms of crash factors such as traffic control devices, pre-crash event, and driver’s age and sex.

Many interesting findings are obtained in this study. For example, crash occurrence may be attributed to illegal maneuver or inattention while crossing over at intersections controlled by traffic signals or stop signs. For both male and female drivers 55 and older, crash occurrence may be attributed to misjudgment of gap or other’s speed and inadequate surveillance. Male drivers of all ages are likely to be involved in intersection-related crashes due to illegal maneuver or driving aggressively or too fast for conditions.

17. Key Words
Intersection-related crashes, critical reason, driver characteristics

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Executive summary

Crashes often occur at intersections because these are the locations where two or more roads cross each other and activities such as turning left, crossing over, and turning right have the potential for conflicts resulting in crashes. Based on the Fatality Analysis Reporting System (FARS) and National Automotive Sampling System-General Estimates System (NASS-GES) data, about 40 percent of the estimated 5,811,000 crashes that occurred in the United States in 2008\textsuperscript{1} were intersection-related crashes. Identifying characteristics of intersection-related crashes (traffic control device, critical pre-crash event, and atmospheric condition) as well as of the crash-involved drivers (age, sex, and driving behavior) can provide useful guidelines for crash prevention.

This study examines general characteristics of motor vehicle traffic crashes that occur at intersections using the National Motor Vehicle Crash Causation Survey (NMVCCS). The NMVCCS data, collected at the crash scene, pertain to only those crashes that occurred between 6 a.m. and midnight. Additionally, at least one of the first three crash-involved vehicles had to be a light passenger vehicle that was towed due to damage. The focus of analysis is on studying the association of the critical reasons, i.e., the immediate reasons for the critical pre-crash event, with crash factors. The crash factors considered in this analysis include the critical pre-crash event (an event or action that puts a vehicle on the course that makes the collision unavoidable), driver’s sex and age, traffic control device, and atmospheric condition. All statistics presented in this report are based on the weighted frequencies.

In this study, intersection-related crashes refer to crashes that have critical pre-crash events coded as turning left, crossing over, or turning right at an intersection. Descriptive statistics show that 36 percent (787,236) of the estimated 2,188,969 NMVCCS crashes were intersection-related crashes. Of the 787,236 intersection-related crashes, about 96 percent (756,570 crashes) had critical reasons attributed to drivers, while the vehicle- or environment-attributed critical reasons were assigned in less than 3 percent of these crashes. Similarly, about 92 percent (1,289,283 crashes) of the non-intersection-related crashes had critical reasons attributed to drivers. However, the distributions of the driver-attributed critical reasons in intersection-related and non-intersection-related crashes were quite different. Of the 756,570 intersection-related crashes with driver-attributed critical reasons, the most frequent critical reasons were inadequate surveillance (44.1%), followed by false assumption of other’s action (8.4%), turned with obstructed view (7.8%), illegal maneuver (6.8%), internal distraction (5.7%), and misjudgment of gap or other’s speed (5.5%). In contrast, the most frequent critical reasons in non-intersection-related crashes were too fast for conditions/aggressive driving (22.8%), followed by driver performance error (overcompensation, poor directional control) (15.9%), internal distraction (13.4%), critical non-performance errors (10.8%), inadequate surveillance (7.3%) and external distraction (4.7%).

The relative ratio analysis shows that intersection-related crashes are almost 335 times as likely to have “turned with obstructed view” as the critical reason than non-intersection-related crashes. The second highest relative ratio of intersection-related crashes versus non-intersection-related crashes is for “inadequate surveillance,” followed by “illegal maneuver,” “false assumption of other’s action,” “misjudgment of gap or other’s speed,” etc. “Inadequate surveillance” is likely to happen about 6 times more often in intersection-related crashes than in non-intersection-related crashes. Also, the intersection-related crashes are likely to have “illegal maneuver” and “false assumption of other’s action” as critical reasons about 4 times more than non-intersection-related crashes. The critical reasons with high relative ratio of intersection-related crashes as compared with non-intersection-related crashes form a major portion of intersection-related crashes.

