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Pedestrians, vehicles, and cell phones

Mark B. Neider*, Jason S. McCarley, James A. Crowell, Henry Kaczmarski, Arthur F. Kramer

Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, 405 N. Mathews Avenue, Urbana, IL 61801, USA

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ABSTRACT

With cellular phones and portable music players becoming a staple in everyday life, questions have arisen regarding the attentional deficits that might occur when such devices are used while performing other tasks. Here, we used a street-crossing task in an immersive virtual environment to test how this sort of divided attention affects pedestrian behavior when crossing a busy street. Thirty-six participants navigated through a series of unsigned intersections by walking on a manual treadmill in a virtual environment. While crossing, participants were undistracted, engaged in a hands free cell phone conversation, or listening to music on an iPod. Pedestrians were less likely to successfully cross the road when conversing on a cell phone than when listening to music, even though they took more time to initiate their crossing when conversing on a cell phone (∼1.5 s). This success rate difference was driven largely by failures to cross the road in the allotted trial time period (30 s), suggesting that when conversing on a cell phone pedestrians are less likely to recognize and act on crossing opportunities.

1. Introduction

During the course of day-to-day activity, we are often confronted with multiple concurrent tasks or environmental stimuli demanding attention. A number of classical studies, including those examining the effects of divided attention on memory (e.g., Sternberg, 1966), visual search (e.g., Shiffrin, 1975), and reaction time (e.g., Hick, 1952), have suggested that dividing attention amongst multiple concurrent stimuli or tasks generally compromises performance on the whole, suggesting attentional capacity limitations (e.g., Duncan, 1980; see Pashler, 1998, for a review). This is particularly relevant in today's extraordinarily complex world, where people cope not only with the distracting qualities of the environment, but also with the attentional demands imposed by technology. Indeed, when walking through a crowded urban area it is common to observe passers—by talking on cellular phones or listening to portable music devices. However, it is unclear what effect, if any, these potential distractions have on an individual's ability to perform other important tasks in parallel, such as crossing a street. Recent estimates have indicated that as of 2007 mobile phone usage has grown to over 255 million subscribers in the United States (CTIA, 2008). With over 61,000 pedestrian–motor vehicle accidents that occur annually (NHTSA, 2006), it is not particularly surprising that questions concerning the possible effects of distraction on pedestrian behavior have arisen.

Field studies examining the effect of cell phone use on street-crossing behavior have observed that pedestrians cross more slowly when conversing on a cell phone, are less likely to look at traffic before entering the roadway, and make more unsafe crossings compared to non-distracted pedestrians (e.g., Hatfield and Murphy, 2007; Nasar et al., 2008). However, to date no systematic experimental studies have been conducted to investigate the impact of distraction on pedestrian crossing behavior. An experimental study by Simpson et al. (2003) used virtual reality to simulate a road-crossing task, allowing for experimental manipulation of previously uncontrolled environmental factors (e.g., car speed and traffic density). However, performance under conditions of distraction, such as when conversing on a cell phone or when listening to music, was not examined (also see, Schwebel et al., 2008, for similar work with children, and Schwebel et al., 2009, for similar work examining individual personality differences and crossing behavior). Other virtual reality studies, such as those examining crossing behavior when riding a bicycle, have primarily focused on children and have also not considered the effects distraction (e.g., Plumert et al., 2007).

Our goal was to experimentally examine the effects of distraction on pedestrian crossing behavior. To do this we modeled a street intersection in a virtual environment. The use of virtual reality allowed us to maintain control over all properties of the environment, including the number of traffic lanes, traffic density, and car speed, while maintaining realism. The use of experimental manipulation in our study represents an extension of the extant observation-based literature, allowing us to compare behavior under a variety of task demands while maintaining road and traffic conditions. To mimic real-world task demands, participants

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* Corresponding author. Tel.: +1 217 244 9252.
E-mail address: mneider@illinois.edu (M.B. Neider).

