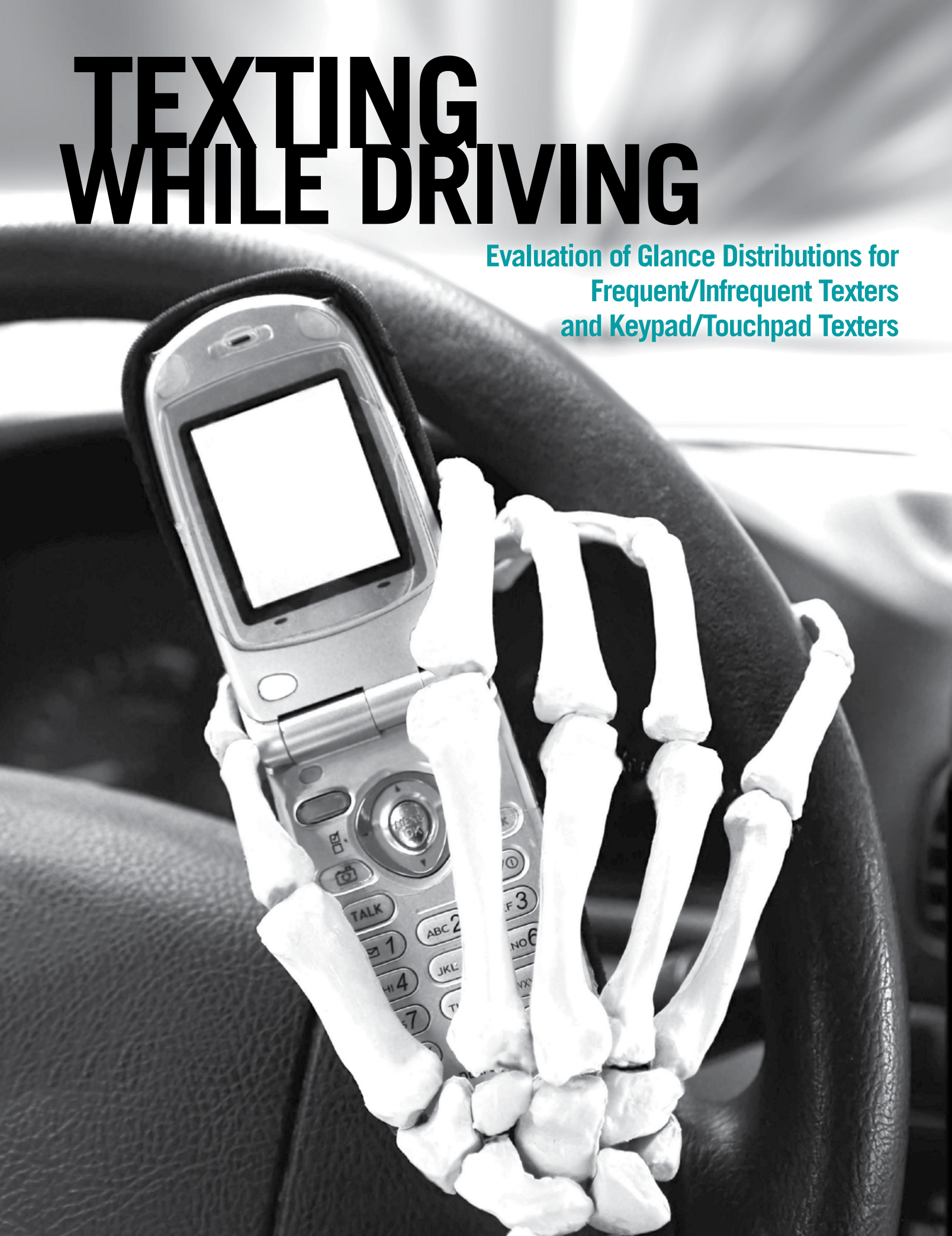
TEXTING WHILE DRIVING

Evaluation of Glance Distributions for Frequent/Infrequent Texters and Keypad/Touchpad Texters



Driver distraction has become a critically important safety issue — and both the government and researchers are starting to pay attention.

As technology advances, potential distractions for drivers are growing ever more numerous. High-technology, in-cab control and display systems (plus new nomadic devices) compete with the primary task of driving.

