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The influence of driver distraction on the severity of injuries sustained by teenage drivers and their passengers

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Abstract

Studies show that teenage drivers are at a higher risk for crashes. Opportunities to engage in technology and non-technology based distractions appear to be a particular concern among this age group. An ordered logit model was developed to predict the likelihood of a severe injury for these drivers and their passenger using a national crash database (the 2003, U.S. DOT–General Estimate System [GES]). As one would expect, speeding substantially increases the likelihood of severe injuries for teenage drivers and their passengers. The results of the analysis also reveal that teenage drivers have an increased likelihood of more severe injuries if distracted by a cell phone or by passengers than if the source of distraction was related to in-vehicle devices or if the driver was inattentive. Additionally, passengers of teenage drivers are more likely to sustain severe injuries when their driver is distracted by devices or passengers than with a non-distracted or inattentive driver. This supports the previous literature on teenage drivers and extends our understanding of injuries for this age group related to distraction-related crashes.

Keywords: Driver distraction; Driver inattention; Teenage drivers; Young drivers; Injury severity; Crash database

1. Introduction

Teenage drivers have substantially higher crash risks when compared to other driver age groups (Jonah et al., 2001). They are more likely to be involved in fatal crashes, as well as in crashes with no injuries. The increased crash risks and frequency of this age group has been attributed to driving ability, increased risk-taking behavior, and willingness to engage in distracted driving behavior (Jonah et al., 2001; Laapotti and Keskinen, 1998; McCartt et al., 2003; Olsen et al., 2005). Driver education and graduated licensing programs are designed to allow novice drivers to gain skills that will help them become better drivers (Lam et al., 2003). In 2003, very few states addressed driver distraction in their driver education manuals (Sundeen, 2005). However, more states are now including a section on driver distraction (Stutts, 2007) indicating the importance that has been placed in this area.

Driver distraction has been defined as a process or condition that draws the driver attention away from the driving task (Donmez et al., 2006; Sheridan, 2004). Recent studies have also indicated that the opportunity for distractions will increase as drivers adopt more in-vehicle technologies and devices (Olsen et al., 2005; Sarkar and Andreas, 2004). Driver inattention is the inability to process the appropriate information for the primary task in the absence of a secondary task (Pettitt et al., 2005). Because inattention is defined in the absence of a mechanism or agent through which the driver is actually distracted, Pettitt et al. (2005) have suggested that driver distraction and inattention remain separately categorized. Regardless of their classification, both are major problems resulting in degraded driving performance and increased likelihood of crashes (Bunn et al., 2005; Consiglio et al., 2003; Donmez et al., 2006; Hancock et al., 2003; Laapotti and Keskinen, 1998). They are also part of a larger class of driver behaviors that have been shown to influence crash likelihood (Neale et al., 2005) and are therefore, of great interest to researchers.

Four elements of driver distraction: visual, auditory, biomechanical, and cognitive have been previously identified (Ranney et al., 2000). Although these elements of distraction may not always be easily distinguished, each can greatly decrease a driver's performance. Cell phones and passengers are examples

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of distractions that encompass several categories and have been widely studied because of their relationship to crash risks (Johnson et al., 2004; Lesch and Hancock, 2004; Strayer et al., 2003). In particular, cell phone use was associated with a fourfold increase in crash injuries resulting in hospitalization (McEvoy et al., 2005). The use of cell phones raises concerns because conflicts that arise between the demands of such devices and the driving task may increase driver workload. Passenger-related distractions have also been studied separately. Lam et al. (2003) showed that younger drivers are at a greater risk for crash injury when there are passengers in their vehicles. The risks are even higher if the passengers are also young. Similar findings were observed by other researchers (Faucett et al., 1998; Preusser et al., 1998; Williams, 2003). This may relate to distractions from passengers or the increased risk taking behavior when teenage passengers are present (Simons-Morton et al., 2005).