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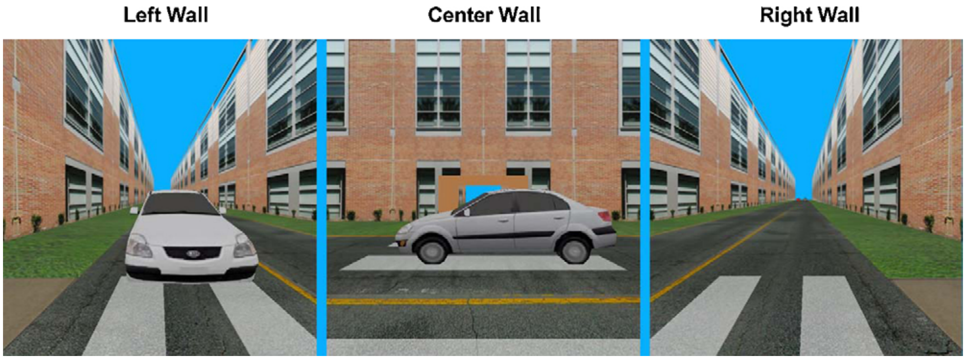

Fig. 1. A sample image from the virtual reality street-crossing task. Note that the image presented here was created from still captures of the three separate images projected on the three walls (left, center and right) of the Beckman virtual reality CAVE. Although the image appears to show a "U" shaped road, when projected on the walls of the CAVE the road appeared seamlessly to run straight, and perpendicular to the participant. During the experiment vehicles were always moving. Liquid crystal shutter goggles were worn by the participants to create the feeling of depth and immersion.

were required to locomote through the environment by walking on a treadmill. Under single-task control conditions, participants performed the street-crossing task without distraction. Dual-task conditions imposed distraction by having participants perform the street-crossing task while either conversing on a cell phone or listening to music on an iPod. Given the results of traditional laboratory studies of divided attention (see Pashler, 1998, for a review), we might expect that street-crossing performance would be poorer when participants are conversing on a cell phone or listening to music as compared to when they are undistracted. However, it is also possible that cell phones and music may affect performance differently, as the former requires that participants produce and comprehend speech while the latter only requires passive listening (see Kubose et al., 2006, and Strayer and Johnston, 2001, for an examination of the effects of speech comprehension and production on driving behavior, and Hatfield and Chamberlain, 2008, for an investigation on the effects of passive listening on simulated driving).

2. Methods

2.1. Participants

Thirty-six students (19 female, 17 male; mean age = 21.75; range 18–30) from the University of Illinois participated. All participants had normal (20/20; full color vision), or corrected-to-normal vision, and were paid $8 per hour for their participation. Visual acuity was tested using a Snellen Chart and color vision was assessed using Ishihara plates.

2.2. Apparatus, stimuli, and design

The experiment was conducted in the Beckman Institute's virtual reality CAVE environment. The task on each trial was to safely cross an unsigned intersection while avoiding traffic (see Fig. 1). The street consisted of two lanes totaling 8 m in width. Car speed ranged from 40 to 55 mph and initial car spacing ranged from 45 to 90 m. Both car speed and initial car spacing were randomly selected at the start of each trial. Vehicle starting points were occluded by a building at the participants' starting point (an alleyway; additional detail provided under Section 2.3). Hence, the distance to the nearest vehicle (once the participant reached the roadway) was determined both by the speed of the vehicle and the time at which the participant reached the side of the road (see Fig. 2 for a simplified overhead schematic of the crossing environment). A car slowed to match the speed of the car in front of it if the distance between them was less than 15 m, and then maintained that speed for the duration of the trial; cars never increased their speed. The cars were in no way sensitive to the presence of the participants at any time during the experiment (i.e., speed did not change because participants were crossing the roadway). To cross the street participants simply had to walk on a LifeGear Walkease manual treadmill that was synced to the virtual reality environment. Since the treadmill was manual there was some friction to overcome when initiating walking (i.e., some additional energy was required to start the treadmill moving from a standstill and in this way the task did not perfectly reflect normal walking, which does not require as much effort to initiate), however, this friction was the same on every trial and for all subjects. To enable synchronization, eight magnets were placed

