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Mobile telephones, distracted attention, and pedestrian safety

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Abstract

Driver distraction is a major cause of traffic accidents, with mobile telephones as a key source of distraction. In two studies, we examined distraction of pedestrians associated with mobile phone use. The first had 60 participants walk along a prescribed route, with half of them conversing on a mobile phone, and the other half holding the phone awaiting a potential call, which never came. Comparison of the performance of the groups in recalling objects planted along the route revealed that pedestrians conversing recalled fewer objects than did those not conversing. The second study had three observers record pedestrian behavior of mobile phone users, i-pod users, and pedestrians with neither one at three crosswalks. Mobile phone users crossed unsafely into oncoming traffic significantly more than did either of the other groups. For pedestrians as with drivers, cognitive distraction from mobile phone use reduces situation awareness, increases unsafe behavior, putting pedestrians at greater risk for accidents, and crime victimization.

Keywords: Distraction; i-Pod; Mobile telephones; Safety; Pedestrians; Situation awareness

1. Introduction

1.1. Prevalence of mobile phones

Americans carry mobile phones and conduct conversations on them just about anywhere (Sunderland, 1999). Mobile phone use has grown from 1% of the U.S. population in the mid-1980s to about 14.5% or 38 million subscribers in 1996 to 207 million U.S. users in 2005 (Cellular Telecommunications and Internet Association, 2005; Katz and Aspden, 1998).

1.2. Safety and distracted attention among drivers using mobile phones

The growth in mobile phone use has brought attention to safety associated with the technology. Some major concerns include radiation emission and distraction while driving. Because many drivers have a mobile phone and use it while driving—up to 974,000 at any moment during the day (Glassbrenner, 2005; Mussa and Upchurch, 1999), researchers have raised concerns about traffic accidents associated with mobile phone use while driving (Lamble et al., 1999; McKnight and McKnight, 1993; Violanti, 1997, 1998). There is evidence of increased distraction and motor vehicle collisions associated with mobile phone use (Redelmeier and Tibshirani, 1997; Strayer and Johnson, 2001). In addition, in spite of laws that ban handheld calls while driving while allowing hand free calling, it appears that driver distraction relates more to the difficulty and complexity of the conversation than whether it is a hands free or handheld unit (Patten et al., 2004). Studies of auditory distraction have produced contradictory results (cf. Hatfield and Murphy, 2007).

1.3. Mobile phone use and pedestrian safety

Our research dealt with a related aspect of mobile phone use and safety: pedestrian distraction associated with mobile phone conversation. It is not clear that walking safety will be similarly affected by phone conversation distraction, since walking represents more of a natural human behavior than driving. Although driving often becomes routine, perhaps the extra effort required to manage an automobile makes drivers more vulnera-

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ble to distracted attention. On the other hand, crossing a street also requires cognitive attention (cf. Hatfield and Murphy, 2007); and pedestrians, 4641 of whom were killed and 68,000 injured in traffic crashes in 2004 (NHTSA, 2006), are often at risk. Most such crashes occur when the pedestrian crosses the street (daSilva et al., 2003), and many seem to result from pedestrian inattentiveness (Bungum et al., 2005). Thus, for pedestrians using mobile phones, distracted attention may increase their risk of accidents. We conducted two studies related to this, one addressing distracted attention and the other addressing pedestrian street-crossing behavior.

2. Study 1: mobile phone use and object recall for pedestrians

2.1.1. Study aims

This study sought to find if pedestrians suffer distraction from conversation on mobile phones, which might reduce their situational awareness, making them less safe and more vulnerable to an accident.

2.1.2. Design

The study centered on a real pedestrian environment using one hand held mobile telephone in two experimental conditions. All participants walked a prescribed route, but half of them did so while having a telephone conversation on a mobile phone, and the other half simply held the mobile phone, awaiting a potential call, which never came.

2.1.3. Participants and sampling

Researchers stopped 60 passersby near the main pedestrian entrance to a large urban state land-grant university campus and asked them to participate in a test of mobile phone reception. Pedestrians walked through the area alone, in small groups, or among a larger number of independent pedestrians (such as might occur between classes). To avoid potential bias in the sample, a researcher approached most pedestrians walking alone and in small groups to request participation, occasionally bypassing a male or female to keep the sample balanced for gender. For sets of unaffiliated pedestrians, the research team used random numbers to select which person to approach, occasionally bypassing males or females to keep the sample balanced for gender. If the person agreed, he or she was assigned to either the conversation or the no conversation condition. To obtain 15 males and 15 females in each condition, the researchers assigned every second male to the "no conversation group" and did the same for females.

