TechBrief

**The goal of the Federal Motor Carrier Safety Administration (FMCSA) is to reduce the large truck fatality rate by 41% from 1996 to 2008. This reduction translates into a rate of 1.65 fatalities in truck crashes per 100 million miles of truck travel.**

**FMCSA's Research and Technology programs encompass a range of issues and disciplines, all related to motor carrier and bus safety and security. FMCSA defines a "research program" as any systematic study directed toward fuller scientific discovery, knowledge, or understanding that will improve safety, and reduce the number and severity of commercial motor vehicle crashes. Similarly, a "technology program" defines those programs that adopt, develop, test, and/or deploy innovative driver and/or vehicle best practices, and technologies that will improve safety and reduce the number and severity of commercial motor vehicle crashes.**

**Currently, FMCSA's Office of Research and Technology is conducting programs in order to *produce safer drivers, improve safety of commercial motor vehicles, produce safer carriers, advance safety through information-based initiatives,* and *improve security through safety initiatives.* The study described in this Tech Brief was designed and developed to support the FMCSA Research and Technology strategic objective to *produce safer drivers.* The primary goals of this initiative are to ensure that commercial drivers are physically qualified, trained to perform safely, and mentally alert.**

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**FEDERAL MOTOR CARRIER SAFETY ADMINISTRATION**

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# Light Vehicle-Heavy Vehicle Interactions: A Preliminary Assessment Using Critical Incident Analysis

## Background

Data from a number of independent research efforts indicate that certain interactions between light vehicles (LV) and heavy vehicles (HV) on the roadway may be hazardous. Data from a recent Federal Motor Carrier Safety Administration (FMCSA) report on large truck crashes indicate that while only 4 percent of all roadway fatalities involved large trucks,"most victims [in these crashes] were people in the other vehicles, on bicycles, or pedestrians." As part of an ongoing attempt to reduce the number of injuries and fatalities involving large trucks, FMCSA sponsored a preliminary study of "Light Vehicle-Heavy Vehicle (LV-HV) Interactions."

To gain a better understanding of the kinds of driving behaviors that potentially result in crashes involving both light and heavy vehicles, FMCSA directed the Virginia Tech Transportation Institute to conduct an in-depth analysis of data from two naturalistic studies of heavy truck drivers. One study involved local short haul drivers (drivers who returned to their terminal each night); the other study involved long haul drivers (drivers who utilized sleeper berths to travel for several days before returning to their terminal). The two studies employed similar data collection protocols: initial focus groups with truck drivers, followed by on-the-road objective data collection involving performance sensors and video recording in and around the vehicle.

## Project Design

There were two phases to this project. In the first phase, the critical incident interactions between light vehicles and local/short haul (L/SH) vehicles were studied. The on-road data analyzed in the first phase were taken from the FMCSA-sponsored project entitled "The Impact of Local/Short Haul Operations on Driver Fatigue."

In the second phase, the LV-HV critical incident interactions captured in the FMCSA-sponsored project entitled "The Impact of Sleeper Berth Usage on Driver Fatigue" were studied.

For both phases, archived videotape recordings collected during each on-road data collection effort were retrieved and re-examined. Critical incidents that involved LV-HV interactions were separated and studied in detail. Video cameras recorded multiple views both inside and outside the truck. These multiple views were


***Figure 1. Split-screen presentation showing the five camera views, recording inside and outside of the heavy vehicle.***

combined in a composite image and provided good coverage of the external vehicle environment as well as the driver's face and eye glance positions (Figure 1). The tapes also included driver comments from a microphone placed in the cab of the truck.

## Results

A total of 142 LV-HV interaction-critical incidents were identified in the L/SH data. The light vehicle drivers initiated 117 (82.4 percent) of these incidents, while 25 (17.6 percent) of the incidents were attributed to the L/SH drivers.

Further analysis showed that the types of incidents differed between the two driver classes. For incidents attributable to light vehicle drivers, the three most prevalent types were:

1. Lane change without sufficient gap
2. Entering roadway without sufficient clearance
3. Left turn without clearance

All of these categories confirm what L/SH drivers stated in focus groups–that they were often "cut off" by light vehicle drivers.

For incidents attributable to L/SH drivers, the three most prevalent types were:

1. Entering roadway without sufficient clearance
2. Backing in roadway (in presence of through traffic)
3. Late braking for stopped/stopping traffic, tied with wide turn into adjacent lane

Table 1 provides a diagrammatic explanation of the various incidents. Note specifically that Item 2, above, "Backing in roadway (in presence of through traffic)," is probably a result of tight maneuverability conditions related to infrastructure (roadway layout). Similarly, elements of Item 3, "Late braking for stopped/stopping traffic, tied with wide turn into adjacent lane," may be a result of roadway layout.

Similar results were found in the analysis of the LV-HV incidents in the sleeper berth data set. Of the 68 interaction incidents identified, 47 were initiated by a light vehicle driver. The most prominent type of incident for light vehicle drivers was "lane change without sufficient gap." This particular incident type accounted for 32 percent of all light vehicle driver-initiated incidents.

For incidents initiated by heavy vehicle drivers, the most common classification type was "late braking for stopped/stopping traffic," occurring in 48 percent of the HV driver-initiated incidents.

In addition to identifying the initiator of each incident and categorizing the type of incidents recorded, analyses involved assessing the primary maneuver, general contributing factor, and specific contributing factor associated with each incident. Taxonomy was developed as part of the effort, which aided in characterizing the recorded incidents.