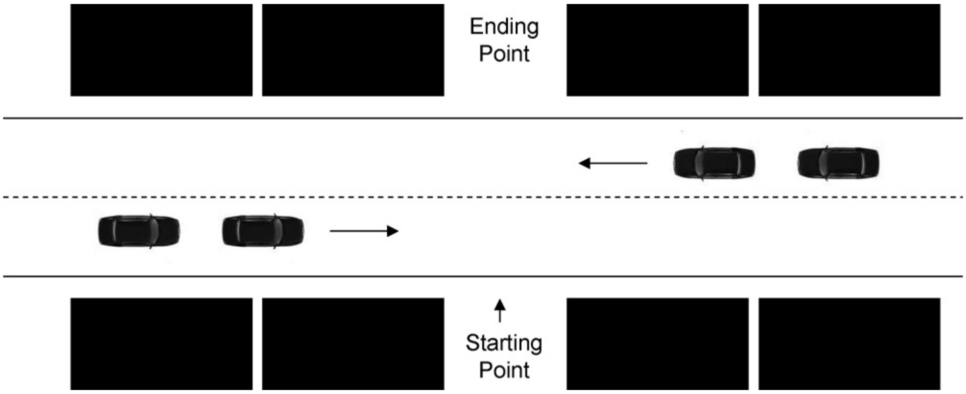

Fig. 2. An overhead schematic of the crossing environment. Note that in the actual experiment inter-vehicle distance varied. The large boxes on the sides of the road represent buildings, and the arrows in each lane represent the direction of traffic in that lane. A sidewalk was located between the buildings and the roadway. The arrow at the "Starting Point" location indicates the direction that the participants walked.

around the flywheel on the treadmill with each closing a switch on the frame as it passed by. The switch was wired to a PC parallel port. The experiment program advanced the point of view within the virtual environment by 2 cm. for each switch-closing event. Participants were required to hold on to the treadmill's handlebars at all times.

The virtual reality environment was composed of three viewing screens and a floor. Each screen measured 303 cm wide by 273 cm high (about 10 ft. × 9 ft.), with a screen resolution of 1024 × 768 pixels (frequency = 50 Hz/eye). When standing on the treadmill each participant was approximately 149 cm from each viewing screen (about 4.9 feet), creating a viewing angle of approximately $91^\circ \times 85^\circ$. Environment presentation, motion simulation, and data collection were integrated via a custom designed program written in house by the Illinois Simulation Laboratory using a combination of C++ and Python. Images were projected to the screens via a PC with an Intel Xeon Core 2 Quad CPU and 8 GB of RAM running on 64-bit Windows Server 2003 SP2. Graphics were handled by an nVidia Quadro Plex 1000 Model 2. Head position and orientation were monitored through an Ascension Flock of Birds 6DOF electromagnetic tracker. Head movements were quantified as movements of the head from 10° in one direction to at least 10° in the other direction. In order to create the virtual reality experience, participants wore a pair of wireless CrystalEyes liquid crystal shutter goggles. These goggles rapidly alternated the display to each eye, resulting in the impression of depth.

All participants performed the road-crossing task in three different distraction conditions: no distraction; listening to music through headphones on an iPod Nano; conversing on a cell phone using a hands free device. Before the experiment began, each participant selected a list of songs to listen to on the iPod from a menu of seven playlists representing different musical tastes (e.g., rock, jazz and classical). Conversations in the cell phone condition were conducted between the participant and a confederate. The confederate was instructed to keep the conversation flowing, and asked a number of open-ended questions (see Table 1). Questions were created that would appeal to a wide range of different people. If participants showed an interest in a particular line of questioning then related questions were used in following up and continuing the conversation. The distraction conditions were blocked and counterbalanced across 96 experimental trials (two blocks of 16 trials for each distraction condition; six total blocks per participant). Block order was counterbalanced such that each block and distraction type was presented an equal number of times in each presentation position (e.g., 1st, 2nd,. . ., 6th) an equal number of times across all participants. Each subject received 10 practice trials prior to the experiment to acclimate to the treadmill and virtual reality environment.

Table 1
Sample topics and questions used for the cell phone distraction condition.

Classes
  What were your favorite classes?
  Which classes have you liked least?
  What classes are you taking next semester?

Major
  Did you come to college knowing your major?
  What are you future career plans?

Job
  What kinds of jobs have you had?
  What has been your favorite job?

Movies
  Have you seen any movies recently?
  What are your favorite moves?
  Who was in it?

Hometown
  Where is your home town?
  Which High School did you go to?
  What activities did you participate in during High School?

