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THE EFFECTS OF CELL PHONE AND TEXT MESSAGE CONVERSATIONS ON SIMULATED STREET CROSSING

BY

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THESIS

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A fully immersive, high fidelity street crossing simulator was used to examine the effects of texting on pedestrian street crossing performance. Research suggests that street crossing performance is impaired when pedestrians engage in cell phone conversations. Less is known about the impact of texting on street crossing performance. Thirty-two young adults completed three distraction conditions in a simulated street crossing task: no distraction, phone conversation, and texting. A hands-free headset and a mounted tablet were used to conduct the phone and texting conversations, respectively. Participants moved through the virtual environment via a manual treadmill, allowing them to select crossing gaps and change their gait. During the phone conversation and texting conditions, participants had fewer successful crossings and took longer to initiate crossing. Furthermore, in the texting condition, lower percentage of head orientation toward the tablet, fewer number of head orientations toward the tablet, and greater percentage of total characters typed before initiating crossing predicted greater crossing success. Our results suggest that 1) texting is as unsafe as phone conversations for street crossing performance, and 2) when subjects completed most of the texting task before initiating crossing they were more likely to make it safely across the street. Sending and receiving text messages negatively impact a range of real-world behaviors. These results may inform both personal and policy decisions.
To my family, for their unconditional love and support
ACKNOWLEDGMENTS

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CHAPTER 1

INTRODUCTION

Recent years have witnessed a proliferation in mobile technology. In 2013, 97% of American adults under 35 were using cell phones (Rainie, 2013). Beyond making calls, these devices offer the ability to perform a range of tasks including sending text messages, checking email, and playing video games.

This growth in mobile technology has increased the extent to which our collective attention is regularly divided between our phones and other tasks, such as driving or walking. At any given moment, nearly 700,000 drivers are distracted by a secondary task, such as a phone or text conversation (Pickrell & Ye, 2009). In 2011, 68% of American adults reported recently holding a phone conversation and 31% reported sending or reading text or email messages while driving. Multitasking in the vehicle has a negative impact on both driving performance (e.g., Horrey & Wickens, 2006; Caird et al., 2008) and secondary task performance (Becic et al., 2010; He et al., 2014). Evidence suggests that texting while driving may be even more dangerous. On-road and simulator studies have shown an increase in crash likelihood while texting, in addition to delayed response times and impaired lane keeping, relative to driving undistracted (Drews, Yazdani, Godfrey, Cooper, & Strayer, 2009; Owens et al., 2011). Importantly, naturalistic driving data also show inflated crash risk when young adult drivers are texting (NHTSA, 2013).

The cost associated with texting is theorized to result from a combination of factors. Texting physically diverts a drivers eyes from the road, increasing the chance of missing critical information. Texting drivers spend 400% more time looking away from the driving scene compared to undistracted drivers (Hosking, Young, & Regan, 2009). Importantly, texting also imposes a significant cognitive demand that diverts a subset of the drivers attention away from driving, similar to a cell phone conversation (Yager, Cooper, & Chrysler, 2012).

The prevalence and impact of distraction is not limited to driving. Research has consistently
shown the dual-task cost on walking while conducting a secondary task (Kemper, Herman, & Lian, 2003; Lindenberger, Marsiske, & Baltes, 2000). Distraction-related pedestrian injuries represent a significant public health issue. In 2009, approximately 16,000 pedestrian injuries required hospital room visits (NHTSA, 2009). Preliminary observational data suggest that the number of distraction-related pedestrian injuries is rising (Nasar et al., 2013). Recently, laboratory studies demonstrated the cost of conversing on a cell phone while crossing a busy simulated street. Using a high-fidelity street crossing simulator, Neider and colleagues (2010) showed that naturalistic cell phone conversations impair crossing performance and increase crash rates (see also Gaspar et al., 2014; Nagamatsu et al., 2011; Chaddock et al., 2011; Neider et al., 2011). Similarly, Stavrinos and colleagues (2009; 2011) demonstrated significant costs to simulated crossing performance while conversing on a cell phone.

