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Distracted pedestrian behavior on two urban college campuses

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Abstract

Pedestrian injuries injure about 180,000 individuals and kill 6,000 each year in the United States, and pedestrian injury rates have increased each of the last several years. Distracted pedestrian behavior may play a role in the trend of increasing risk for pedestrian injury. Using *in vivo* behavioral coding over the course of two weeks on two urban college campuses, this study aimed to 1) understand the type and rate of distractions engaged in by pedestrians on urban college campuses, and 2) investigate the impact of distraction on street-crossing safety and behavior. A total of 10,543 pedestrians were observed, 90% of them young adults. Over one-third of those pedestrians were distracted while actively crossing roadways. Headphones were the most common distraction (19% of all pedestrians), followed by text-messaging (8%) and talking on the phone (5%). Women were more likely to text and talk on the phone than men, and men were more likely to be wearing headphones. Distracted pedestrians were somewhat less likely to look for traffic when they entered roadways. As handheld device usage continues to increase, behavioral interventions should be developed and implemented. Changes to policy concerning distracted pedestrian behavior, including improvement of the built environment to reduce pedestrian risk, should be considered in busy pedestrian areas like urban college campuses.

Keywords

distracted walking; pedestrian behavior; texting; young adults; college campuses

Pedestrian injury is a significant and growing public health concern-- 180,000 pedestrians are injured and 6,000 killed each year in the United States alone in motor vehicle-pedestrian crashes [1, 2]. Between 1980 and 2010, the rate of pedestrian deaths in the United States decreased [3]. Alarmingly, this decreasing trend reversed between 2010 and 2015, with

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pedestrian deaths rising over 25% during this 5-year period [2, 3, 4]. Furthermore, a recent report from the Governors Highway Safety Association projects an 11% increase in the number of persons on foot killed on roadways in 2016, the largest yearly increase in the number and percentage of pedestrian fatalities in the past 40 years [2]. Among teens and young adults aged 13 to 34, pedestrian death comprises 11.44% of motor vehicle traffic-related deaths in the United States, which is the second leading cause of unintentional death in this group; over 1,500 pedestrian traffic deaths occurred in this age group in 2015 [1].

One hypothesized cause for the rapidly-increasing rates of pedestrian injury and death is the rate of distraction amongst pedestrians [5]. In the past two decades, cell phone and hand-held mobile device usage has increased dramatically; as of 2016, 95% of American adults own a cell phone and 77% of own a smart phone that can access the internet [6]. Observational studies of pedestrian behavior indicate that a quarter to a third of pedestrians are distracted by mobile devices when they cross the street at marked crosswalks [7, 8]. Basch and colleagues (2015) observed that nearly 28% of pedestrians crossing legally with the walk sign were distracted by technology (i.e., listening to music, talking on a mobile phone, looking at a mobile device) in Manhattan, while nearly half were similarly distracted when crossing illegally with the “Don’t Walk” sign illuminated [7]. In a Seattle-based study, around 30% of pedestrians were distracted via handheld device; in both studies, wearing headphones was the most frequent distraction [7, 8]. Compared to a study conducted in 2005, which found only 5.7% of pedestrians were distracted by handheld device use [9], these studies portray a substantial increase in technology-related distraction among pedestrians.

For students on urban college campuses, a confluence of factors introduces particularly elevated pedestrian injury risk. In fact, college-age young adults incur pedestrian injuries at a higher rate than any other age group [10]. College students are frequent pedestrians, yet pedestrians on college campuses often fail to observe traffic rules [9, 11]. While pedestrians on college campuses may expect to be safe due to the prevalence of walking, frequently-walked areas are known to be dangerous places for pedestrians [9]. Further, college-aged young adults use handheld technology more than any other age group, which may lead to distracted walking; nearly 100% of 18- to 29-year-olds own a cell phone and 92% own a smart phone [6]. Young adults text over 100 times a day on average and check their cellular device multiple times an hour even when not prompted by an alert [6, 12]. In a virtual reality pedestrian environment, college students who were distracted by texting or listening to music were more likely to be hit by a car while crossing the street than their undistracted peers [13]. In addition to being distracted, college-aged young adults frequently engage in riskier pedestrian activities such as walking at night and while intoxicated [14]. Finally, pedestrian injuries are more common in cities —over 70% of all pedestrian fatalities occur in urban areas [3]. Taken together, these factors contribute to creating particularly dangerous circumstances for pedestrians on urban college campuses.

