The Impact of Age and Gender on Reaction Time While Texting and Driving

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Abstract
Although distracted drivers are claiming more and more lives each year, drivers continue to perform dangerous behaviors behind the wheel of a moving vehicle. Of all driving distractions, texting and driving has proven to be one of the most dangerous. This research investigated the effect of text messaging on driver reaction, and whether the effect varied as a function of gender. Thirty-five Wichita State University students ranging in age from 18-29 participated in 5 different experimental conditions, a driving only condition, manually texting while driving, manually texting only, verbally texting while driving, and a verbally texting only condition. Reaction time was measured by the participant braking when the car in front of them braked. The participants were also asked to rate the perceived risk of texting and driving on a five-point scale. The results indicated that reaction times in the driving only task were significantly faster, compared to the task of driving and manually texting. There was evidence of a trend suggesting that women perceived the risk of texting to be greater than men, especially after completing the driving and texting task.

Introduction
Driving under normal circumstances can be a complicated task on its own. Adding distractions such as cell phone usage (texting, calls, and maps), applying makeup, and arguing with passengers makes it much more difficult. Research by Madden and Lenhart shows that there were 5,870 fatalities and 515,000 injuries in 2008 due to some form of driver distraction (2009). Their research also shows that teen drivers are generally at a much higher crash risk than other drivers. It is believed that driving inexperience may account for the significant risk faced by young drivers. In 2009, Alex Brown, a 17-year-old high school senior, was fatally crushed by her pick-up truck. This unfortunate event was the result of a few distracted moments of texting while driving. The article featuring Alex’s story mentions her texting four friends around the time of her accident. Her mother is currently one of many fighting to make texting and driving illegal in the state of Texas (Chammah, 2013).

Past research has brought to light the true dangers of texting while driving. Research indicates that the deaths associated with texting while driving are becoming more common. Despite the new advances in technology and convenience of hands free devices the risks have not been reduced. The research conducted investigates further into the relationship between gender, age and reaction time.
**Literature Review**

**General Information**

In 2008, one in every six vehicle fatalities was caused by a distracted driver. A study conducted by Wilson and Stimpson (2010) from 1999 to 2008 revealed that a total of 51,857 deaths were caused by driver distractions, including cell phone usage. They also reported a 30% increase in fatalities caused by the use of cell phones from 2001 to 2007. The study shows that for every one million additional text messages sent per month, driving fatalities are predicted to increase 76%. Texting and driving is currently banned in 35 states, and many groups across the country are urging for it in the states that have not yet done so (Christofferson, 2012). The analyses of legislative action in Connecticut have shown that more severe penalties can reduce texting while driving and its effects (Christofferson, 2012). Unfortunately, even in the states where texting and driving is banned it is becoming more and more difficult to monitor.

**Reaction Times**

Natural reactions can save people from the threats that surround them in everyday life. Unfortunately, texting and driving slows down our reaction times, opening the door to accidents. Reed & Robins (2008) found that reaction times to trigger stimuli tended to be higher when reading or writing a message. A study conducted by Burns et al. (2002) also found that drivers’ reactions were significantly slower with constant mobile phone conversations. The slowest average reaction time was reported for drivers responding to a visual reaction time task while trying to compose a text message. Reaction time increased 33% from 1.2 to 1.6 seconds. This suggests that participants were significantly more likely to be slower to respond to the reaction time stimuli if engaged in concurrent text messaging. Research conducted by Caird & Scialfa (2004) reviewed 84 published scientific articles, covering seven years of investigation into the effects of cell phone use on driving. Sixty-eight of the articles measured driving performance while using a cell phone, and 16 articles were epidemiological studies that examined cell phone usage and its relationship to vehicular crashes. Many of the articles reported that conversing on a phone affected lane-keeping, speed, headway, and event detection. The researchers conducted a meta-analysis to evaluate the reported effects of cell phone use on driver performance. Three performance measures were considered: reaction time to critical events, driving control variability variables, and driving speed. The study clearly shows that using a cell phone conversation and information processing to simulate a distraction task negatively impacts performance. The largest effect was seen on reaction time to a variety of stimuli. From the larger set of studies, 18 adequately reported reaction time. Results showed an increase in reaction time of about ¼ of a second in the presence of a cell phone distractor for all studies that were analyzed. An important point is that the mean reaction time increased similarly regardless of whether the drivers use a hand-held or hands-free phone. The results also showed that conversations on cell phones, both hand-held and hands-free, negatively influence driving performance and increase crash risk. Responses to critical events and the ability to maintain vehicular control are hampered. The negative effect is larger for cell phone usage in response to critical events than for vehicular control, but driving variables such as lane position and headway variability did show smaller effects. On-road driver behavior tends to be worse than driver performance assessed in settings using a driving simulator. Due to limitations in the available published literature, a number of questions remain unanswered.