Music
  What is your favorite type of music?
  What is your favorite band?

Books
  Have you read any books recently?
  What are your favorite books?
  What was the book about?

2.3. Procedure

The participant began each trial in an alleyway between two buildings. The participant was instructed to walk forward until the entire street became visible, at which point her task was to cross (or not cross) the street in whatever manner she saw fit (although subjects were encouraged not to run). An experimenter was present with the participant in the room throughout the course of the experiment. On the rare occasion that a participant exhibited a desire to run they were reminded by an experimenter that they should walk. Once entering the street, there was no safe zone where a participant could wait for cars to pass. After crossing the street, the participant walked into another alleyway and through a gate, at which point the next trial began. If the participant was struck by a motor vehicle, visual feedback was given indicating so; if the participant crossed the street successfully auditory feedback was given indicating success. If the participant did not complete a trial within 30 s, the trial was ended and counted as an error.

3. Results

All measures were submitted to a repeated measure ANOVA. In cases where the omnibus ANOVA was significant, post hoc comparisons were performed to evaluate differences between the three distraction conditions. To control for family-wise error, all post hoc comparisons were evaluated using a conservative Bonferroni corrected alpha of $p < 0.0167$. Due to the tendency of measures of success rate to violate the statistical assumption of normality, all success rate data were submitted to a logarithmic transformation prior to statistical analysis. For ease of reading, we discuss these data in their untransformed form. All other data were analyzed and are presented in their original form.

3.1. Crossing success rate

Is the likelihood of safely crossing a street influenced by the number or types of tasks a pedestrian is concurrently engaged in? To answer this question we analyzed the percentage of trials in which observers successfully crossed the road (Table 2). If

Table 2
Mean overall trial duration (s), crossing success rates, collision rates, and rate of errors from time outs.

	Trial duration	Success rate	Collision rate	Time out rate
No distraction	11.73 (0.62)	83.85 (1.81)	14.49 (1.73)	1.65 (0.47)
Cell phone	13.27 (0.52)	80.20 (2.32)	15.45 (2.03)	4.34 (1.01)
iPOD	11.47 (0.57)	84.98 (1.83)	13.67 (1.60)	1.65 (0.56)

Note: Values in parentheses indicate one standard error of the mean.

Table 3
Measures of behavior during initiation and crossing: mean initiation duration (s), head turns during initiation, distance to nearest vehicle at start of crossing (m), mean crossing duration (s), head turns during crossing, and distance to nearest vehicle at end of crossing (m).

	Measures during initiation			Measures during crossing		
	Initiation duration	Head turns	Vehicle distance	Crossing duration	Head turns	Vehicle distance
No distraction	8.77 (0.60)	1.10 (0.11)	58.78 (0.93)	2.66 (0.10)	0.53 (0.06)	20.27 (0.84)
Cell phone	10.34 (0.51)	0.99 (0.18)	58.82 (0.94)	2.78 (0.11)	0.60 (.06)	19.67 (0.74)
iPOD	8.55 (0.54)	1.14 (0.13)	58.46 (1.05)	2.66 (0.10)	0.55 (0.06)	20.14 (0.80)

Note: Values in parentheses indicate one standard error of the mean.

listening to music or conversing on a cell phone impaired performance then we would expect success rates in those conditions to be lower than in the no distraction condition. An ANOVA performed with distraction as a within-subjects factor partially confirmed this prediction, $F(2, 70) = 3.96$, $p < 0.05$, $\eta_p^2 = 0.1$. Participants crossed successfully approximately 84% of the time when undistracted and nearly 85% of the time when listening to music, compared to 80% of the time when talking on a cell phone; listening to music induced no performance cost relative to the no distraction condition ($p = 0.53$). Conversing on a cell phone produced significantly lower success rates than listening to music ($p < 0.01$). Participants trended towards poorer performance when conversing on a cell phone compared to the no distraction condition, but the post hoc comparison did not reach significance ($p = 0.09$).

3.2. *Collision rate versus time out rate*

Our analysis of success rates suggested that at least in some cases participants were less likely to successfully cross the street when conversing on a cell phone, however, it remains unclear why that decrease occurred. In our task there were two possible ways for a trial to culminate in a failure to cross. On one hand, participants could make an unsafe crossing that resulted in a collision with a vehicle. On the other hand, observers might simply fail to reach the opposite side of the road before the trail reached its timeout limit (30 s).