Limited current research details distracted pedestrian behavior in urban college campus settings. Thus, this study aims to examine the rate of distraction and crossing behavior of young adult pedestrians on two urban college campuses among pedestrians were observed crossing a busy intersection at two universities. We anticipated a high rate of distraction by mobile devices and hypothesized that pedestrians engaged in distractions would engage in more unsafe crossing behaviors.

Methods

Intersection Selection

Data were collected at busy intersections on two urban university campuses, Old Dominion University (ODU) in Norfolk, VA and the University of Alabama at Birmingham (UAB) in Birmingham, AL. In each case, the intersection included a major thoroughfare with heavy traffic (Hampton Boulevard/Virginia Highway 337 in Norfolk; University Boulevard/Alabama Highway 149 in Birmingham) that passed through the campus and divided locations where many students live from where they attend classes. Cross-streets in each case were more minor thoroughfares (45th street in Norfolk; 14th Street in Birmingham). In both cases, the intersections handle heavy pedestrian traffic throughout the day from students (primarily), faculty, staff, and visitors to the university.

Pedestrian Behavior Coding Protocol

Pedestrian behaviors were coded daily on a continuous basis weekdays from 7:45 AM to 5:45 PM, using rotating coders, during two weeks early in fall semester 2015. Coding stopped only in case of heavy rainfall or lightning. Logistically, coding was divided into 30-minute blocks. Each coding block was conducted from a single corner of the intersection and coders rotated around the intersection counter-clockwise every 30 minutes.

During each coding block, coders completed three sets of observations. First, for 5 minutes the coder counted vehicular traffic. Second, for the next 5 minutes the coder recorded safe and unsafe behaviors of single pedestrians crossing the primary boulevard. An approaching pedestrian was selected from the opposing sidewalk following a standardized and randomized pattern (i.e., middle front pedestrian picked first, then left front, right front, middle back, left back, right back, and so on). Pedestrians were chosen regardless of whether they were crossing with or against the walk sign. That single pedestrian’s behaviors were observed as he or she approached the coder, during the entirety of the time spent crossing the street, including across the median that was present at both coding sites. A new pedestrian was then selected for observation using the same standardized pattern. The third set of coding in each block was a 15-minute observation period of all pedestrians during which time coders observed all pedestrians crossing the primary boulevard toward them on their side of the street and recorded only whether the pedestrians were distracted or not.

The final 5 minutes of each block was used for coders to rest and move counter-clockwise to the next coding corner or rotate to a new coder. To retain alertness and improve accuracy, coders typically completed just two blocks of coding (1 hour) continuously. The same coding paradigm was used on both campuses. The morning starting position was rotated across days to assure evenness in assessing behavior that may fluctuate with class sessions starting and ending. Each coder was extensively trained on the protocol and practiced street-side with experienced coders until reaching agreement for at least 30 minutes with a trained and experienced coder.

Outcome Measures

Vehicular Traffic—Vehicular traffic was measured as a total count of cars traveling on the primary boulevard and crossing the observed crosswalk in one direction (nearest lanes to the coder) during the 5 minute coding session. We multiplied the count by 12 to yield a measure of vehicles/hour.

Individual Pedestrian Characteristics and Behaviors—During the 5 minute block observing individual pedestrians, the following characteristics and behaviors were recorded:

- **a.** apparent gender (male, female);
- **b.** estimated age (child ages 0 to 12, teen ages 13 to 17, young adult ages 18 to 34, adult ages 35 to 54, older adult ages 55 and older). Because very few children or teens were observed, those categories were merged for analyses;
- **c.** crossing with the walk sign, defined as stepping off the sidewalk into the crosswalk when the walk sign was illuminated;
- **d.** looking left before stepping into the road, defined as the pedestrian turning his/her head left to look at oncoming traffic before stepping into the intersection;
- **e.** entering the road in the crosswalk, defined as the pedestrian initially stepping into the crosswalk within the painted lines of the crosswalk rather than outside the lines;
- **f.** looking right at the median, defined as the pedestrian turning his/her head to look right at oncoming traffic before stepping out of the median and into the roadway;
- **g.** exiting the road in the crosswalk, defined as the pedestrian's final step off the roadway and onto the sidewalk occurring from within the painted lines of the crosswalk; and
- **h.** distracted behavior while crossing, defined as a pedestrian who was distracted by talking on the phone, texting and/or looking down at the phone, wearing headphones, reading, eating, or in other visually apparent ways. Multiple distractions could be marked. Distraction was recorded if it occurred at any point during the crossing while the pedestrian was in the roadway where vehicles might pass, but not on the sidewalk or median.