Unfortunately, manufacturers don't always evaluate these devices' possible impact on the average human driver, so their safety remains unknown. This assessment has largely been left to the research community.

Multi-functional mobile phones now permit a broad range of communication activities. Indeed, verbal communication may no longer be these devices' primary function, especially among young users: more than seven billion text messages are sent each day throughout the world. Despite the growing popularity of text messaging, study has only recently begun on its effects on driver performance.

With so many drivers texting behind the wheel, this relative lack of research is cause for concern. Many states have tried to ban the activity, but how effective has that effort been? According to an Insurance Institute for Highway Safety study, crashes have actually increased in states with bans. Why? Two possible answers present themselves.

DRIVER TEXTING: PREVIOUS RESEARCH

First, let's consider the evidence that texting while driving is a frequent activity. In 2010, the Pew Research Center conducted a project that concluded that adults were just as likely as teens (27 percent versus 26 percent, respectively) to have text messaged while driving. Forty-nine percent of adults and 48 percent of teens said that they had been passengers in a car when the driver was sending or reading text messages on his or her cell phone. The Pew Research Center also determined that over 47 percent of all text-messaging adults admitted to having sent or read a text message while driving. Compare this statistic to that of the one in three text-messaging teens who said they had "texted while driving" in a September 2009 survey.

Next, consider the research on texting and driving. Although the research on cell-phone use and driving is extensive, far less research has taken place on texting and driving. Four studies stand out. First, Monash University Accident Research Center (MUARC) conducted a study on a driving simulator to evaluate the effects of text messaging on the driving performance of young novice drivers. MUARC hypothesized that there would be a decrease in mean speed and an increased variability in speed. They also predicted increased lane excursions and poor lane positioning. They found that the proportion of time drivers spent glancing away from the forward roadway in the text-messaging condition (40 percent) was consistently higher than for their control condition (10 percent). The authors found no significant differences between the text-messaging and non-text-messaging conditions on mean speed and mean standard deviations of speed. Lane-positioning and lane-excursion analyses revealed no significant differences either.

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Second, Drews et al. also conducted a study on a driving simulator. They found that drivers (a) were more likely to crash while text messaging, (b) were more likely to respond to the onset of lead-vehicle brake lights, and (c) were less able to control their vehicle in both the forward and lateral positions. Drews et al. concluded that the type of attentional demand has an impact on the severity of distracted driving. They hypothesized that texting while driving requires task switching coupled with extended durations of time spent looking away from the forward roadway, and that it also poses a higher crash risk than other tasks, like talking on a cell phone, that require task switching too.

Third, Reed and Robbins conducted a simulator study in which they tested the hypothesis that driver performance would be worse while entering a text message than while reading a text message. The results of this study demonstrated impairment by concurrent text-messaging tasks. The study found that drivers tended to reduce their speed under text-messaging conditions. The authors also suggested that the drivers were aware of their impairment while engaged in text-messaging tasks and hence chose to reduce their speeds in order to mitigate accident risk.

Finally, a recent naturalistic study conducted by the Virginia Tech Transportation Institute determined that truck drivers were 23 times more likely to be in a crash while texting than while not texting. This research also showed that, among the various in-vehicle tasks in which the drivers were engaged, the drivers' eyes were off the road for longer periods of time while texting than they were for any other in-vehicle task.

A DESCRIPTION OF THE STUDY

In this study, we wanted to explore two explanations for why it is that bans on texting may not have the intended effect. For lack of a better term, we will refer to the first explanation as the "Lake Wobegon effect." In brief, many individuals text frequently – so frequently that they may think they are of "above average" ability and therefore do not need to obey texting laws, since they are irrelevant to them. As more and more drivers acquire texting capabilities, especially with predictive

SENDING THE MESSAGE:
Telecom Companies Try to Debunk the Multi-tasking Myth

"WHERE U AT?"

That's the last text message 18-year-old Mariah West received before her car crashed into a bridge, ending her life.

The accident occurred while West was reading a text from a Springfield Cardinals' baseball player who had invited her to a game.