Considerably less is known, however, about the impact of texting on pedestrian behavior. Schwebel and colleagues (2012) studied the effect of multimedia distraction, including texting, on pedestrian safety using a simulator. Participants stood in front of three computer monitors watching two-way traffic pass through a virtual crosswalk. Participants indicated by stepping off of a wooden curb the time selected to initiate crossing and then watched an avatar complete the crossing on the screens. They found that participants looked away from the screens of the crossing task more with the multimedia distraction conditions including texting. This led participants to select more crossing opportunities that may have resulted in a possible collision compared to undistracted participants.

The goal of the present study was to further examine the effect of reading and sending text messages on street crossing performance using a high-fidelity, immersive street crossing simulator. We compared the effects of naturalistic hands-free phone and text messaging conversations against a no distraction baseline. Whereas the simulator used by Schwebel and colleagues (2012) assumed a fixed crossing speed and a computerized avatar finished the street crossing, in the present study participants walked on a treadmill yoked to the immersive virtual environment to cross the street, allowing them to account for their individual gait when selecting gaps and to vary walking speed within the context of a crossing maneuver. This enabled participants to engage in both the street crossing task as well as the distractions throughout the three phases of the task.

Thus, we were able to examine the effect of distraction on pedestrian behaviors at each
stage of crossing (approach, preparation, crossing). Previous research has established the
sensitivity of this paradigm to detect dual task effects related to cell phone conversations, in-
cluding group differences such as age (Neider et al., 2011), falls risk (Nagamatsu et al., 2011),
athletic experience (Chaddock, Neider, Voss, Gaspar, & Kramer, 2011), fitness (Chaddock,
Neider, Lutz, Hillman, & Kramer, 2012), and action video game experience (Gaspar et al.,
2013). An additional benefit of the street crossing simulator is that stereo goggles provided
the impression of depth in the virtual environment, creating an immersive simulation and
allowing for a realistic assessment of distance and speed judgments.

We predicted that both cell phone conversations and text messaging would impair street
crossing relative to the no distraction condition. We predicted that these dual task costs
would manifest both in fewer successful crossings and impaired decision making, as measured
by slower decisions to initiate crossings. Furthermore, based on data comparing the effects of
cell phone conversations and texting on driving performance (e.g., Drews, Yazdini, Godfrey,
Cooper, & Strayer, 2009), we predicted that text messaging would result in larger dual task
impairments than hands-free conversations.
CHAPTER 2

METHODS

2.1 Participants

Thirty-seven young adults from the University of Illinois were recruited for the study. Five participants were excluded due to technical issues during the experiment. The final sample consisted of 32 participants (mean age = 22.28 (SD = 3.04), range: 18-30, 12 male). Participants provided written consent before the testing session and the procedure was approved by the Institutional Review Board of the University of Illinois, Urbana-Champaign.

2.2 Street Crossing Paradigm

The street crossing environment was developed in the virtual reality Cave Automatic Visual Environment (CAVE) at the University of Illinois (see Figure 1; http://www.isl.uiuc.edu/Labs/CAVE/CAVE.html). The CAVE consists of three screens measuring 303 cm wide by 273 cm high, on which images were projected. Participants walked on a Woodway "Curve" manual treadmill that was linked with the virtual environment. On each trial, the participant started from an alleyway before a busy street, approached the roadway and crossed when deemed safe (see Figure 2). Each trial ended when the participant made it to the other side of the street, an oncoming car hit the participant, or the participant took longer than 90s to complete the trial. Participants were visually informed regarding crossing success or failure. All cars had a fixed velocity of 33 mph (14.75 m/s)), while the inter-vehicle distance varied between trials: either 75 or 90 m. Head position and orientation was measured with a Flock of Birds 6 DOF electromagnetic tracker (Ascension Technology Corporation). Further details of this paradigm can be found in previous work (Gaspar et al., 2013).
A within-subjects design compared the effects of three secondary task conditions. In the no distraction conditions, participants crossed the street undisttracted. This served as a baseline for street crossing performance. In the phone condition, participants crossed the street while engaging in a naturalistic conversation with a confederate research assistant using a hands-free headset. These conditions were replicated from previous studies using versions of the CAVE paradigm (Chaddock et al., 2011; Gaspar et al., 2013; Neider et al., 2010; 2011; Nagamatsu et al., 2011). In the novel texting condition, participants engaged in a naturalistic texting conversation with an experimenter on a tablet mounted to the side arm of the treadmill (see Figure 1). Participants were alerted to the receipt of a text message via an audible beep and a red block obscuring the text on the tablet. Messages were sent and received throughout all phases of the street crossing trials to replicate a naturalistic continuous exchange. The message remained obscured until the participant touched the screen, after which a keyboard appeared allowing the participant to type and send a response to the experimenter. The initial conversation prompts (e.g., What classes are you taking?, Have you seen any movies lately?, Where is your home town?) for both the phone and texting conversations were taken from previous studies (i.e. Neider et al., 2010; 2011). During both distraction conditions participants were asked to complete the street crossing task while engaging in a conversation via phone or text with the experimenter. Participants were not provided any further information on how they should complete the distraction trials.

