Distraction and Drowsiness in Motorcoach Drivers

BACKGROUND

Motorcoach crashes—when they occur—can involve multiple injuries and deaths, beyond what is typically experienced in light vehicle crashes. Driver error is often cited as a factor in these crashes, with distraction and drowsiness being primary concerns. When compared to truck crashes, bus fatalities occur at a rate that is more than one-third higher than large truck fatalities per 100 million vehicle miles traveled (VMT). Despite the large number of motorcoaches registered in the United States and the higher fatality rates associated with motorcoach crashes, limited research has been conducted on motorcoach operations. The primary aim of this study was to investigate the impact that driver distraction and drowsiness have on motorcoach operations. A summary of key findings is presented in Table 1.

APPROACH

This study used data collected (between 2013 and 2015) from the recently completed Onboard Monitoring System (OBMS) Field Operational Test (FOT), which collected snippets of data using an OBMS. As part of the study method, the research team also installed a data acquisition system (DAS) in each vehicle and collected continuous naturalistic data.

Two motorcoach fleets (Fleets A and B) participated in the OBMS FOT. For the current analysis, each fleet participated in the study for approximately 1 year. During this time, the research team collected approximately 600,000 miles of naturalistic driving data from 43 motorcoaches and 65 drivers. The average driver age was 49, and participating drivers reported an average of 16 years of driving experience.

Table 1. Research questions and key findings.

Research Question	Key Findings
What tasks do motorcoach drivers engage in and what is the relationship of these different tasks with safety-critical event (SCE) involvement?	• 59 percent of all recorded SCEs and 89 percent of at-fault crashes involved secondary and driving-related task engagement. • Specific types of secondary tasks associated with a significant odds ratio (OR) included reaching for an object, looking outside (external distraction), and intercom use.
In what environmental conditions do motorcoaches operate and what impact do those different conditions have on a driver's choice to engage in secondary and driving-related tasks?	• Most SCEs occurred in daylight with no adverse conditions. • Most SCEs occurred in non-junctions (i.e., roadway that is not an intersection or connection between a driveway access and a roadway other than a driveway access). A second notable area for SCEs was intersections. • Entrance/exit ramps had some of the highest values for OR calculations.
What is the relationship between eyes-off-forward-roadway time and SCE involvement?	• The distribution of ORs was nearly linear from 0.05 seconds or less through 1.5–2.0 seconds. The risk jumped significantly and exponentially when the driver's eyes were off the forward roadway for more than 2 seconds. • The eyes-off-forward-roadway times across the different SCE types were similar, ranging from 1.7 to 1.9 seconds for at-fault events. • The intercom task had one of the highest mean eyes-off-forward-roadway times of any secondary task.
What is the relationship of task engagement and observed drowsiness?	• Approximately 1 percent of the SCE and baseline data involved a driver in the "high drowsiness" category. • Both SCEs and baselines with a secondary task tended to have lower drowsiness ratings than SCEs and baselines without a secondary task. Similar results were found when SCEs were limited to at-fault. For driving-related tasks, the results were not as strong and events and baselines showed similar distributions of drowsiness levels in the presence and absence of the task.

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DATA COLLECTION

The DAS used in the study included five video cameras, which captured five views: forward, face, over-the-shoulder, left mirror, and right mirror. In addition to the continuous collection of video data, various channels of kinematic data were continuously collected.

The study data were processed with a set of sensor trigger values to identify safety-critical events (SCEs). Manual review of the video and data were conducted to ensure SCE validity and to bin them into one of five categories:

1. Crash.
2. Crash—tire strike.
3. Near-crash.
4. Crash-relevant conflict.
5. Unintentional lane deviation.

This process resulted in 1,086 valid events (17 crashes, 37 tire strikes, 431 near-crashes, 562 crash-relevant conflicts, and 39 unintentional lane deviations). To support the analyses, 4,600 baseline epochs (normative driving) were created and coded using the same process as the SCEs.

DATA ANALYSIS

Once coded, the data were analyzed to evaluate the risk associated with engaging in secondary tasks and driving-related tasks. Secondary tasks are defined as non-driving related tasks, such as cell phone use (with multiple sub-categories), eating, and external distraction. Driving-related tasks are defined as tasks directly related to driving, such as checking the speedometer and turn signal use. Each analysis grouped the data into the following categories:

- All secondary tasks and/or driving-related tasks.
- All secondary tasks.
- All driving-related tasks.

Odds ratios (ORs) were calculated to estimate the risk of being involved in an SCE when the driver was engaged in a secondary and/or driving-related task, as compared to when the driver was not engaged in those behaviors.

RESULTS

A summary of key findings is presented in Table 1. Additional discussion is presented below.

Secondary Tasks

An analysis of SCEs and baseline driving found that motorcoach drivers can be impacted by driver distraction. Though some of the secondary tasks that increase risk are common across driver domains (i.e., light vehicle and truck), there were some new findings for this particular driver group. In particular, driver interaction with an intercom system (to talk to passengers) may warrant further investigation.

Environmental Conditions

A seemingly consistent finding was that roadway conditions and characteristics that involved significant vehicle interaction produced many of the SCEs. For example, buses at airports, on entrance/exit ramps, and at intersections were all found to have high ORs. This could be due, in part, to the difficulty that motorcoach drivers face when interacting in relatively confined spaces with other vehicles.

Eye Glance Analysis

Collectively, the results from the eye glance analyses show a pattern consistent with similar analyses conducted with light vehicle drivers and truck drivers. The longer the eyes-off-roadway time, the more likely an SCE is to occur. Furthermore, this study validates the 2.0-second demarcation as the threshold where risk of an SCE increases exponentially (as shown in Table 1).

Drowsiness

As discussed in Table 1, both SCEs and baselines with a secondary task tended to have lower drowsiness ratings than SCEs and baselines without a secondary task. Based on these findings, it appears that motorcoach drivers may engage in secondary tasks (though usually not driving-related tasks) as a strategy to counteract the negative impact of drowsiness.

FUTURE RESEARCH OPPORTUNITIES

The data set resulting from this study is rich and could be mined to answer other research questions. By mining the current data set, additional insights will be gained; however, given the scale, this study may be best treated as a pilot, with a clear need for additional efforts, including larger studies that would provide additional data for Federal Motor Carrier Safety Administration (FMCSA) and industry stakeholders to gain a better understanding of the safety issues facing motorcoach drivers.

To read the complete report, please visit: http://ntl.bts.gov/lib/60000/60400/60466/15-017-Distraction_and_Drowsiness_in_Motorcoach_Drivers-FINAL-508C.pdf.