The analysis of a generalized logit model reveals statistically significant association of critical reason with crash factors and their two-factor interaction effects (traffic control device and critical pre-crash event;
traffic control device and driver’s age; driver’s sex and critical pre-crash event; driver’s sex and age; driver’s sex and traffic control device). Configural frequency analysis (CFA) identifies the patterns of driver-attributed critical reasons in terms of the statistically significant two-factor interaction effects in intersection-related crashes. The main findings of these statistical analyses include:

- Crash occurrence may be attributed to “illegal maneuver” or “inattention” while crossing over at intersections controlled by traffic signals or stop signs; “turned with obstructed view” or “misjudgment of gap or other’s speed” while turning left at intersections controlled by traffic signals or stop signs; and “false assumption of other’s action” while turning right at stop signs.

- Regarding driver age as a crash factor, crash occurrence at intersections controlled by traffic signals involving drivers 24 and younger may be attributed to “internal distraction,” “false assumption of other’s action,” “too fast for conditions or aggressive driving,” or “external distraction.” On the other hand, the crash occurrence at intersections controlled by traffic signals involving drivers 25 to 54 years old may be attributed to “critical non-performance error,” “illegal maneuver,” “inattention,” and “too fast for conditions or aggressive driving.” Also, the crash occurrence at intersections controlled by stop signs involving drivers 55 and older may be attributed to “inadequate surveillance” and “misjudgment of gap or other’s speed,” while the crash occurrence involving drivers 24 and younger may be attributed to “turned with obstructed view.”

- For both male and female drivers, the crash occurrence at intersections while turning left may be attributed to “turned with obstructed view,” “misjudgment of gap or other speed,” “inadequate surveillance,” or “false assumption of others action.” Also, the crash occurrence while crossing over at intersection may be attributed to “illegal maneuver” or “internal distraction.” However, in the case of female drivers crossing over at intersections, the crash occurrences may also be attributed to recognition errors such as “inattention,” or “internal or external distractions,” while for male drivers crossing over at intersections, the crash occurrences may be due to “illegal maneuver,” “too fast for conditions or aggressive driving,” or “critical non-performance error,” where critical non-performance error includes sleeping, heart attack, other physical impairment, and being passed out as a result of alcohol or drug ingestion.

- The analysis also shows an interaction effect of driver sex and age in crash occurrence at intersections. For both male and female drivers 55 and older, crash occurrence may be attributed to “misjudgment of gap or other’s speed” and “inadequate surveillance.” The crash occurrence at intersections may be due to “illegal maneuver” for male drivers and “internal distraction” or “inattention” for female drivers, irrespective of their ages. The crash occurrence involving female drivers 24 and younger at intersections may be attributed to “turned with obstructed view” or “internal distraction,” while for male drivers 24 and younger it may be attributed to “internal or external distraction,” “illegal maneuver,” or “false assumption of other’s action.”

- At intersections controlled by traffic signals, the crash occurrence may be attributed to “false assumption of others action,” “inattention,” or “internal distraction” for female drivers, while for male drivers it may be attributed to “critical non-performance error,” “illegal maneuver,” “false assumption of other’s action,” “too fast for conditions or aggressive driving,” or “internal distraction.” At intersections controlled by traffic control devices (traffic signals or stop signs), crash occurrence may be attributed to “inattention” of female drivers and “illegal maneuver” by male drivers. The crash occurrence at intersections with no traffic control devices may be attributed to “misjudgment of gap or other’s speed” for both female and male drivers.
The findings about the intersection-related crashes, presented in this report, can be used in the evaluation and development of the design of intersection collision avoidance technologies, such as the Cooperative Intersection Collision Avoidance System (CICAS), which would warn a driver about an imminent violation of the traffic control device at the intersection. These findings may also help improve road design, use of traffic control device, and driver training.