The tragic story is one of several in a 10-minute documentary by Dallas-based AT&T – *The Last Text* (http://www.att.com/gen/press-room?pid=2964) – featuring stories from individuals whose lives were dramatically altered by texting while driving. The film is part of a campaign AT&T launched in 2009 to educate all wireless users, but especially teen drivers, about the dangers of texting when driving.

"Ultimately, our goal is to help generate a change in the thinking and behavior of all wireless users," says Dave Nichols, president of AT&T Texas. "We've reached millions through our efforts already, but we know that it will take time and a steady drumbeat from carriers like AT&T."

The AT&T campaign, along with a similar one by Verizon Wireless – Don't Text and Drive – comes amid growing concerns about the dangers of texting and driving. A study by the Virginia Tech Transportation Institute found that those who text while driving are 23 times more likely to be involved in an accident.

The National Safety Council estimates that 1.3 million crashes, or 23 percent of all crashes, involve distracted drivers using cell phones. Of all crashes, an estimated 3 percent involve texting.

John Ulczycki, group vice president of the National Safety Council, says that by taking their eyes and at least one hand off the steering wheel, drivers who text are cognitively distracted, substantially reducing their response times to emergency driving situations.

"People think they can multi-task, but multi-tasking is a myth," Ulczycki says. "When it comes to your brain, your brain is not capable of multi-tasking on two cognitively demanding tasks. While texting, we have to think about what we're doing. In doing that, there is a substantial risk because our brain is switching on and off, switching from the driving task to the texting task."

In response to the dangers, 35 states have passed texting-while-driving bans.

texting, the sheer number of experienced texters will increase. Thus, we wanted to determine whether individuals who text frequently are indeed less likely to crash than individuals who text less frequently. If not, then an increase in the number of individuals who consider themselves skilled at texting and persist in doing so while driving could explain the increase in crashes.

Second, we wanted to determine whether the method of entry, keypad ("QWERTY") or touchpad, has an effect on the likelihood of crashing. There is a sense among teens that touchpad phones like iPhones are less risky than keypad phones like the BlackBerry. The BlackBerry uses a more conventional keypad that mimics computer keyboards to a certain extent. These keyboard entry systems are called "QWERTY" systems. The name "QWERTY" is derived from the first six keys (from left to right) located on the far-left portion of a standard keyboard just below the top-row number keys. The QWERTY layout was designed to prevent people from typing too quickly and jamming various keys on early typewriters as they moved to strike the paper. If iPhones are as dangerous as or more dangerous than keypad phones, then as they become relatively more common, they too may lead to an increase in crashes.

We used several surrogate measures of crashes, comparing frequent and infrequent texters in relation to these surrogate measures. To begin, we measured the percentage of glances longer than two seconds inside the vehicle while drivers were texting. Several authors have shown that long glances inside the vehicle are particularly associated with an increased risk of crashing. For example, Horrey and Wickens showed that 80 percent of the crashes in a driving simulator were associated with the 20 percent of glances inside the vehicle that were longer than 1.8 seconds. And a naturalistic study completed at the Virginia Tech Transportation Institute showed that glances inside the vehicle that were longer than two seconds during the five seconds preceding a crash or near-crash and the one second after the

crash were associated with an increase of two to three times in the crash rate. We also measured the percentage of texting tasks involving at least one glance longer than two seconds inside the vehicle.

METHOD

Participants were asked to send text messages while navigating a vehicle through a virtual world. The timing of sending messages was experimenter-paced to exercise control over the experiment. The participants' eyes were tracked throughout the drives.

Participants

The participants were ages 18 and 19. All participants were regular users of iPhones or BlackBerries. A participant was said to be a "regular user of a cell phone interface" if he/she used that particular cell phone for dialing, text messaging, and internet access on a day-to-day basis. This population selection was done in order to ensure that the participant was familiar with the interface. The participants were recruited from the University of Massachusetts Amherst and the town of Amherst itself. Sixty percent of the participants were female. Subjects received $25 for their participation.

The study contained 18 participants. Ten of the participants usually used a BlackBerry while texting, and eight usually used an iPhone while texting. "Frequent texters" were defined as drivers who text at least 20 to 25 times per day. "Infrequent texters" were defined as drivers who text one to five times per day. Five of the frequent texters used a BlackBerry, and four used an iPhone. Similarly, five of the infrequent texters used a BlackBerry, while the other four used an iPhone.