Participants completed 60 trials in blocks of 10 trials, and were allowed to rest between blocks. Two blocks were assigned to each condition and the order of blocks was counterbalanced across participants. A total of 7 trials, across all participants and conditions, were discontinued because the participant took longer than 90s to complete the trial. These time out trials were excluded from analyses.

Participants were trained on the tasks in a three-step process. First, participants typed ten pre-defined sentences on the texting interface while standing on the unmoving sides of the treadmill. Participants then used the treadmill to propel themselves through a virtual forest to acclimate to the manual treadmill. Finally, each participant completed eight practice trials of the street crossing task. Data from the typing phase of this training were used to calculate a baseline typing speed for each participant.
2.3 Crossing Data Processing

Trials were divided into three sections based on location in the virtual world: approaching the street from the alleyway (approach), at the curb prior to initiating crossing (preparation), and crossing the street until successfully reaching the other side (crossing). Motion of the participant throughout the trial, restricted to one dimension, was recorded and time-stamped. The intertrial period after the current trial ended and during which the new trial loaded was excluded from all analyses.

Several variables of interest were derived from the street crossing trials and averaged across distraction conditions. Success was defined as percentage of trials where the participant made it across the street without collision. Preparation duration was defined as the length of time the participant stood at the curb before entering the street on successful trials. Average approach, preparation, and crossing durations, defined as the total time within each segment of the trial, were examined for successful trials across the three distraction conditions. Additionally, time to contact (TTC) was defined as the distance between the participant and oncoming vehicle, measured from the front bumper, divided by the speed of the oncoming vehicle. TTC enter was calculated for the car approaching from the left as the participant entered lane 1. TTC exit was calculated for the car approaching from the right as the participant exited lane 2.

2.4 Texting Data Processing

The primary variables used to assess texting behaviors and performance included the percentage of time the head was oriented toward the tablet, the number of times the head was oriented toward the tablet, as well as the percentage of characters typed. To determine when participants were looking forward versus at the texting display, head orientation data were exported in azimuth-elevation form at every frame (Metz & Rauch, 2009). An equal solid angle square below the equator (outlined in red) was defined as the region of head orientations in the direction of the texting display. The angular size of the region (50 degrees in azimuth by 35 degrees in elevation) was fixed across all subjects. This region was manually assigned for each participant by identifying a cluster of head position points below eye level and independently checked by two experimenters (see Figure 3). The box location varied
between participants with participant height and head movements. Using these designated regions, each frame was classified as head oriented toward the tablet or head oriented away from the tablet (see Figure 4).

Figure 1. Photograph of virtual environment where the participants head was oriented away from the tablet (left) and toward the tablet (right).
Figure 2. Street crossing paradigm and outcome variables.

Figure 3. Sample head position data from one texting trial. Head positions within the red box are categorized as looking away from the street.
Figure 4. Sample data of head orientation from one texting trial.
CHAPTER 3

RESULTS

Crossing performance was analyzed using repeated measures ANOVAs with distraction condition (no distraction, phone distraction, or texting distraction) as a within-subjects factor. Consistent with previous studies (e.g. Neider et al., 2011), we also analyzed performance differences between the two intervehicle distances (IVD; 75 and 90 m). Although the shorter IVD resulted in lower success rates overall, we found no interactions of IVD with distraction condition; subsequently, for all of the following analyses, values were collapsed across IVD. Crossing measures are presented in Table 1.