2.1.4. Mobile phone conditions

Each individual who agreed to participate received a mobile phone and the following instructions: "We're testing the performance of different cell phones from various buildings on campus. We'll hand you a phone and have you walk from here to there" (pointing to the other end of the walk about 100 yards away). Participants in the no conversation condition received instructions to, "hold the phone by your side and walk like normal; and if it rings, answer it. Otherwise don't worry about it. It rings loud." They did not receive a call or converse with anyone while they walked. They simply held the phone. Participants in the conversation condition received a call from a member of the research team once they had started walking. They spoke on the mobile phone with the caller while walking. The team member had a conversation script that required the participant to remember and comment on recent experiences. The script, shown in Table 1, had them recall such things as recent meals, favorite part of growing up, and recent movies. Investigators told all participants that their participation was voluntary; and obtained voluntary consent from them.

Table 1
Script for the conversation condition

"Hi, what's your name?" ___
"My name is . . . "
"What's your major?" ___
"Oh, my major is . . ."
"What did you have for breakfast?" ___
"I had toast, juice and coffee."
"What did you have for lunch?" ___
"That's interesting. I had a hamburger, fries and a soda."
"What was your favorite part about where you grew up?" ___
"Seen any good movies lately?" IF YES, "What did you like about that movie?"
"Do you have a favorite TV show?" IF YES, "What do you like about it?"
(If necessary, they asked similar questions about favorite book, song or group, city or place until they approach the end point).
"Thanks for participating in our study."

2.1.5. Situation awareness task

Prior to the study, five "out-of-place" objects had been planted along the route: three at eye level (a sign reading UNSAFE!, a boot, and a cup) and two at ground level (two pieces of fake vomit, and a chalk sketch of an Ostrich with its head in the ground). At the end of the walk, an interviewer apologized for the deception, explained that this was a study of people's recall, and obtained verbal informed consent to ask some questions about what they remembered seeing during the walk. All participants consented. The interviewer showed them five sets of four photographs. Each set had one planted object mixed with three deflector objects (see Fig. 1). The interviewer explained that all, some, or none of the objects might have been along the route, and asked the participant which if any they recalled seeing.

2.2. Results

The analysis revealed that pedestrians noticed significantly more objects in the no conversation condition (LS mean = 1.58, S.E. 1.28) than in the conversation condition (LS mean = 1.15, S.E. 1.26) ($F_{1,51}$ d.f. = 5.71, $p < 0.05$). The effect size was relatively small, at 0.11 (SS condition = 2.435, SS error = 21.754).

2.3. Conclusion

In agreement with the results of similar studies of mobile phone use among drivers (Patten et al., 2004; Redelmeier and Tibshirani, 1997; Strayer and Johnson, 2001), these findings suggest reduced situation awareness or recall associated with talking on a mobile phone among pedestrians. The findings also agree with studies of fixation or reduced visual scanning among drivers with a high workload (Harbluk and Noy, 2001). Would such reduced situation awareness generalize to increased unsafe behavior among pedestrians talking on a mobile phone? One study suggests that it does. It found unsafe behavior among pedestrians talking on mobile phones when crossing a street (Hatfield and Murphy, 2007). However, the authors of that study caution against generalizing the results beyond the three suburbs tested. In addition, that study did not try to establish if the unsafe behavior related to the active conversation on the mobile phone or generalizes to less demanding passive listening such as that on another widely used technology—the i-pod. In response to three i-pod using pedestrians who were killed by passing cars, New York Senator Carl Kruger introduced a bill aimed at "iPod oblivion." It would become a crime to "enter and cross a crosswalk while engaging in the use of an electronic device in a city with a population of one million or more" (Zeller, 2007). The senator called it a threat to the public safety. In six months, three pedestrians had been killed, and another seriously injured while crossing listening to music.

