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Prevalence of and factors associated with distraction among public transit bus drivers

Russell Griffin, Ph.D.^{1,2,3}, Carrie Huisinigh, M.P.H.³, and Gerald McGwin Jr., M.S., Ph.D.^{1,2,3}

¹Department of Epidemiology, School of Public Health, University of Alabama at Birmingham, Birmingham, AL

²Center for Injury Sciences, Department of Surgery, Division of Trauma, University of Alabama at Birmingham, Birmingham, AL

³Center for Clinical and Translational Science, University of Alabama at Birmingham, Birmingham, AL

Abstract

Objective—Recent research has suggested that driver distraction is a major cause of driving performance impairment and motor vehicle collisions. Research on the topic has focused on passenger vehicles, with studies suggesting that drivers may be distracted nearly 33% of the time spent driving. To date, no study has examined the prevalence of distraction specifically among public transit bus drivers.

Methods—Over a three-month period, trained investigators observed and recorded distraction behaviors of bus drivers. Distraction prevalence was compared by route characteristics (e.g., geographic area, travel speed) using chi-square test. A general estimating equation logistic regression was used to estimate p-values for distraction prevalence by driver demographics.

Results—Overall, there was a 39% prevalence of distraction. The most prevalent distractions were due to interactions with another passenger. Distractions were more prevalent among drivers <30 years of age or ≥50 years of age, on city streets or highways (relative to residential streets), and when there were more than 20 passengers. Distractions were the least prevalent in suburban areas, with the highest prevalence observed in city centers and rural areas.

Conclusions—Driver distraction is a common problem for public transit bus drivers, mainly due to other passengers. Drivers should be educated on the hazards of distracted driving and on ways to avoid distraction.

Keywords

Bus; driver; distraction; prevalence; public transit

Send correspondence to: Russell Griffin, 1665 University Blvd, RPHB 230P, Birmingham, AL 35294-0022, E-mail: RussellG@uab.edu, Fax: (205) 975-3040.

Mailing addresses for authors:

RG: 1665 University Blvd, RPHB 230P, Birmingham, AL 35294-0022

CH and GM: 1922 7th Avenue South, room K120, Birmingham, AL 35294-0016

INTRODUCTION

Recently, driver distraction has become a focal point on research related to the incidence of and injuries due to motor vehicle collision (MVC). This research has been mainly focused on the effects of cellular phone use in regards to driving performance (Lesch & Hancock 2004; Rakauskas et al. 2004; Strayer & Drews 2004; Beede & Kass 2006; Caird et al. 2008; Drews et al. 2008; Ishigami & Klein 2009) and risk of MVC (Violanti & Marshall 1996; Hunton & Rose 2005; McEvoy et al. 2007a; McEvoy et al. 2007b; Neyens & Boyle 2007; Neyens & Boyle 2008). Though the prevalence reported in analyses of large collision databases (i.e., Fatality Analysis Reporting System, General Estimates System) is approximately 10% (National Highway Traffic Safety Administration 2013), naturalistic research has reported that the prevalence of distraction among drivers involved in collisions or near-collisions is as high as 40% (Klauer et al. 2006). The high prevalence is likely due to the fact that driver distraction is associated with a variety of risky driving behaviors, including fluctuations in vehicle speed (Rakauskas et al. 2004), increased reaction time (Caird et al. 2008), slower brake response (Lesch & Hancock 2004), or increased aggression (McGarva et al. 2006) due to the increased attention demand (Hunton & Rose 2005). These distractions, however, are not limited to use of technology (e.g., cell phones), as research has also suggested that passenger-related distractions are also related to an increased risk of MVC, though this risk is not as strong when compared to cell phone usage (McEvoy et al. 2007b).