Researchers have recently begun to study the effects of texting on driver behavior. Burge & Chaparro (2012) began their study on texting and hazard perception by reviewing a set of articles and statistics demonstrating that drivers who are engaged in text messaging while in a driving simulator reported a slower reaction time. Burge & Chaparro (2012) used a low fidelity simulator, similar to the one used in the current study, to assess hazard perception when drivers were texting. They focused on the ability of drivers to successfully detect events that could cause a collision apart from speed and lane control. Two text message conditions were used to compare the effects of cognitive load. The first condition was a copy-text and the second, an alphabetize-text condition. The two conditions represented low vs. high cognitive load. Signal Detection Theory was used to provide information on missed hazards and false alarm data. This helped assess the degree to which drivers compensate for engagement in text messaging and their ability to discriminate hazards when distracted.
They reported a significant effect of the texting task on the number of missed hazards compared to a baseline drive-only condition. The drivers missed more hazards when completing the alphabetize-text task compared to the copy only conditions. There were no significant differences between the baseline and copy-text conditions. Interestingly, they showed that when completing the copy-text task participants were significantly more likely to respond to potential hazards than in the alphabetize-texting task. There was no difference shown between the baseline and copy-text conditions, nor between the baseline and alphabetize-text conditions. They reported that results showed a significant difference in reaction time for the texting, alphabetize-text and baseline, copy-text, and alphabetize-text conditions. They also showed that drivers missed more hazards and were slower in responding to the hazards when performing the more difficult alphabetizing texting task. Signal Detection Theory analyses indicated that drivers adopt a more liberal response criterion in the copy-text condition relative to the alphabetized-text condition. This resulted in fewer missed hazards but more false alarms. The poorer performance in the alphabetized task may be due to competition for a focal vision between the driving and text-messaging task. Drivers had to choose which looking at the phone or the driving scene. In addition to driver reaction time, investigators assessed the effects of distraction using a variety of other dependent measures, including driver glances on and off the road, speed control, and vehicle lane control. A summary of these findings is reported below.

**Glances/Attention to Road**

Libby & Chaparro (2009) investigated the effects of texting on driver glance behavior. Unlike talking on a phone, entering a text message may increase the number and duration of glances away from the roadway, thereby increasing a driver’s risk. Libby & Chaparro had the participants complete three different tasks: 1) driving without a cell phone, 2) driving while talking on a cell phone, and 3) driving while texting on a cell phone, participants were instructed to categorize words appearing on billboards along the side of the road. They were asked to respond either by phoning it in verbally or by texting. A driving simulator was used to measure the driving performance.

The driving-dependent measures included the number of times the driver’s eyes left the roadway, mean driving speed, and reaction time. Drivers in the text messaging condition took their eyes off the road more often than in either the cell phone condition or the verbal response condition, had significantly slower reaction times to peripheral letter targets, drove more slowly, and exhibited greater variance in their lane position. Their results were consistent with the findings of Reed & Robins (2008) who reported that texting subjects glanced away from the road environment 40% of the time, as opposed to only 10% when undistracted.