3.1 Crossing Performance

3.1.1 Success

There was no main effect of distraction on the success rate of crossing, $F(2,62) = 1.91, p = .16, \eta^2_p = .06$.

Table 1. Crossing Performance Measures.

<table>
<thead>
<tr>
<th></th>
<th>Approach duration (s)</th>
<th>Preparation duration (s)</th>
<th>Crossing duration (s)</th>
<th>Success rate (%)</th>
<th>TTC enter (s)</th>
<th>TTC exit (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No distraction</td>
<td>4.63 (1.32)</td>
<td>6.66 (3.70)</td>
<td>5.12 (.59)</td>
<td>82 (10)</td>
<td>4.16 (.29)</td>
<td>1.44 (.32)</td>
</tr>
<tr>
<td>Phone</td>
<td>5.30 (1.12)</td>
<td>9.79 (6.91)</td>
<td>5.25 (.76)</td>
<td>78 (16)</td>
<td>4.15 (.28)</td>
<td>1.26 (.27)</td>
</tr>
<tr>
<td>Texting</td>
<td>8.97 (3.91)</td>
<td>13.53 (8.18)</td>
<td>5.27 (.69)</td>
<td>78 (16)</td>
<td>4.11 (.27)</td>
<td>1.32 (.30)</td>
</tr>
</tbody>
</table>

Note: Mean (SD) values.
3.1.2 Approach duration

There was a main effect of distraction on approach duration \((F(2,62) = 35.24, p < .001, \eta_p^2 = .53)\). Planned pairwise comparisons indicated that pedestrians approached fastest in the no distraction condition, followed by the phone condition and the texting condition. All conditions were significantly different from each other \((p's < .01)\).

3.1.3 Preparation duration

There was also a main effect of distraction on preparation duration \((F(2,62) = 19.11, p < .001, \eta_p^2 = .38)\). Again, pairwise comparisons indicated that pedestrians spent the least amount of time at the curb in the no distraction condition, followed by the phone condition and then by the texting condition. All conditions were significantly different from each other \((p's < .01)\).

3.1.4 Crossing duration

There was no effect of distraction on crossing duration \((F(2,62) = 1.72, p = .19, \eta_p^2 = .05)\).

3.1.5 Time to Contact (TTC)

There was no main effect of distraction on TTC enter \((F(2,62) = .90, p = .41, \eta_p^2 = .03)\); however, there was a main effect of distraction on TTC exit, \(F(2,62) = 5.90, p < .05, \eta_p^2 = .16\). Pairwise comparisons indicated that TTC at exit was greater in the no distraction condition than the phone or texting conditions \((p's < .05)\); however, TTC was equivalent in both the phone and the texting conditions \((p = .27)\).
3.2 Texting Behaviors

Three descriptive variables were extracted from the texting data: percentage of total trial time the head was oriented toward the tablet, number of times the head was oriented toward the tablet, and percentage of total characters typed. These variables were calculated by averaging performance in only successful trials as with previous studies and were divided into approach, preparation, and crossing periods (see Table 2). The percentage of time the head was oriented toward the tablet was significantly different across all three distraction conditions ($F(2, 62) = 271.37, p < .0001$). There was a significant greater percentage of time oriented toward the tablet during the texting condition compared with both the phone ($p < .0001$) and no distraction conditions ($p < .0001$).

3.2.1 Relation between texting and crossing performance

To determine whether engagement in certain components of the texting task predicted crossing success rates, hierarchical linear regressions were performed with crossing success rate as the outcome variable and texting behaviors (percentage of time the head was oriented toward the tablet, number of times the head was oriented toward the tablet, and percentage of total characters typed) as predictors while controlling for baseline texting ability. Separate regressions were performed using texting behaviors from the approach, preparation, and crossing periods (see Table 3).

The preparation and crossing models reached significance in predicting crossing success. During the preparation period, the number of head orientations toward the tablet, percentage

---

Table 2. Texting Measures.