Both collision and time out rates are shown in Table 2. Interestingly, the rate at which participant–vehicle collisions occurred did not vary with distraction type, $F(2, 70) = 0.86$, $p = 0.43$, $\eta_p^2 = 0.02$; talking on a cell phone thus did not increase the likelihood that a participant would be involved in a collision with vehicle. Time out rates, however, did vary as a function of distraction, $F(2, 70) = 7.06$, $p < 0.005$, $\eta_p^2 = 0.92$. More specifically, participants were less likely to complete a crossing within the 30 s trial time period when conversing on a cell phone than when listening to music ($p < 0.005$) or undistracted ($p < 0.0167$). Participants were equally likely to fail to complete a trial within 30 s when listening to music or undistracted ($p = 1$).

3.3. *Overall trial duration*

Conversing on a cell phone decreased the likelihood of a participant successfully crossing the street in our street-crossing task, but what were the behavioral impairments that led to this decreased success rate? To begin unraveling this question we examined the overall time it took for participants to complete a trial (i.e., the total time to walk from one gate at the start of the trial, to another gate which ended the trial, including initiation and crossing time) in trials where the participant successfully crossed the road. Mean trial durations are shown in Table 2. Overall, we found a main effect of distraction type on overall trial duration, $F(2, 70) = 16.43$, $p < 0.001$, $\eta_p^2 = 0.32$. Listening to music produced similar trial durations as no distraction ($p = 0.29$), whereas conversing on the cell phone produced longer crossing times (~1.5 s) than listening to music ($p < 0.001$), or being undistracted ($p < 0.005$).

3.4. *Behavior while initiating a crossing*

To assess the behavioral components underlying the observed differences in overall trial time, we examined three measures during the crossing initiation period (i.e., when the participant was standing on the sidewalk prior to entering the roadway) in trials where the participant successfully crossed the road. The mean initiation time (i.e., amount of time the observer waited on the sidewalk before initiating a crossing as measured by a bounding region; does not include time taken when walking from the trial starting point to the side of the road), number of head turns during initiation, and nearest vehicle distance at the time of roadway entry are shown in Table 3. Analysis of varianced indicate a main effect of distraction condition on initiation time, $F(2, 70) = 16.52$, $p < 0.001$, $\eta_p^2 = 0.32$. As with previous measures, no statistical difference was observed between the music listening and no distraction conditions ($p = 0.38$). Direct comparisons of the cell phone condition to the music listening ($p < 0.001$), and no distraction ($p < 0.001$), conditions confirmed that more initiation time (~1.5 s) was taken when conversing on a cell phone than when listening to music or when undistracted.

No significant differences were observed across conditions in the mean number of head turns during initiation, $F(2, 70) = 1.47$, $p = 0.24$, $\eta_p^2 = 0.04$, or the distance to the nearest vehicle at roadway entry, $F(2, 70) = 0.26$, $p = 0.77$, $\eta_p^2 = 0.01$.

3.5. *Behavior while crossing*

Similar measures to those analyzed during preparation were also examined during crossing (Table 3). Specifically, we examined the mean crossing duration (only includes the time spent by participants in the roadway), number of head turns during crossing, and distance to the nearest vehicle at roadway exit in trials where the participant successfully crossed the road. The pattern of results was nearly identical to those observed during preparation. We observed a main effect of distraction on crossing duration, $F(2, 70) = 6.79$, $p < 0.005$, $\eta_p^2 = 0.16$. Participants took more time to cross the street (i.e., walked slower) when conversing on a cell phone compared to when listening to music ($p < 0.01$) or when undistracted ($p < 0.01$); comparison of the music listening to no distraction condition revealed no difference in crossing duration ($p = 0.79$).

We observed no significant differences in the mean number of head turns during crossing, $F(2, 70) = 0.99$, $p = 0.37$, $\eta_p^2 = 0.03$, or distance to nearest car at roadway exit measures, $F(2, 70) = 0.37$, $p = 0.69$, $\eta_p^2 = 0.01$.