Driving Simulator

The fixed-base driving simulator included a full-size Saturn sedan in which all vehicle controls were fully operative. The visual world was displayed on three screens, allowing 150° of vision in the horizontal direction and 30° in the vertical direction. Images were displayed with a refresh rate of 60 Hz and a resolution of 1400 by 1050.

> "A second reason that texting crashes may be increasing despite the ban could be that **the distribution of keypad and touchpad devices is leaning ever more toward touchpad devices..."**

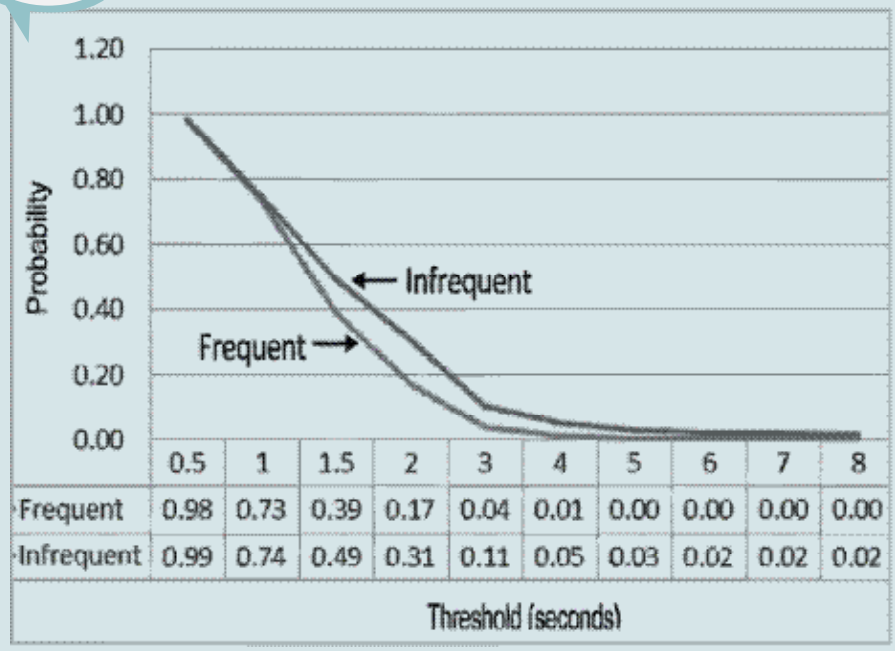
Eye Tracker

A portable eye-tracker system (ASL Mobile Eye) was used to monitor the drivers' eye movements. The eye tracker sampled the position of the eye at 30 Hz. The visual range was 50° in the horizontal direction and 40° in the vertical direction. The system's accuracy was 0.5° of visual angle.

Scenarios and Texting

The virtual environment through which the participants drove was a single environment inclusive of both urban and rural sections. The environment was populated with parked vehicles in the city section, and randomly occurring traffic occurred in all sections. The participants were asked to send three text messages at the start of various scenarios embedded within the drive. Each participant was asked to send the same text and numeric strings. The strings that the participants were asked to send as messages while driving

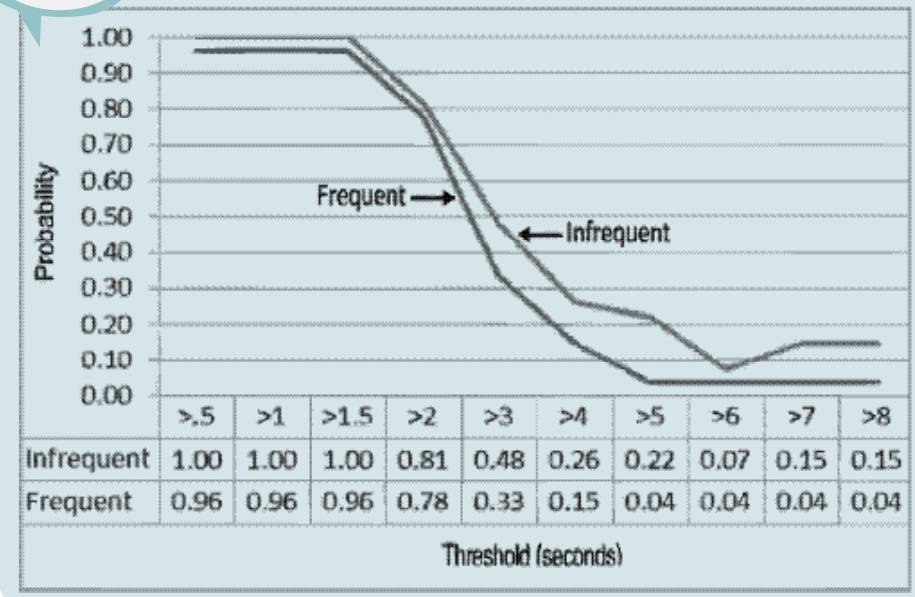
FIGURE 1 Probability Of Glances Greater Than Thresholds For Frequent/Infrequent Texters