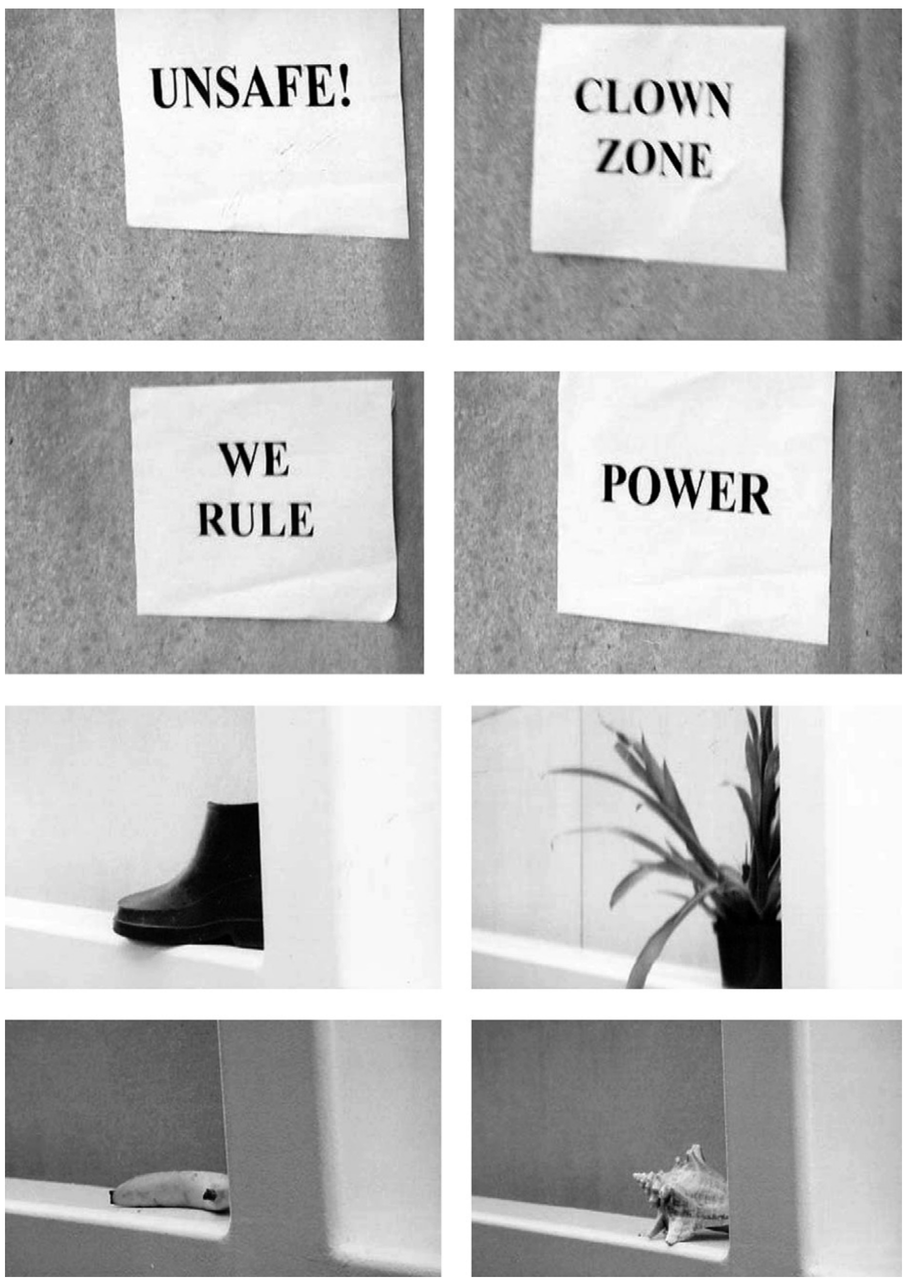

Fig. 1. Photos of planted objects (top left in each set of four) and distractors.