To date, research on driver distraction has focused on passenger vehicles, and research among commercial motor vehicles (e.g., commercial truck drivers) has been relatively limited. The research that has been published on commercial motor vehicle distraction ranges from a prevalence of slightly over 50% (Olson et al. 2009) to approximately 10% (Hanowski et al. 2005, Hickman & Hanowski 2012), the latter being more similar to prevalence estimates reported for passenger vehicles (Stutts et al. 2001, National Highway Traffic Safety Administration 2013). It should be noted, though, that the prevalence estimates reported by Hanowski et al. and Hickman et al. may be underestimates as the permeation of cell phone use was much lower at the time of the Hanowski study, and the Hickman study had an active intervention to prevent distraction. To knowledge, only one study has examined prevalence of distraction among bus drivers, though this study did not report the prevalence specifically for bus drivers and included transit and commercial buses (Hickman & Hanowski 2012). In addition to this research, there has been anecdotal evidence of crashes occurring as a result of bus drivers using cell phones (National Transportation Safety Board 2004) and recent research has suggested severity of collisions involving buses increases with inattentive driving (Kaplan & Prato 2012). The objective of this study is to address the fact that prior research has not exclusively examined the prevalence of distraction among public transit bus drivers, and to estimate the prevalence of and examine factors associated with bus driver distraction.

METHODS

Study Design and Data Collection

For this cross-sectional study, over a period of three months in an urban metropolitan area in central Alabama, trained investigators rode buses along selected routes (i.e., from the time the bus left the terminal to the time it arrived at the terminal). On each ride, the investigators utilized a tablet device to record information on driver, traffic, roadway, and passenger characteristics of the route. The driver of the bus was not aware of the observation taking place, and the drivers did not receive any payment. The investigators were instructed to sit in a seat in which they could directly see the driver, but were not instructed as to a certain seat in which to sit given the fact that seat availability changes from route-to-route. Routes were chosen based on the schedule made available by the local transit authority. Of the 30 available routes, 15 were chosen for the study. The reason for doing so was two-fold: first, some routes were run only on the weekend, and second, to allow each route to be included in the data twice in order to account for temporal variation in traffic and passenger flow. This study was approved by the University of Alabama at Birmingham Institutional Review Board.

Variable Definitions

Information was collected regarding the number of passengers on the bus, route characteristics, and information on the bus driver's gender, race, and estimated age (defined as < 30 years, 30–49 years, 50 years). For route characteristics, street type was defined as residential, city street, or highway; traffic flow was defined as free-moving, moderately paced, or slow moving; geographic area was defined as city center (i.e., downtown), urban (i.e., urban areas other than downtown), suburban, and rural; and speed was estimated by data collectors, who selected one of four categories: <25, 25–34, 35–44, or 45+ mph. Number of passengers, including the trained investigator, and was defined as 1 to 5, 6 to 10, 11 to 15, 16 to 20, or > 20 passengers. For each route, these characteristics were collected once per route stop, such that multiple observations were collected for each route.

The main outcome of interest was driver distraction. For purposes of the current study, the operational definition of distraction was an extraneous factor (in relation to the driver) that caused the driver's attention to be taken from the road ahead while the bus was in motion. Thus, observers were directed to make note of the task at the time at which the driver's attention was removed from the forward view of the road. Distraction was categorized as being due to interaction with another passenger (e.g., conversation), eating or drinking, use or search for a personal item (e.g., bag), use of a cellular phone, and bus instrumentation (i.e., ticket machine). Each distraction was only counted once for each drive between stops, but could occur for multiple stops along the route, and the distraction had to take place while the bus was in motion in order to be included.

Statistical Analysis

Generalized estimating equations (GEE) using logistic regression for binary response were utilized to calculate p-values for the association between driver characteristics (i.e., age, race, and gender) and distraction adjusted for time between stops. The use of GEE

regression allows for adjustment of covariance between driver characteristics and distractions (i.e., to account for the clustering of stops within a single route for a given driver). For purposes of the analysis, because of the low frequency of certain characteristics values, traffic flow was defined as free-flowing or moderately paced, and the last two categories for speed (i.e., 35–54, 55) were combined into one category. Because only one driver was Asian, race was categorized as black and white/Asian. A Wald chi-square test estimated from an unconditional logistic regression adjusted for time between stops was used to estimate p-values for the association between route characteristics and distraction. P-values <0.05 were considered significant, and SAS v9.3 was used for all analyses.

RESULTS

A total of 22 bus routes were traveled during the study period, accounting for observations from 796 stops. Drivers were mostly aged 30–49 years (57.1%), approximately equally proportioned of males and females (47.6% and 52.4%, respectively), and more often black (90.5%) (Table 1). Routes more often traversed city streets (64.7%), were in free-moving traffic (93.6%) in urban areas (62.9%), with the bus travelling a speed of <25 mph (39.2%) or 25–34mph (46.9%). Overall, the observed prevalence of bus drivers was 39.3%. The most frequent distractions were distraction by interaction with another passenger (27.5%) and searching for a personal item (8.3%).