<table>
<thead>
<tr>
<th></th>
<th>Approach</th>
<th>Preparation</th>
<th>Crossing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of head</td>
<td>.86 (.51)</td>
<td>.71 (.39)</td>
<td>.67 (.40)</td>
</tr>
<tr>
<td>orientations to tablet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of total characters</td>
<td>31.57 (18.29)</td>
<td>43.94 (24.57)</td>
<td>5.22 (11.02)</td>
</tr>
<tr>
<td>% of time the head was oriented toward the tablet</td>
<td>38.67 (.18)</td>
<td>28.27 (.16)</td>
<td>17.42 (.18)</td>
</tr>
</tbody>
</table>

Note. Mean (SD) values.
of total characters typed, and percentage of time with head orientated toward the tablet each significantly contributed to the model. No individual variables of interest in the crossing model significantly contributed to the model.
Table 3. Hierarchical linear regression models.

<table>
<thead>
<tr>
<th>Phase of Trial</th>
<th>Approach Phase 1</th>
<th>Preparation Phase 1</th>
<th>Crossing Phase 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>p</td>
</tr>
<tr>
<td>Constant</td>
<td>1.052</td>
<td>.239</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>(.564, 1.539)</td>
<td>(.564, 1.539)</td>
<td>(.564, 1.539)</td>
</tr>
<tr>
<td>Baseline typing</td>
<td>-.009</td>
<td>.008</td>
<td>-.197</td>
</tr>
<tr>
<td>ability</td>
<td>(-.026, .008)</td>
<td>(-.026, .008)</td>
<td>(-.026, .008)</td>
</tr>
<tr>
<td>Step 2</td>
<td>Constant</td>
<td>1.011</td>
<td>.247</td>
</tr>
<tr>
<td></td>
<td>(.505, 1.517)</td>
<td>(.488, 1.403)</td>
<td>(.695, 1.487)</td>
</tr>
<tr>
<td>Baseline typing</td>
<td>-.008</td>
<td>.009</td>
<td>-.175</td>
</tr>
<tr>
<td>ability</td>
<td>(-.026, .010)</td>
<td>(-.019, .012)</td>
<td>(-.019, .012)</td>
</tr>
<tr>
<td>Number of head</td>
<td>-.037</td>
<td>.071</td>
<td>-.118</td>
</tr>
<tr>
<td>orientations to</td>
<td>(-.182, .107)</td>
<td>(.488, 1.403)</td>
<td>(-.358, .028)</td>
</tr>
<tr>
<td>tablet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% characters</td>
<td>.003</td>
<td>.002</td>
<td>.294</td>
</tr>
<tr>
<td></td>
<td>(.001, .007)</td>
<td>(.003, .012)</td>
<td>(.003, .012)</td>
</tr>
<tr>
<td>% time head</td>
<td>-.099</td>
<td>.203</td>
<td>-.108</td>
</tr>
<tr>
<td>tablet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Approach phase step 1: $\Delta R^2 = .039$, $p = .279$, step 2: $\Delta R^2 = .057$, $p = .639$; Preparation phase step 1: $\Delta R^2 = .039$, $p = .279$, step 2: $\Delta R^2 = .323$, $p = .010$; Crossing phase step 1: $\Delta R^2 = .039$, $p = .279$, step 2: $\Delta R^2 = .475$, $p = .000$. 

- $\delta R^2$: Change in R-squared.
- SE: Standard error.
- p: Statistical significance level.
Mobile technology provides the potential for distraction in everyday activities like driving or crossing a busy street. While the effects of distracted driving have been extensively observed (Drews, Yazdani, Godfrey, Cooper, & Strayer, 2009; NHTSA, 2013; Owens et al., 2011), the implications of distraction on pedestrian behaviors are less studied. Several simulator studies examining the effects of phone conversations on pedestrian behaviors have shown the negative implications of conversation on street crossing performance. A previous street crossing simulator study found a negative effect of texting on gap acceptance decisions (Schwebel et al., 2012). The present study replicated and extended these results by examining the distraction potential of texting in a highly immersive street crossing simulator and by comparing texting to no distraction and phone conversation conditions.

First, we compared crossing performance under no distraction, hands free phone conversation, and texting conditions. Previous simulator studies have established the negative impact of phone conversations on crossing performance compared with no distraction in a number of groups, including children (Chaddock et al., 2011), young adults (Gaspar et al., 2014; Neider et al., 2010), and older adults (Nagamatsu et al., 2011; Neider et al., 2011). Despite trends in the expected direction, no significant differences were observed in success rates as a function of distraction condition. However, participants did make riskier crossing choices in both the phone conversation and texting conditions compared with no distraction. Shorter TTC upon exiting the road in the phone and texting conditions suggests impaired planning and greater risk in evaluating the second lane traffic while distracted.