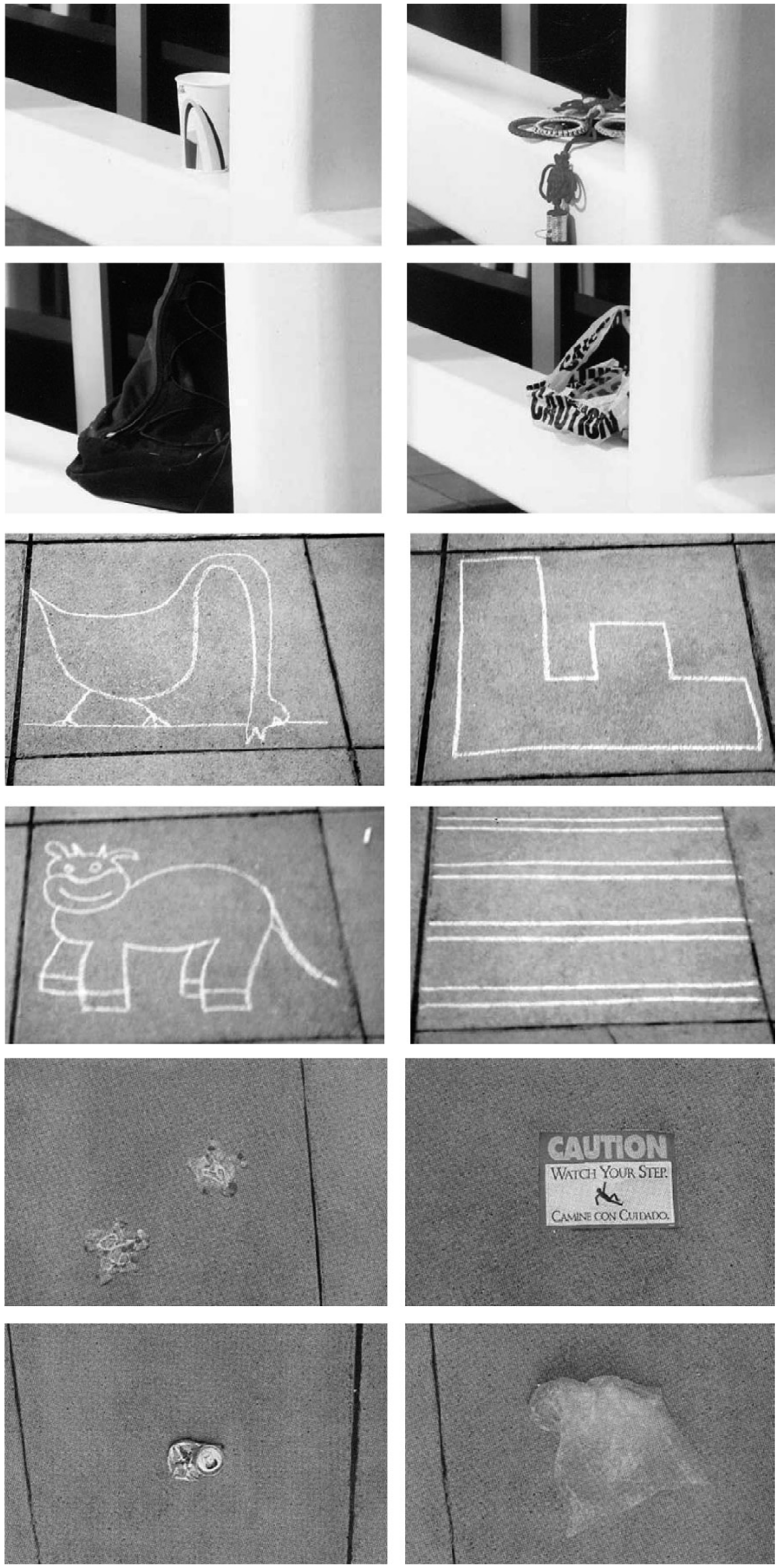

Fig. 1. (*Continued*).

3. Study 2: safety implications of mobile phone use while walking

3.1. Study aims

In light of the decrement in situation awareness or recall associated with mobile phone use among pedestrians, this study sought to see if people using hand-held mobile phones at street crossing were more likely to exhibit unsafe behavior than those listening to i-pods, and those not using a mobile phone or an i-pod. Like the mobile phone, an i-pod brings information from outside the situation to the user, but unlike the mobile phone, it places less demand on the user, in that it does not require the user to talk. As searching or setting an i-pod may involve an extra distraction similar to searching for a number, dialing or answering a mobile phone, the observations in this study excluded those behaviors and centered on pedestrians listening to an i-pod or conversing on a mobile phone.

3.2. Method

3.2.1. Selecting crosswalk to observe

Prior to the study, an investigation sought to identify a street crossing on a university campus, which met several conditions for the period of class breaks between 11 a.m. and 2 p.m. (previously established as the best time to find large numbers of pedestrians). First, it had to have an adequate number of mobile phone users and i-pod users so that sufficient number of each could be selected for an observational sample. Second, it had to have an adequate flow of moving vehicular traffic to give pedestrians a potential conflict and a choice of crossing or not. Too much slow moving traffic might make any crossing relatively safe. Too little traffic would seldom give pedestrians a conflict. Third, the crosswalk would have enough people walking alone (rather than in groups), to avoid group effects on the individual's behavior. The analysis yielded three crosswalks for observation.