Driver Characteristics

The prevalence of any distraction among route stops was highest among younger (60.0%) and older drivers (57.5%) ($p=0.005$) (Table 2). By specific distraction, the only significant association was by distraction by interaction with another passenger, with the 50 year age group having the highest prevalence of distraction (49.8%) compared to drivers <30 years (30.0%) and 30–49 years (17.0%) ($p=0.024$). For most distractions, there was no difference in distraction prevalence by gender; however, females had three times the prevalence of distraction by use of a personal item compared to males (14.5% vs. 4.4%, $p=0.003$). There were no differences in the prevalence of distraction by race.

Route Characteristics

Distractions occurred more often on city streets and highways ($p=0.0006$), in city centers or rural areas ($p=0.0005$), and when the number of passengers was between 1 to 5 or > 20 ($p=0.0001$) (Table 3). By distraction type, distraction by interaction with another passenger was more common on city streets or highways ($p=0.0005$), in city centers or urban areas ($p<0.0001$), for lower speeds ($p=0.014$), and when the number of passengers was > 20 ($p=0.0004$). Distraction by eating and drinking was over twice as common on highways ($p=0.047$), nearly ten times as common in rural areas ($p<0.0001$), four times as common when the speed was at least 35 mph ($p<0.0001$), and more common when there were 1 to 5 or 6 to 10 passengers ($p=0.031$). Distraction by personal item more often occurred on highways ($p=0.013$) and in moderately paced traffic ($p=0.046$). Distraction due to use of a cellular phone occurred more often when the number of passengers was >20 ($p=0.004$).

DISCUSSION

The results from the current study suggest that driver distraction is prevalent among bus drivers in our sample. Approximately one-third of all observations (i.e., the drives between stops), bus drivers had some form of distraction, with distraction by interaction with another passenger being the most prevalent distraction types. Distraction was more common on city streets and highways and in the city center and rural areas. Additionally, drivers under the age of 50 were less likely to be distracted.

To date, the research examining distraction among commercial drivers (including bus drivers) has utilized naturalistic driving data (Olson et al. 2009, Hickman & Hanowski 2012). Of these studies, the current estimate of 39% prevalence of distraction is closest to the prevalence reported by Olson et al. (2009); however, Olson et al. (2009) did not include bus drivers in their population, preventing these estimates from being directly comparable. Hickman & Hanowski (2012) reported a prevalence of distraction to range from 3% in baseline events (i.e., events not involving a safety-critical event) to 7% during safety-critical events, both numbers much lower than the currently reported prevalence of 39%, though estimates specifically for bus drivers was not given. One possible explanation for this difference is that the most prevalent distraction in the current study was distraction by interaction with another passenger, a distraction that was not included in the prior research. Excluding this distraction from the current analysis results in a similar prevalence estimate.

Hickman & Hanowski (2012) did examine distraction prevalence specifically for bus drivers and included distraction by interaction with another passenger, reporting a distraction prevalence of approximately 3% among all baselines and safety-critical events. One likely explanation for the large difference in prevalence estimates between the current study and Hickman & Hanowski (2012) is that the data that included triggered baseline events (e.g., running over a pot hole, hard braking)—the events that are most comparable to the current data—was collected after a period of increased focus on reducing distractive behaviors following both a webinar hosted by the Federal Motor Carrier Safety Administration and increased media coverage on preventing distractive behaviors. Thus, the drivers of the vehicles in the study may have been more likely to avoid distractive behaviors during observation. Another possible explanation is that Hickman & Hanowski (2012) may have underreported distraction prevalence as the data included video footage that was triggered by a given event, whether related to a safety-critical event or triggered baseline event. As these represent a non-random selection of video footage, it is possible that the chosen events are not reflective of the true prevalence of distraction. That is, distractive events may occur more often, but were not captured by the trigger-based system.