**Speed**

Speeding is a dangerous act in itself, and adding a more difficult task like texting increases the risk of causing an accident. Caird, Siclaffa, Ho, & Smilys’ (2004) research revealed a small effect (average .26, median .2) of cell phone usage on driving speed. More specifically, results showed that drivers tended to drive more slowly while using a cell phone. Cell phone usage does not impact drivers’ speed as significantly as it does their reaction time or vehicle control. However, it can still be a critical factor. At higher speeds, a quarter of a second made a difference between striking a vehicle or pedestrian and avoiding a collision. Studies show that individuals are aware of danger when texting and driving, and they are shown to slow down when they are preparing to read or send a text message.

**Vehicle Lane Control**

Vehicle Lane Control is an important aspect to consider when studying texting and driving. Studies show that the more an individual texts and drives the more likely he or she is to unintentionally cross lanes. Reed & Robbins (2008) conducted a study that showed an inconsistency in keeping vehicles in correct lanes. Specifically, there was a 70% increase in variability of lateral lane positioning, and a 28% increase in lateral lane excursions. There was a 104% increase of drivers consistently missing road signs instructing lane changes. The study results showed that the driving behavior of the participants was impaired by concurrent text messaging tasks, and that writing a text message is significantly more impairing than reading a text message. A limitation of this study could be that the participants were tested on a non-familiar road, but whether or not this was a concern of the researchers, was not addressed by the article.
**Passengers or Lone Driving**

An important issue to consider is whether all forms of distractions are equal in their effects. Holding a conversation with a passenger is not unlike holding a cell phone conversation and thus could have a similar effect. However, studies show that drivers are more likely to drive safely and attentively with a passenger in the car because they are likely to have the passenger text or call for them. Recent findings (Drews, Pasupathi, & Strayer, 2008) show that drivers conversing on a cell phone exhibited greater lane keeping variability than participants conversing with a passenger. The authors reported that passengers are more likely to talk about the surrounding traffic, and that passengers tend to support the driver by directing attention to the surrounding traffic when they feel it is necessary.

**Age and Gender**

Many investigations on driving and distraction have been conducted on young novice drivers and their texting behaviors while driving. According to a study by Madden & Lenhart (2009) one in three teens, ages 16 - 17, say they have texted while driving. That translates into 33% of American teens ages 16 - 17 texting while driving. Fifty-two percent of teens, between ages 16 and 17, who own cell phones say they have talked on a cell phone while driving. While 48% of teens ages 12 - 17 say they have been in a car when the driver was texting, and 40% say they have been in a car when the driver used a cell phone in a way that put themselves or others in danger (Madden and Lenhart, 2009). Furthermore, McEvoy et al. (2006) identifies young drivers (18 - 30) as being significantly more likely to text while driving than older drivers. Similar research by Gras et al. (2006) found that among Spanish drivers, 19% admitted to texting on highways and 23% on rural roads at least once a month. A survey of Swedish drivers found that on average one text message was sent per month while driving, with drivers between 18 and 24 sending three texts per month, suggesting that younger drivers are much more likely to text while driving than older drivers (Thulin & Gustafsson, 2004). The National Highway Traffic Safety Administration, a section of the U.S. Department of Transportation, has reported that drivers under the age of 20 had the greatest portion of distracted drivers. Driving impairment caused by texting is shown to be more significant in females than males. Females tend to drift into other lanes more often than males while distracted by texting. They do however have a larger reduction in speed when attempting to text and drive, reducing the amount of danger they may cause to others (Reed & Robbins, 2008). An article published by the Litchfield County Times on February 13, 2012, mentions that men in Connecticut are more frequent offenders than women when it comes to texting and driving. A law was passed in Connecticut in 2006, banning the use of handheld cell phones while driving and text messaging while driving. Since then, men have received more citations for texting and driving. The article shows that male drivers have received about half of the distracted-driving citations annually for six years in a row. Last year in Connecticut men received 16,000 tickets while women received approximately 13,000. Two years before, men received about 25,000 and women received 21,000. These figures have gone down approximately 9,000 for men and 8,000 for women since the law has been in place (Christoffersen, 2012). These results suggest that the laws passed by legislation can play a role in decreasing infractions. When it comes to gender and age, no specific group is immune to the risk of texting and driving.