3.2.2. Observation instrument and procedures

We pre-tested and refined an observation instrument, with rows for each pedestrian observed and columns for the various categories of information observed. Each sheet also had spaces for the observers to record the observation location (one of the three crossings), date, time, and their name.

The three observers would then pick a pedestrian approaching the crosswalk. Observers were trained to identify and observe pedestrians walking alone in a situation where the pedestrian might come into potential conflict with an approaching vehicle. This required observing the speed and distance of the pedestrian from the street and the speed and the distance of the vehicle from the crosswalk. Once they picked the pedestrian, the observers would independently record the following information:

- The pedestrian's gender (M or F).
- The pedestrian's use of technology (C for using a cell/mobile phone, I for using an i-pod, or N for no technology).
- Did the pedestrian bump into something (–: no bump, P: person, O: object, X: no one else there).
- What action the pedestrian took at the crosswalk (S: stop, H: hesitate, or W: walk into it).
- Safety of that action (√: unsafe, –: okay), whether it looked like the pedestrian put him or herself at risk of getting hit by a car.
- Did the pedestrian force others to evade them (C: car, P: pedestrian, G: group, –: no evasion, X: not applicable).
- Other comments.

Unlike Hatfield and Murphy (2007) which recorded only the behavior, the present study also included an assessment of the safety of the behavior. In pilot tests of the observations, we observed and agreed that some behaviors which might out of context appear unsafe (such as crossing with a car approaching), were safe in the context of the distance and speed of the car and the driver's awareness.

3.2.3. Observations

The observations took place at the three intersections at peak between noon and 2:00 p.m. during the first two weeks of March 2005 (44 observations at one crosswalk, 42 at another, and 45 at the third). The observers had substantial inter-observer agreement, with disagreements on a single measure for only 4 of the 131 pedestrians observed. The analyses dropped those 4 pedestrians, and include only the remaining 127 pedestrians.

3.3. Results

Of 127 pedestrians, the observers observed 19.0% using a mobile phone, 24.2% using an i-pod, and 55.9% not using either one. Although most observations (52%) took place with a car approaching, observations also involved no car (24.4%) or a stopped car (23.6%).

The observations revealed no bumping, but a substantial number of pedestrians crossing when a car approached. Across all vehicle conditions, most pedestrians walked (60.6%), while fewer stopped (26.0%) or hesitated (39.4%). For the full sample (Table 2), the highest percentage of pedestrians walked with no car present, followed by those who walked with an approaching car and those who walked with a stopped car. For no car, a significantly higher percentage of i-pod users stopped than either of the other groups (χ^2 1d.f. = 6.31, $p < 0.05$).

Table 2 shows that for mobile phone users, most of them walked for an approaching car, while most of them stopped for a stopped car, the opposite of what one would expect for pedestrians aware of their surroundings; and with no car present, most of them walked. For i-pod, Table 2 shows that more pedestrians stopped than walked in all three conditions, but for no car, a lower percentage of i-pod users ($n = 5$) walked (40%) than observed for mobile phone users ($n = 9$, 88.9%) or neither ($n = 17$, 88.2%) (χ^2 2d.f. = 6.31, $p < 0.05$). The neither group exhibited the safest behavior. A higher percentage walked with no cars present, than with stopped cars, which in turn had a higher percentage of walkers than with car approaching.

Table 2
Percentage of pedestrians who walked in various conditions

	Approaching car ($n=66$)	Stopped car ($n=30$)	No car ($n=31$)
Percent who walked	57.6 χ^2 2d.f. = 7.91, $p<0.05$	46.7	80.7
	Mobile phone ($n=25$)	i-Pod ($n=31$)	Neither ($n=71$)
Percent who walked	72.0	41.9	64.8
	Mobile phone users		
	Approaching car ($n=11$)	Stopped car ($n=5$)	No car ($n=9$)
Percent who walked	81.8 χ^2 2d.f. = 8.51, $p<0.01$	20.0	88.9
	i-Pod users		
	Approaching car ($n=17$)	Stopped car ($n=9$)	No car ($n=5$)
Percent who walked	47.1	33.3	40.0
	Neither		
	Approaching car ($n=38$)	Stopped car ($n=16$)	No car ($n=17$)
Percent who walked	55.3 χ^2 2d.f. = 5.64, $p=0.06$	62.5	88.2