Though there is little literature with which to compare the results, there are studies on distraction among passenger vehicle drivers. In a study utilizing roadside observation of passenger vehicle drivers, nearly 15% of drivers were observed to have some form of distraction while driving (Sullman 2012). Similar to the current study, talking to another passenger was the most common form of distraction. Additionally, the current study found no difference between drivers aged <30 and 50 or older, but did observe a decrease among middle-aged drivers. This difference could be due to the fact that the prior research was

conducted in the United Kingdom where cell phone use while operating a vehicle has been illegal since 2003 (Leyden 2003), a law that does not exist for the state of Alabama (IIHS 2013).

Unlike the current study, Johnson et al. (2004) reported that distractions were more likely among younger ages. This could be due to the fact that the distraction rate was driven by cellular phone use, but the current study reported no difference in cellular phone use by age. Despite this, the current and previous study reported null associations by gender. In another observational study, researchers examined photos taken from cameras along the New Jersey Turnpike to estimate the prevalence of distraction (Johnson et al. 2004). The authors reported that approximately 4% of drivers were distracted, with the most frequent distraction being the use of a cellular phone.

The likely reason for the ten-fold difference in the overall rate of driver distraction is that the prior study utilized photos to determine whether a driver was distracted; therefore, it is possible this approach resulted in an underestimate of the true prevalence as the distraction had to occur while the camera was taking a picture in order to be counted. That is, the amount of time for being observed in a distracted state is much lower in the prior study examining photos, with the time being when the vehicle is within range of the camera. As the current study utilized direct observation of drivers over an extended period, the amount of time for being observed in a distracted state was much greater, resulting in higher prevalence (though not necessarily) incidence of distraction. Additionally, the prior study was limited to distraction among highways. When examining distraction among highways only in the current study, the overall distraction rate remained high, though a similar rate of distraction by cellular phone use was observed (Johnson et al., 2004).

These studies only observed driver behavior for a short period of time (i.e., as the vehicle passed the observer or camera). A more accurate comparison to the current study is a naturalistic study that observed 70 drivers through their driving exposure over the course of one week through the use of a video camera mounted in the vehicle (Stutts et al. 2005). The authors reported the drivers had some form of distraction slightly over 30% of the driving time, a frequency that is closer to the currently reported distraction frequency. Though the current study similarly reported that distraction due to interaction with another passenger was most frequent, the proportion was higher than the frequency reported in prior literature (27.5% vs 15.3%). A similar proportion of distraction from eating or drinking was observed between the current study and Stutts et al. (2005).

The fact that the most common type of distraction was due to interaction with another passenger is of concern given that previous research has reported that this distraction can increase the frequency of time drivers spend with their hands off the steering wheel or with their focus on an object within the vehicle rather than on the road ahead (Stutts et al. 2005). This is particularly true for internal distractions such as manipulating vehicle controls such as the ticket machine or from the search or use of a personal item, which, though not the most prevalent distractions in the current study, occurred more often than reported in previous research (Johnson et al. 2004, Stutts et al. 2005, Sullman 2012).

In light of this, the current results must be viewed within the contexts of certain strengths and limitations. This is the first study to assess the prevalence of distraction among bus drivers. Unlike previous research that examined distraction at transient points in time (Johnson et al. 2004, Sullman 2012), the current study observed drivers for up to three hours (depending on the length of the route) across a period of three months. Despite these strengths, the study was limited by the fact that the routes were ridden between early morning and noon; however, there is no reason to expect that, for the population of bus drivers, that distraction would differ between morning and afternoon routes. Therefore, the probability of bias by time of day is minimal. Additionally, though routes were chosen randomly across the study period, it is possible that the demographics of the bus drivers in the study may not be representative of the true demographic distribution, though the random selection of the routes suggests this is not the case.

Regarding data collection, the observers were trained to identify a distraction as any activity that took the driver's attention away from the road; however, to facilitate maximizing the observation time within a limited calendar period, only one observer was placed on each bus, thus precluding the ability to calculate reliability measures. As a result, it is possible that the data collectors did not observe all possible distractions or did not reliably identify distraction as given within the operational definition (i.e., the observer identified an activity as a distraction when truly it was not or missed a distraction). There is no reason to believe that this misclassification of distraction would be differential by factors examined in the analysis, and any associations observed are likely underestimates of the true association. Related to the definition of distraction, we used a dichotomous measure of cell phone use; however, it has been suggested in prior research (Hickman & Hanowski 2012) that cell phone use should be categorized according to the specific task (e.g., dialing, talking, texting), as each task confers a different risk of safety-critical events. While we agree with this point, the purpose of the current study was not to assess how distraction affects risk of safety-critical events, but rather to provide an estimate of distraction among bus drivers. Thus, the bias associated with dichotomizing cell phone use does not apply in the current study.