Young drivers appear more willing to accept new technologies and devices. As they gain more confidence, they tend to over-estimate their ability to multitask with in-vehicle devices while driving (Sarkar and Andreas, 2004). This is clearly a growing concern that needs further research as in-vehicle systems become more popular (Olsen et al., 2005; Sarkar and Andreas, 2004) and the need to evaluate mitigation strategies become more prevalent (Donmez et al., 2006). Additionally, different distractions can present different crash risks (Neyens and Boyle, 2007).

Injuries from distraction-related crashes can vary depending on type of distraction or inattention as well as with driver age. An exploratory study done by Lam (2002) revealed that age affected the relationship between in-vehicle distractions and the risk of vehicle crash injuries. Other studies have also shown that driver distraction may impact young drivers differently from other age groups and that willingness to engage in distracting activities declines with increases in age (Ferguson, 2003; Olsen et al., 2005). Young drivers may not realize the results of the increased attentional demands placed on them due to their willingness to engage in non-driving (and potentially distracting) tasks.

The goal of this paper is to provide insights into how driver distraction and inattention influence the injury severity of teenage drivers and their passengers. This goal is achieved with an examination of severe injuries resulting from driver distraction-related crashes and estimating the odds that teenage drivers will impose these injuries on themselves and others. Data from the year 2003 in the U.S. DOT–General Estimate System (GES), a national crash database, are used as the basis of the analyses.

2. Method

The U.S. DOT–General Estimates System crash data from 2003 were used for this analysis (NHTSA, 2003). The GES dataset is a stratified sample of crashes weighted to represent national crash trends, and includes information about drivers and their passengers, crash type, and injury severity. Driver distraction type is also included based on observations or deductions of the reporting police officer or investigator. It is important to note that many state crash reports do not have detailed codes for many distraction types (such as cell phone use, eating or drinking). However, many of these indicators are written in the additional comments of the police accident report. As part of the reporting that is conducted for GES, a NHTSA investigator discerns how these driver distraction variables are to be segmented in conjunction with the respective precincts.

The data was reduced to include only teenage (16–19 years old) drivers and all of their passengers. It was also limited to crashes occurring in passenger vehicles (as opposed to semi-trucks and motorcycles). Driver inattention, passenger-related, cell phone, and in-vehicle distractions were the four major categories of driver distraction and inattention used in this study. These were compared against crashes in which the driver was reported to be not distracted (or inattentive). Drivers were not included in the analysis if a driver distraction code was not included as part of their crash record or when the information was not included on the police accident reports. It should also be noted that the GES database includes more specific driver distraction variables; however, for the goals of this study, the distractions were grouped into categories (see Table 1) that are similar to the classification by Neyens and Boyle (2007). Inattentive driving include both ‘inattention, lost in thought’ and ‘looked but did not see’ variables as coded in the GES database. Cell phone distractions include interacting with the device as well as the conversational components of using cell phones. The passenger-related distractions category includes only passenger distractions that were classified as distractions in the GES database. The in-vehicle distraction category includes all other factors within the vehicle that were identified as distracting the driver (e.g. climate control adjustments, smoking). Fatigue or sleepiness was not included in this analysis, because they are not within the distraction or inattention paradigm used in this analysis and have also been studied separately in the literature (Bunn et al., 2005).

Maximum likelihood methods are used to create the set of regression coefficients for the ordered logit model. These coefficients can then be used to predict the logit-transformed probability that the dependent variable will fall into one category when compared to another category. This model is also known as the proportional-odds model, because the odds ratios of the events are independent of the categories, and thus are assumed to be constant for all categories. Adjusted odds ratios are calcu-

Table 1
Categorization of the specific driver inattention and distraction

Distraction category	Specific GES distraction name
Inattention	Looked but did not see Inattentive or lost in thought
Cell phone	Talking or listening to cellular phone Dialing cellular phone
Passengers	Passengers
In-vehicle	Moving objects in vehicle Adjusting climate control Adjusting radio cassette, CD Using other devices/controls integral to the vehicle Eating, drinking or smoking