3.6. *Split-half data*

Given the physically demanding nature of our street-crossing task, it might be reasonable to expect that participant fatigue affected performance. However, split-half analyses conducted on our data indicated that participants were as successful at crossing the road ($F(1, 35) = 1.68$, $p = 0.20$, $\eta_p^2 = 0.05$), and even faster at completing the task ($F(1, 35) = 21.09$, $p < 0.001$, $\eta_p^2 = 0.39$; distraction × experiment half interaction not significant $p = 0.55$), in the second half of trials than in the first. If fatigue was indeed affecting performance, we would have expected the opposite pattern of effects.

4. Discussion

Field studies (e.g., Hatfield and Murphy, 2007; Nasar et al., 2008) have observed that pedestrians make more unsafe street crossings when conversing on a cell phone than when undistracted. Our findings provide partial experimental confirmation of these observations. Participants were less likely to successfully cross the street in our task when they were conversing on a cell phone than when they were listening to music on an iPod. Furthermore, engaging in a cell phone conversation while crossing the street led to higher time out rates in our virtual street-crossing task than did listening to music or performing the task undistracted. Additionally, participants took more time to initiate a crossing when conversing on a cell phone, and walked more slowly during crossing. The last result is consistent with data from field studies of pedestrian street crossing that have observed slower walking during cell phone conversations (e.g., Hatfield and Murphy, 2007; Nasar et al., 2008).

The fact that our successful crossing rates were somewhat low (one would certainly hope that in the real-world pedestrians successfully cross the street more than 84% of the time) might suggest that our task was artificially difficult, and hence not representative of the real world. As noted, though, most of the failures to cross successfully were the result of the trial timing out, not the result of collision. The low rate of successful crossing therefore does not suggest that the simulated environment or task was unduly hazardous. Pilot data collected in preparation for the current study (identical task but with vehicles traveling at a constant speed and distance from each other), moreover, found similar effects of distraction even when the crossing task was substantially easier. In the pilot testing, parameters for car movement and density allowed participants to successfully cross the road 99% of the time in the no distraction and music listening conditions, success rates far higher than observed in the present study. Nonetheless, successful crossing rates declined in the cell phone condition, falling to 97% (differences not significant), resulting in a pattern of data that was somewhat similar to that which we report in the current study.

Our findings carry implications for the theoretical understanding of attention in an important everyday situation and for the application of that understanding to the domain of public safety. Although conversing on a cell phone did not increase the chance of a pedestrian–vehicle collision in our task, participants were less likely to complete the task within the 30 s time period when engaged in a cell phone conversation; time outs rarely occurred in the music and no distraction conditions. In cases where time outs occurred, participants spent the vast majority of the trial (∼25–28 s) standing on the sidewalk next to the road while waiting to initiate a crossing. Since traffic conditions were similar across all distraction conditions, the general increase in initiation time in successful trials, and the numerous failures to initiate at all in unsuccessful trials, suggests that participants might have been slower or less likely to recognize and act on safe crossing opportunities when they arose during cell phone conversations than when they arose during music listening or in the absence of distraction. An alternative possibility is that the increased initiation times during conversation were in fact a form of compensatory behavior, an effort by the participants to increase safety by adapting a more conservative criterion for judging a crossing opportunity as safe. Conversation may not have compromised processing, that is, but might have engendered more cautious behavior. Such an account, however, predicts that the distance from the participant to the nearest vehicle should have been larger under cell phone conditions than under other levels of distraction. In fact, the data showed no such effect. We therefore speculate that the differences in initiation times and time out rates we observed were the result of processing losses rather than overly cautious behavior. The processing compromises that we observed, moreover, are likely to be consequential outside of the laboratory. In our experimental task there were no real consequences if a participant did not complete a trial (other than having the trial count as an error), and so there was no great urgency when crossing the street. In the real world, pedestrians are often under time duress (e.g., rushing to work; late for an appointment), and *not* crossing a street is not an option. In these cases, any impairment in the ability of that pedestrian to recognize and act on safe crossing opportunities is likely to increase the chance of an unfavorable crossing outcome, including pedestrian–vehicle collisions.