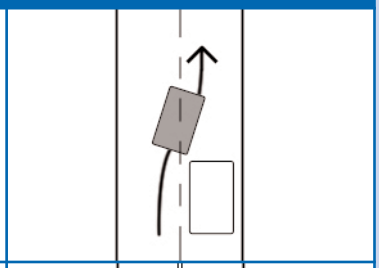
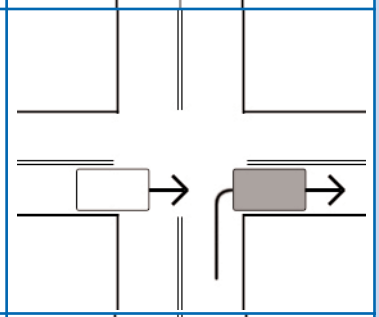
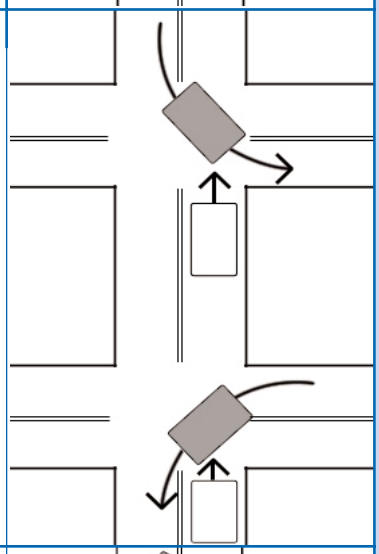
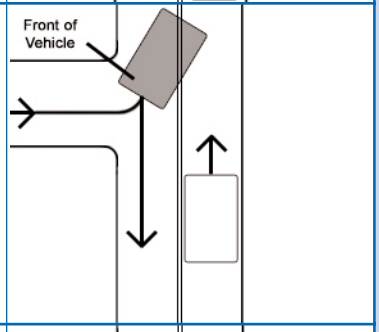
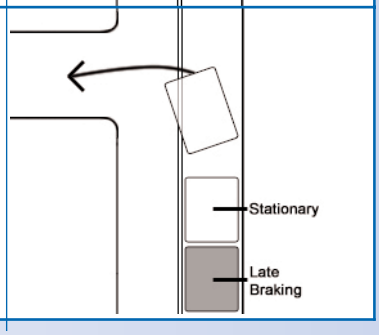
## Conclusions

This study is believed to be the first directed toward LV-HV interaction using naturalistic data. While the study included instrumentation in trucks only and used a limited sample of field data, it does provide insight into the nature of the LV-HV incidents that are occurring. The disproportionate number of incidents attributable to light vehicle drivers may be a result of the greater number of light vehicles in traffic relative to heavy vehicles, and possibly also the fact that heavy vehicle drivers knew they were being observed. A comparison study with instrumentation in light vehicles could be planned to obtain additional insights. However, the results of the current study indicate that LV-HV interactions may represent a serious safety problem, with the detailed analysis that was conducted providing insight into how this problem might be addressed.

Several ideas that should be considered for reducing LV-HV interactions include:

- Focusing on light vehicle drivers, because they were initiators in the majority of the LV-HV interaction incidents recorded in this study.

*Table 1. Most Prevalent Types of Incidents Reported*

| Incident Type | Definition | Illustration |
|---|---|---|
| LV: Lane Change Without Sufficient Gap | A driver entered an adjacent lane without allowing adequate space between the driver's vehicle and a vehicle ahead and/or behind it. |  |
| Both LV and HV: Roadway Entrance Without Clearance | A driver turned onto a roadway without adequate clearance from through traffic. |  |
| LV: Left Turn Without Clearance | A driver turns left without adequate clearance from either oncoming through traffic or cross traffic from the left. The driver crosses another driver's path while entering an intersecting roadway. |  |
| HV: Backing In Roadway | A driver backs the vehicle while on a roadway in order to enter the roadway from a driveway, parking space, etc. |  |
| HV: Late Braking For Stopped/Stopping Traffic | A driver fails to slow in advance for stopped or stopping traffic and must brake abruptly. |  |

**Researchers**
This study was performed at the Virginia Tech Transportation Institute, 3500 Transportation Research Plaza, Blacksburg, VA 24061, by Richard J. Hanowski, Aysha Keisler, and Walter W. Wierwille. Contract No. DTFH61-96-C-00105.

**Availability**
The study final report FMCSA-RT-04-004 is available from the National Technical Information Service.

**Key Words**
aggressive driving, crash, critical incident, heavy truck, interaction, naturalistic driving.



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- Specific to light vehicle drivers, the primary area that needs to be addressed involves aggressive driving. The majority of light vehicle driver-initiated critical incidents that were captured in both the L/SH and sleeper berth data collection efforts were due to aggressive driving.
- Regarding heavy vehicle drivers, the critical area that needs to be scrutinized involves driving techniques. Given the high incidence of aggressive driving on the part of light vehicle drivers, one of the primary areas of focus for truck driving training programs should be defensive driving skills.
- Infrastructure was found to play a role in L/SH driver-initiated incidents. Drivers and company dispatchers should be cognizant of problematic sections of routes, (narrow streets with sharp corners, lack of turn-around room) and avoid such locations to the greatest extent possible.

Naturalistic data collection is an effective way in which to study a wide range of safety-related issues in the natural driving environment. The video and performance/behavior data collected from the L/SH and sleeper berth studies have been archived and provide a rich source of information that can be used for studying critical incidents, as was the case in the current effort, or other issues that might be identified at a later time.

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