Furthermore, as expected, participants took significantly longer to initiate crossings (i.e., longer preparation durations) in the phone and texting conditions compared to the no distraction condition. The preparation period is a critical component of the street crossing task. Pedestrians need to assess traffic and initiate appropriate decisions about when to begin crossing. Previous research demonstrated that decision making during this prepara-
tion state was particularly sensitive to cognitive distraction from cell phones (Gaspar et al.,
2011; Neider et al., 2010; 2011). The present results extend these findings by showing that
texting has a similarly detrimental effect on decision making prior to crossing. Importantly,
TTC enter did not differ significantly across the conditions, suggesting that participants were
not simply becoming more conservative with their crossing decisions in either the phone or
texting condition. Instead, this suggests that the main cost associated with distraction is
to decision making prior to executing a crossing. Furthermore, the lack of a dual-task cost
to crossing duration in either the phone or texting conditions suggests that these secondary
tasks affected crossing performance primarily by impairing decision making, not necessarily
by disrupting gait.

The cost to decision making and planning was significantly greater in the texting condi-
tion than in the phone condition. In addition to diverting cognitive resources similarly to a
conversation, texting required participants to physically divert their gaze from the crossing
scene. This is evident in the percentage of time participants oriented their heads toward
the tablet. More head orientations toward the tablet likely reduced situational awareness,
thereby increasing decision making difficulty. Indeed, research from the driver distraction
literature suggests that texting is associated with significant eyes-off-road time, resulting in
increased distraction potential relative to cell phone conversations (NHTSA, 2013).

To further explore the relationship between texting and crossing, we assessed the relation-
ship between texting behaviors during each period of the crossing task and crossing success.
Texting behavior in the preparation and crossing phases significantly predicted crossing suc-
cess. During each phase of crossing participants behaviors were vastly varied (e.g., walking
or standing still, not yet able to see traffic or looking side to side, etc.). For this reason,
comparison of individual variables between phases may not be wholly indicative of behavior.
That is why, in lieu of examining each variable individually, we created overall models for
each phase of crossing to facilitate some understanding of how texting distracts from pedes-
trian behaviors. The preparation and crossing models both significantly predicted crossing
success. The results indicate that more time taken to prepare to cross the street positively
predicted success.

These data have important theoretical and practical implications. From a theoretical per-
pective, the data suggest that, in addition to the cognitive cost associated with a conversa-
tion, diverting the participants eyes might further reduce situational awareness and impair decision making. From a practical standpoint, these data speak to the distraction potential of texting relative to undistracted crossing as well as a well-studied comparison task, talking on a cell phone. Just as previous studies have demonstrated an additional cost to driving performance of conversing on a cell phone, the present results indicate that texting may produce larger dual-task costs to decision making than conversing alone. Indeed, the present study also shows that when participants were heavily engaged in the texting task (i.e., typing more characters and spending more time with their head oriented toward the tablet), they were more likely to be involved in a collision during crossing. The results suggest that, much like texting and driving, regulation of distracting behaviors might be considered in other real-world tasks.

The present study had several strengths. The fully immersive environment maximized how realistic the simulation could be without endangering participants. Additionally, the use of a manual treadmill allowed participants not only to choose the precise moment to initiate crossing, but also the speed at which to cross both lanes. The main limitation of this design was in the hardware for the texting paradigm. Texts were sent and received on a mounted tablet in place of a fully handheld device. This replacement was necessary for safety while on the treadmill; however, it did fall short of exactly replicating the manner in which participants generally conduct texting conversations. The low mounting of the tablet also forced participants gaze further from the road, potentially limiting the use of peripheral vision to complete the crossing task. Another limitation of the study was the highly educated student sample. By using university students, the present sample may not be truly representative of the average multitasking pedestrian. Future studies should attempt to use a handheld texting device as well as a voice-activated texting condition to compare to current knowledge of texting as a distraction.
REFERENCES


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