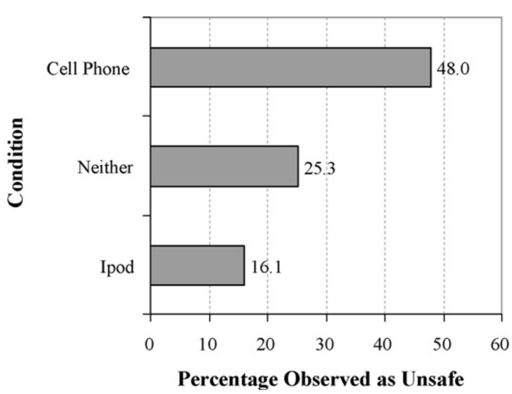

Fig. 2. Cell phone users exhibited a higher percentage of unsafe behavior than either of the other groups.

Among those who walked with an approaching car, the analysis found no significant difference in evasive actions required by cars in relation to the pedestrian behavior across the conditions. Furthermore, few of the 127 pedestrians exhibited behavior judged as unsafe (27.6%), but comparisons of the three groups (mobile phone, $n=25$; i-pod, $n=31$; neither, $n=71$) found a higher percentage of unsafe behavior among the mobile phone group than among the i-pod or neither group (see Fig. 2) (χ^2 2d.f. = 7.43, $p<0.05$). Pairwise comparisons confirmed a significantly higher proportion of unsafe behavior among the mobile phone users than among the i-pod users (χ^2 1d.f. = 6.65, $p<0.05$), or the neither group (χ^2 1d.f. = 4.414, $p<0.05$).

4. Discussion

The first study found for pedestrians reduced situation awareness or recall associated with talking on a mobile phone. As with drivers (Patten et al., 2004; Redelmeier and Tibshirani, 1997; Strayer and Johnson, 2001; Violanti, 1997, 1998), it is likely that pedestrians talking on mobile phones might have an increase risk of accidents, due to distracted attention (Lamble et al., 1999; McKnight and McKnight, 1993). These data also agree with findings of fixation or reduced visual scanning among drivers with a high workload (Harbluk and Noy, 2001).

An earlier study suggested that such reduced awareness or recall may generalize to increased unsafe behavior among pedestrians talking on mobile phones when crossing a street (Hatfield and Murphy, 2007). However, the authors of that study cautioned against generalizing the results beyond the three suburbs tested. Our second study confirmed, in a more urban (university campus) setting, the unsafe behavior for pedestrians talking on mobile phones. We also caution against generalizing beyond the likely student population in this study, to places with streets up to four lanes, or to central business districts (such as Manhattan's), which have much heavier and more diverse pedestrian, vehicular, and bicycle traffic, push-cart vendors, etc. The Hatfield and Murphy (2007) study did not try to establish if the unsafe behavior related to the active conversation on the mobile phone or generalizes to less demanding passive listening such as that on another widely used technology—the i-pod. The small number of i-pod users observed in the second study did not display a significantly higher rate of unsafe behavior than pedestrians not using i-pods or mobile phones. However, overall they stopped more often than the others, and they did so in opposite conditions—no car present and an approaching car. Due to the small number of i-pod users observed in each condition, we caution against drawing any conclusion from these results. That said, if observations of a larger sample confirms that they tend to stop more often, we offer some ideas about why that may occur. We do not think they are more cautious than either group, nor did we observe them stopping to select a new tune. Perhaps they stopped to attend to a song without interference or perhaps listening to music is a different kind of distraction from listening to words. Although no pedestrian in the study was hit by a car, the study had a relatively small sample. Newspapers have reported vehicles hitting and killing a pedestrian talking on mobile phones (Sridharan and Parrino, 2005) or using an i-pod (Zeller, 2007). We need better data on pedestrian–auto accidents to establish if mobile phone or i-pod use among pedestrians results in increased risk of accidents. We also call for future work with larger samples of i-pod users to better understand their risks.

Mobile phones have positive values, including use in emergencies to call for help (Chapman and Schofield, 1998), but we need to balance the positives with better knowledge on the ways in which mobile phone use may increase accidents and victimization. If use of portable technology puts the pedestrian at risk, perhaps the technology can offer a solution. Perhaps, the mobile phone or i-pod could alert pedestrians that they were approaching a crosswalk or that a car is approaching. If so, would the pedestrian notice and heed the warning? Only through the study of these effects of existing and new mobile technologies can users and society have the knowledge needed to prevent such accidents.

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