Despite the fact that these routes were chosen randomly, the data collection time frame was within a three-month time period. Thus, these results reflect only a small portion of the total number of drives taken by bus drivers and may not be reliable due to the limited number of drives ridden by observers. Finally, the setting for the study was such that a majority of the time the buses were moving at a slow to moderate pace within free-flowing traffic. It is possible that these results may not be representative for all bus drivers, as the prevalence of distraction may differ if the buses were more often in heavy, slow-moving traffic or travelled at higher speeds.

CONCLUSIONS

Distraction is an as-prevalent (if not more-than prevalent) problem for bus drivers compared to drivers of passenger vehicles. The results suggest, when compared to previous research, that bus drivers represent a distinct population from passenger vehicle drivers in regards to the association between distraction and demographics. When excluding distraction by other

passengers, the prevalence of distraction is similar to prior estimates among commercial drivers, suggesting that distraction by other passengers is a unique problem for transit bus drivers compared to other commercial drivers. Future research should determine whether distraction among transit bus drivers by interaction with another passenger is associated with safety-critical events using methods such as the naturalistic approach employed by prior research among commercial drivers.

Hickman & Hanowski (2012) reported that, among drivers of trucks with three or more axles, tractor-trailers/tankers, and buses, the bus drivers had a disproportionate number of crashes and near crashes. Given that the current study reported a distraction prevalence much higher than reported by research including transit bus drivers (Hickman & Hanowski 2012) and coupled with research suggesting that inattentiveness due to distraction can result in more severe collisions for bus drivers (Kaplan & Prato 2012), it is imperative to ensure that the occurrence of distraction is decreased among transit bus drivers. As noted by Hickman & Hanowski (2012), making the drivers and their companies more aware of preventing distractive behaviors can reduce the prevalence of distraction. Thus, increased awareness and prevention campaigns provided by the transit bus companies may help to reduce distraction prevalence among these drivers.

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Table 1

Driver and route characteristics of selected buses

	N (%)
DRIVER	
N	22
Age (%)	
< 30 years	4 (19.1)
30–49 years	12 (57.1)
50 years	5 (23.8)
Gender (%)	
Male	10 (47.6)
Female	11 (52.4)
Race (%)	
White	1 (4.8)
Black	19 (90.5)
Other	1 (4.8)
ROUTE	
N	796
Street type (%)	
Residential	180 (23.1)
City street	504 (64.7)
Highway	95 (12.2)
Traffic flow (%)	
Free moving	732 (93.6)
Moderate pace	48 (6.1)
Slow moving	2 (0.3)
Geographic area (%)	
City center	71 (9.1)
Urban	489 (62.9)
Suburban	188 (24.2)
Rural	29 (3.7)
Speed (%)	
< 25 mph	306 (39.2)
25–34 mph	366 (46.9)
35–44 mph	107 (13.7)
45 mph	1 (0.2)

Table 2

Association between bus driver characteristics and driver distractions

	Any distraction	Interaction with another passenger	Eating/drinking	Personal item	Phone	Ticket machine
Overall (n=796)	313 (39.3)	219 (27.5)	35 (4.4)	66 (8.3)	32 (4.0)	30 (3.8)
Age (%)						
<30 years (n=60)	36 (60.0)	18 (30.0)	3 (5.0)	12 (20.0)	5 (8.3)	8 (13.3)
30–49 years (n=493)	142 (28.8)	84 (17.0)	12 (2.4)	45 (9.1)	10 (2.0)	22 (4.5)
50 years (n=219)	126 (57.5)	109 (49.8)	20 (9.1)	8 (3.7)	17 (7.8)	0 (0.0)
<i>p-value</i> *	0.005	0.024	0.281	0.074	0.214	–
Gender						
Male (n=477)	199 (41.7)	161 (33.8)	23 (4.8)	21 (4.4)	23 (4.8)	9 (1.9)
Female (n=303)	112 (37.0)	57 (18.8)	12 (4.0)	44 (14.5)	9 (3.0)	21 (6.9)
<i>p-value</i> *	0.671	0.108	0.765	0.003	0.282	0.065
Race						
Black (n=715)	278 (38.9)	194 (27.1)	34 (4.8)	61 (8.5)	32 (4.5)	24 (3.4)
Non-Black (n=61)	31(50.8)	22 (36.1)	0 (0.0)	5 (8.2)	0 (0.0)	6 (9.8)
<i>p-value</i> *	0.218	0.508	–	0.958	–	0.400