	0.5	1	1.5	2	3	4	5	6	7	8
Frequent	0.98	0.73	0.39	0.17	0.04	0.01	0.00	0.00	0.00	0.00
Infrequent	0.99	0.74	0.49	0.31	0.11	0.05	0.03	0.02	0.02	0.02

Threshold (seconds)

FIGURE 2 Probability Of Scenarios Greater Than Thresholds For Frequent/Infrequent Texters



	>.5	>1	>1.5	>2	>3	>4	>5	>6	>7	>8
Infrequent	1.00	1.00	1.00	0.81	0.48	0.26	0.22	0.07	0.15	0.15
Frequent	0.96	0.96	0.96	0.78	0.33	0.15	0.04	0.04	0.04	0.04

Threshold (seconds)

included the following: "The quick brown fox jumps over a lazy dog," "6173204589," and "Few black taxis drive up major roads on quiet hazy nights." Please note that the text strings were pangrams.

Experimental Procedure

The participants were first asked to sign an informed-consent form. They were next asked to message a couple of strings to measure their texting speeds. Every participant received the same two strings ("6875490123" and "Pack my box with five dozen liquor jugs") in the same order. The time it took them to complete these messages was recorded. The participants were then provided with a practice drive that contained a few hazard-anticipation scenarios. This drive was intended to familiarize the participants with simulated driving. The participants were then fitted with an eye tracker that was used to collect eye-movement data. Following this step, the participants were asked to drive a multiple-scenario (the experimental drive had six scenarios) single drive once while performing text-messaging secondary tasks. Participants performed text-messaging tasks on three out of six scenarios that were counterbalanced across participants.

Hypotheses

We hypothesized that the frequent texters would be as likely as infrequent texters to glance inside the vehicle for longer than any given threshold. The touchpad users were expected to be more likely to glance inside the vehicle for longer than almost all the threshold values.

Dependent Variables

As noted above, prior research confirms that glances away from the forward roadway that exceed two seconds are a causal feature of most crashes. To reflect this causal feature, we used glance duration as a dependent variable. "Glance duration" refers to the length of time for which a continuous sequence of eye fixations is confined to a specific area – in our case, the area inside the vehicle. Glance durations were measured by calculating the interval of time between the moment

the participant glances inside the vehicle and the moment that the participant glances back at the forward roadway.

RESULTS AND DISCUSSION

Below we discuss the major differences between the frequent and infrequent texters and the major differences between the users of BlackBerries and iPhones. Threshold values between 0.5 seconds and eight seconds were chosen.

Texting Speeds

The average texting speeds were 12.22 seconds for infrequent texters and 9.60 seconds for frequent texters. These differences were significant: $t(16) = 2.124$, $p < .05$, indicating that the self-reported measure of texting frequency is reflected in performance.