How, more specifically, might cell phone distraction compromise cognitive performance? We speculatively interpret the pattern of increased initiation times as evidence of a diminished ability to process visual stimuli while conversing on a cell phone, a hypothesis consistent with earlier data. Eye movement analyses from previous studies examining change detection (McCarley et al., 2004) and driving (Strayer et al., 2003), for example, have suggested that conversation might interfere with the encoding of visual information into working memory. Such interference might demand that participants switch back and forth between conversing and visually scanning the traffic (perhaps during lulls in conversation), or alternatively, it might allow both tasks to occur in parallel but with a cost to the rate of visual information accumulation. In either case, poorer visual encoding would result.

A complementary account for our findings might be that the distraction arising from conversing on a cell phone impairs a pedestrian's ability to make accurate judgments of the time-to-contact (TTC) of oncoming traffic, which would in turn impact their ability to make safe road crossings (see, Hecht and Savelsbergh, 2004, for a review). TTC is considered to be the time it takes for a given moving object, in our case a motor vehicle, to reach a given point in space or observer (e.g., Schiff and Detwiler, 1979; Seward et al., 2006). Previous research has suggested that observers tend to make TTC judgments with a conservative bias, meaning that TTC is often underestimated (e.g., Bootsma and Craig, 2002; Heuer, 1993). It is certainly possible that this conservative bias is magnified when an observer is distracted, as is the case when conversing on a cell phone. Unfortunately, our experimental program did not log vehicle speed, making it impossible for us to calculate a direct TTC measure. Although a direct measure was not possible, we do speculate that any TTC differences that may have occurred in our study across distraction conditions were likely to be small. This speculation is based on the fact that the mean and standard deviation of vehicle speeds was the same in all three distraction conditions, and the fact that the mean distance to the nearest vehicle at crossing initiation did not differ across conditions ($M = \sim 58$ m in all conditions). None the less, given the importance of TTC measures in interpreting the quality of pedestrians' road-crossing judgments, the lack of a solid measure of TTC represents a limitation of the current design. Future studies will be designed examine this important issue directly. Additionally, it should be noted that an explanation citing a diminished ability to encode visual information during cell phone conversations, as we speculated to above, is likely to be compatible with any data indicating that TTC judgments differ as a function of distraction type. That is, if visual information is encoded poorly under certain distraction conditions then it is certainly conceivable that TTC judgments might be made either less accurately or less quickly.

Why did listening to music fail to degrade performance as much as conversing on a cell phone? While both speech production and comprehension during conversation have been shown to produce similar behavioral impairments during simulated driving (Kubose et al., 2006), studies examining more passive types of listening, such as listening to music on a radio while driving, have found few behavioral effects (Strayer and Johnston, 2001). Hence, it seems possible that the extent to which dividing attention affects performance might be directly related to the goals of the individual. Whereas a conversation might be considered relatively high priority in terms of current attentional demands, listening to music might be less important, and therefore more easily filtered from attentional processing. It is certainly possible that participants in our study simply considered music to be equivalent to ambient noise and engaged only in passive listening. Whereas the cell phone conversation required participants to listen and respond to questions, no content-related demands were placed on participants when listening to music, and hence they were free to tune out. It should be noted that our experiment was devoid of road noise. If such noise provides a cue for action then it is possible that listening to music might in fact hinder crossing performance when road noise is present. Future work will investigate these possibilities more directly by exploring different types of listening tasks (e.g., listening to an informational podcast for comprehension vs. listening to music passively) in increasingly realistic simulations.

In conclusion, the added task load associated with conversing on a cell phone does impact a pedestrian's ability to successfully navigate a street crossing compared to crossing when undistracted. Our experimental findings mirror observations from field studies that pedestrians tend to make more unsafe crossings when conversing on a cell phone (e.g., Hatfield and Murphy, 2007; Nasar et al., 2008). Although it is unclear at this point whether this impairment can manifest in increased pedestrian-automobile accidents, our data do suggest that there is at least a strong possibility that decision making processes, such as those associated with identifying and acting on safe crossing opportunities are impaired, perhaps due to a decrease in the pedestrians ability to encode visual information. Given the prominence of technological distractions now inherent to everyday living, our findings highlight the need for continued experimental research on the effects of these distractions on our ability to successfully and safely complete everyday tasks.

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