* *p*-values based on GEE logistic regression adjusted for time between stops

– Unestimable because of 0 count for at least one group

Table 3

Association between bus route characteristics and driver distractions

	Any distraction	Interaction with another passenger	Eating/drinking	Personal item	Phone	Ticket machine
Overall (n=796)	313 (39.3)	219 (27.5)	35 (4.4)	66 (8.3)	32 (4.0)	30 (3.8)
Street type (%)						
Residential (n=180)	50 (27.8)	30 (16.7)	5 (2.8)	12 (6.7)	7 (3.9)	5 (2.8)
City street (n=504)	213 (42.3)	157 (31.2)	20 (4.0)	38 (7.5)	23 (4.6)	16 (3.2)
Highway (n=95)	45 (47.4)	27 (28.4)	9 (9.5)	16 (16.8)	1 (1.1)	9 (9.5)
<i>p-value</i> *	0.0006	0.0005	0.047	0.013	0.186	0.029
Traffic flow						
Free-flowing (n=732)	290 (39.6)	207 (28.3)	35 (4.8)	57 (7.8)	29 (4.0)	27 (3.7)
Moderate pace (n=50)	22 (44.0)	11 (22.0)	0 (0.0)	9 (18.0)	3 (6.0)	3 (6.0)
<i>p-value</i> *	0.598	0.361	–	0.046	0.408	0.424
Geographic area						
City center (n=71)	36 (50.7)	27 (38.0)	2 (2.8)	5 (7.1)	8 (11.3)	4 (5.6)
Urban (n=489)	206 (42.1)	153 (31.3)	15 (2.9)	45 (9.2)	17 (3.5)	19 (3.9)
Suburban (n=188)	53 (28.2)	30 (16.0)	9 (4.8)	11 (5.9)	6 (3.2)	7 (3.7)
Rural (n=29)	15 (51.7)	6 (20.7)	10 (34.5)	5 (17.2)	1 (3.5)	0 (0.0)
<i>p-value</i> *	0.0005	<0.0001	<0.0001	0.237	0.108	0.427
Speed (%)						
< 25 mph (n=306)	119 (38.9)	92 (30.1)	6 (2.0)	18 (5.9)	13 (4.3)	10 (3.3)
25–34 mph (n=366)	154 (42.1)	106 (29.0)	13 (3.6)	35 (9.6)	18 (4.9)	18 (4.9)
35 mph (n=108)	37 (34.3)	18 (16.7)	16 (14.8)	11 (10.2)	1 (0.9)	2 (1.9)
<i>p-value</i> *	0.336	0.014	<0.0001	0.180	0.086	0.235
Number of passengers						
1 to 5 (n=318)	156 (49.1)	106 (33.3)	21 (6.6)	31 (9.8)	6 (1.9)	11 (3.5)
6 to 10 (n=259)	82 (31.7)	51 (19.7)	11 (4.3)	20 (7.7)	10 (3.9)	9 (3.5)
11 to 15 (n=123)	41 (33.3)	30 (24.4)	1 (0.8)	11 (8.9)	11 (8.9)	5 (4.1)
16 to 20 (n=72)	25 (34.7)	23 (31.9)	2 (2.8)	4 (5.6)	2 (2.8)	5 (6.9)
>20 (n=16)	9 (56.3)	9 (56.3)	0 (0.0)	0 (0.0)	3 (18.8)	0 (0.0)
<i>p-value</i> *	0.0001	0.0004	0.031	0.386	0.004	0.558

*p-values based on Wald chi-square estimated from logistic regression adjusted for time between stops

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