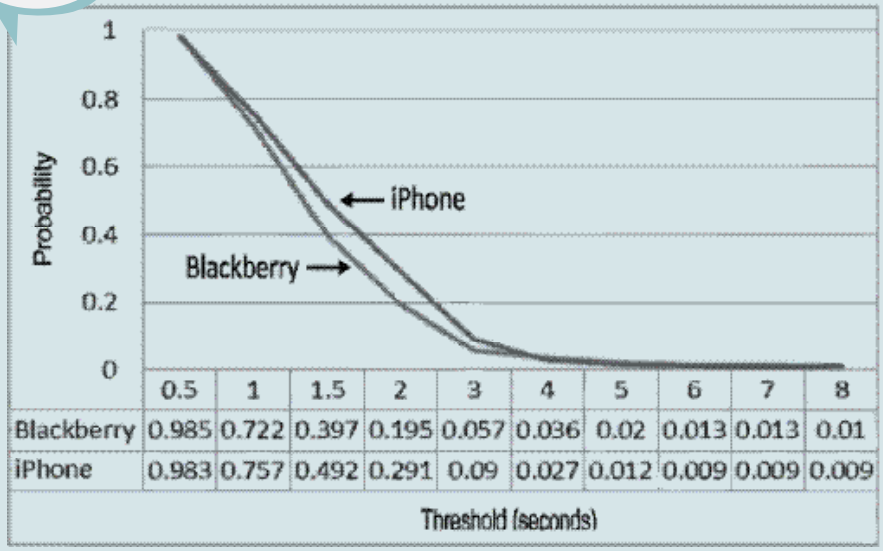
Percentage of Glances Greater than Threshold

The probability of a glance greater than each threshold between 0.5 seconds and eight seconds was smaller for the frequent texters than it was for the infrequent texters (Figure 1). Although the hypothesis that the frequent texters would be as likely to glance inside the vehicle for longer than any given threshold, especially two seconds, could not be rejected, the trend is clear: frequent texters are slightly less likely than infrequent texters to take a glance longer than each of the various thresholds inside the vehicle. Perhaps a larger sample would have shown these differences to be significant (Figure 1).

Percentage of Scenarios Greater than Threshold

We also looked at the probability that an individual glanced at least once inside the vehicle while completing a texting task for each of the thresholds. None of the differences were significant at any of the thresholds. At the critical two-second threshold, the glance probabilities of the frequent and infrequent texters were nearly indistinguishable: 0.78 and 0.81, respectively (Figure 2).

FIGURE 3 Probability Of Glances Greater Than Thresholds For BlackBerry And iPhone Users



	0.5	1	1.5	2	3	4	5	6	7	8
Blackberry	0.985	0.722	0.397	0.195	0.057	0.036	0.02	0.013	0.013	0.01
iPhone	0.983	0.757	0.492	0.291	0.09	0.027	0.012	0.009	0.009	0.009

Threshold (seconds)

Comparison between BlackBerry and iPhone Cellular Interfaces

Finally, a comparison was made between the BlackBerry and iPhone users of the probability of making a glance inside the vehicle greater than various threshold values. Although the touchpad users were more likely to take glances inside the vehicle longer than almost all the threshold values, in the most critical region (two seconds), one could not reject the hypothesis that the iPhone users differed from the BlackBerry users: $t = -1.91$, $p = .07$. Nor could one reject this hypothesis at any of the other threshold values.

IN CONCLUSION

Texting while driving is known to be dangerous, leading many states to introduce bans on texting. Paradoxically, in three of the four states examined in an early study, crashes related to texting have actually increased. One might ask why this is the case. One reason may be that, as drivers become more experienced with texting, they come to believe that they can ignore anti-texting laws. In order for it to be the case that the total number of texting-related crashes increases as bans are put in place, it would need additionally to be true that frequent texters are no safer than infrequent texters. We have shown that this is indeed the case. In fact, if frequent texters send messages while they are driving as frequently as they do in general, they are almost five times more likely to be involved in a crash because of their increased exposure.

A second reason that texting crashes may be increasing despite the ban could be that the distribution of keypad and touchpad devices is leaning ever more toward touchpad devices. In order for this to be the case, it would have to be true that drivers were less safe using touchpad devices. Although for almost all thresholds it was true that touchpad users were more likely to look inside the vehicle for a length of time longer than the threshold value, in no case was the difference between touchpad and keypad users statistically significant. Clearly more research is needed on this topic.

If texting bans are not working as intended, one might ask whether any strategy would succeed in reducing texting-related crashes. Recent research suggests that training individuals to keep their glances to less than two seconds inside the vehicle can produce safer drivers both on the driving simulator and in the field. Perhaps such training alternatives should be pursued in addition to text-messaging bans. N