**Technologies**

Many cell phone providers have upgraded phones for the convenience of the customer. For example, many cell phones have a wand that can be used to write out a text instead of typing it in. Some phones even have the capability of generating texts from voice input. A recent study (Crandall & Chaparro, 2012) found that texting and using a touch screen phone resulted in poorer vehicle control compared to a physical keyboard. The difference is that physical keyboards allow the user to recognize finger placement on the raised buttons by touch rather than sight. Although these new technologies have not done away with the risk that texting and driving poses, some of the features require less attention towards texting, which in turn allows more attention for driving.

**Methods**

**Participants**

Participants included 33 individuals between the ages of 18 and 29, with a mean age of 21.3 (SD = 3.38). Nine participants were male, 24 were female. All participants were undergraduate students chosen...
from the SONA Experiment Management System at Wichita State University. The students were all currently taking a Psychology class, and were granted 6 SONA credits for participating. The subjects all had normal vision and were required to have at least two years of driving experience. The mean of driving experience was 6.15 years (SD = 3.4).

Procedure

The purpose of this study was to observe the relationship between age, gender and reaction time. A Latin Square was used to decide in what order the participants would conduct each condition. To begin the experiment, the nature and purpose of the study was explained to the subjects. All participants were required to sign a consent form stating their wish to participate. A visual acuity test was then conducted to ensure the participant had 20/20 vision. Then, each participant completed a background survey. The survey consisted of 24 questions asking participants how many years of driving experience they had, their gender and age, the type of phone they had, if they ever texted and drove, if they talked on the phone while driving, how risky they felt texting and talking on the phone while driving, and the type of keyboard they used to text. Before using the driving simulator, a fan was turned on to minimize any feelings of dizziness caused by the simulator. Every subject participated in each scenario. Each participant took approximately 75 minutes to run. Each condition was 12 minutes long, with the alerts for a new text message arriving randomly. The text messages consisted of 10 numbers. Four of the five conditions included text messaging. There was one driving only condition, two conditions in which participants physically texted a message they received while driving and while not driving, and two conditions in which participants verbally responded to a message that they received while driving and also while not driving. The voice response conditions were captured by a voice recorder to track accuracy. The participants were instructed to follow the vehicle in front of them at a safe distance. They were instructed not to pass the vehicle, and to brake when the lead vehicle did. The participants were instructed to inform the researcher of feelings of sickness caused by the simulator.

Materials

Materials used were a low-fidelity driving simulator (PlayStation steering wheel and pedals), a voice recorder, two laptops (one for the surveys given at the beginning and the end of the experiment, and one for the alert notifying the participant of a new text message), a fan, a flat screen TV, and an Android touch screen phone. An app was also used to generate “messages” and send them to participants.

Results

Participants were asked to rate the perceived risk associated with texting and driving both before (M = 4.48, SD = .61) and after (M = 4.54, SD = .83) completing the experiments. The results show that the ratings of perceived risk did not change (t (32) = -.403, p = .690). Figure 1 depicts the results broken down by gender. The results hint that women may have perceived the risk of texting and driving to be greater after participating in the experiment (M = 4.5 versus M = 4.63), whereas males may perceive it to be lower (M = 4.44 versus M = 4.33). Statistical analyses on the data were not performed due to the unequal representation of males (N = 9) and females (N = 24) in the study. A future study is planned to determine whether these results can be replicated. Data for self-reported accidents reveal that women reported more accidents than men (women = .29, men = 0.0), but there were no differences in the number of self-reported traffic citations (F = .21 versus M = .22).
A one-way ANOVA was conducted in order to evaluate the effects of task on brake reaction time. A significant difference was found between brake reaction time for the drive-only condition (M = 1.5 SD = .57) and drive manual-texting condition (M = 1.73, SD = .48, t (32) = -2.279, p = .030). The drive only condition and drive while verbally texting (M = 1.65, SD = .46) conditions did not differ significantly (t (32) = -1.56, p = .128). The manual texting and verbal texting conditions did not differ (t (32) = -1.28, p = .208).

![Figure 2. Brake reaction time by driving condition.](image)

Correlation tests were performed between age and brake reaction times separately for each of the conditions. None of the correlations were significant. The results could possibly be due to the limited age range of the participants (age range = 18 - 29 yrs., M = 21.3, SD = 3.38).

**Discussion**

The purpose of this study was to investigate whether gender and age moderate the effects of secondary task distraction on driving performance. Studying gender and the types of distractions that complicate driving is important because it could change the way people view the dangers of distracted driving. Although society is well aware of the risk associated with distracted driving, individuals still convince themselves that they are always in control. Knowing how gender and age moderate the effects of distraction is important for informing training programs and public policy, and reducing the number of fatalities and car accidents. Distracted driving is dangerous and should be handled as such. This study could help advocate for stricter distracted driving laws. Driving laws against texting and driving have been proven to reduce accidents significantly.

The results of the study suggest that participants may respond more slowly (particularly in the manual response condition in relation to the drive only condition; interestingly, the results also offer some evidence that women were slower than men by 200 milliseconds). Future research should investigate whether this is the case. Mean reaction times for women were longer in the two texting conditions (i.e., manual and verbally responding) compared to men. A reason for these results could be the way participants were recruited.

Interestingly, it was found that men reported a higher number of accidents whereas women reported a higher number of citations. The former result is consistent with accident data, which indicate that men have more accidents than women (Evans, 2004). These results suggest that it does not necessarily follow that individuals with a higher number of citations will also have more accidents.

It is not clear how to interpret the data on risk perception. The means for this comparison show that women perceived a higher risk before the conditions and an even higher risk after the conditions. Interestingly men perceived a lower risk than women before the conditions and an even lower risk than their initial perception after the conditions. More conclusive evidence of gender differences in risk perception is required from further investigation.

**Limitations**

There are a number of limitations to this study. Due to the unequal number of male and female participants, researchers could not test the effects of gender. The gender difference may reflect a growing imbalance in the representation of males and females majoring in psychology. Our participants were recruited using the Wichita State University SONA system, which allows psychology students to sign up for studies. A majority of the psychology student population is female. The study could be improved by recruiting equal numbers of males and females.

Unexpectedly, we found that the text application being used for the experiment had a different type of
touch keyboard than any of the participants currently use. This could be the cause of their inability to respond quickly and efficiently to the text messages. Having a variety of phones for the participants to choose from could allow for more accurate results. Also, the driving simulator was more sensitive compared to a normal vehicle.

**Conclusion**

In conclusion, there are many different factors that contribute to distracted driving. Factors, such as environment, age and gender can play a role in how dangerous it is for an individual to text and drive. Acts that seem normal to individuals can actually be putting them in hazardous situations without the driver even realizing it.

Texting and driving is a very dangerous act. Unfortunately, it will never cease to exist. There is no way to completely eliminate this behavior. No matter the amount of upgrades to texting technology, it will never be as safe as society would like. Therefore, the amount of fatalities may decrease with new technology, but deaths will still occur. The purpose of this experiment was to investigate how gender and age impact reaction time while texting and driving. This is important because it will help keep individuals aware of the risk associated with texting and driving.

**References**