All Pedestrians' Engagement in Distractions—During the 15-minute coding block, every approaching pedestrian in the crosswalk was coded as either distracted or not distracted while crossing. Given the heavy volume of pedestrians, no other data were recorded. The following distractions were recorded using the same criteria as the previous block of coding: talking on the phone, texting and/or looking down at phone, wearing headphones, reading, eating, or other distractions. Multiple distractions could be recorded. Distraction was recorded while pedestrians crossed the roadway on the half of the intersection nearest the coder (i.e., between the median and the corner where the coder was standing).

Data Analysis Plan

Data analyses were conducted in four steps. First, we considered descriptive data about traffic and pedestrians. Second, we considered distraction and safety among the individual pedestrians who were observed in detail, both overall and then comparing men versus women with chi-square analyses. Third, we considered the safety behaviors of distracted versus undistracted pedestrians in this group. Finally, we examined distracted behavior of all pedestrians in the crosswalk; this examination included gross counts of distraction as well as the extent of types of distractions among all pedestrians.

Results

Across both sites, we observed an average of 2,659 vehicles per hour (44/minute) crossing the intersections. Coding of individual pedestrians offered the most detailed data concerning the characteristics of the pedestrians. As shown in Table 1, 1,020 individual pedestrians were observed over the two-week period, 625 at ODU and 395 at UAB. Pedestrians were overwhelmingly classified into the young adult age category (89.2%) and were 50.6% female.

Examination of individual pedestrians who were observed in detail suggested 41.2% of the pedestrians were distracted; rates were similar across the two sites (43.6% at ODU and 37.3% at UAB). Using headphones was the most common distraction at both sites (20.6% at ODU, 16.3% at UAB, and 19.0% overall), but there were significant amounts of all types of distraction at both sites (Table 1), including 6.4% of pedestrians who were distracted in multiple ways simultaneously while crossing busy streets.

Table 2 shows differences in distraction across the male and female pedestrians. As shown, there were significant differences in the number of individuals who were distracted by talking on the phone, texting, and using headphones. Women were more likely to be distracted by talking on the phone ($x^2 = 5.57$, $p = .02$) and texting ($x^2 = 13.84$, $p < .001$), while men were more likely to wear headphones while crossing the street ($x^2 = 8.42$, $p < .001$). Women were also more likely to have multiple distractions present ($x^2 = 6.25$, $p < .05$).

We also considered rates of safe behavior. As shown in Table 1, about half or slightly more than half of pedestrians across both sites engaged in each safe behavior. There were significant differences across sites, with pedestrians at ODU more likely to look left before entering the roadway and look right before entering the median but pedestrians at UAB more likely to cross with the walk sign and enter in the crosswalk. These differences likely reflect the contextual demands of the crossing task at each site. When we compared safe behaviors across men and women (Table 2), we found that men were more likely to look right before reentering traffic at the median ($x^2 = 5.25$, $p = .02$) and women were more likely to exit the roadway within the crosswalk lines ($x^2 = 8.50$, $p = .01$). Otherwise, men and women engaged similarly.

Next, we considered distracted pedestrians' engagement in safe pedestrian behaviors (Table 3). Distracted pedestrians tended to obey walk signs more often than undistracted pedestrians, perhaps as compensation to their distracted state (with one exception; just 7 of the 29 pedestrians (26.9%) who were eating or drinking while crossing crossed with the walk sign). Looking behavior was notably lower among distracted pedestrians, however, especially after crossing the median. Most startling, just 29.8% of pedestrians who were talking on the phone looked right for traffic after crossing the median, compared to 50.7% of undistracted pedestrians.

Finally, Table 4 presents data from all 9,523 pedestrians observed crossing during the 15-minute coding blocks (n = 6,477 at ODU and n = 3,046 at UAB). As shown, 67% of pedestrians across both sites were undistracted, 33% of pedestrians were distracted in at least one way, and 3.1% of pedestrians were distracted in two or more ways. Headphones were the most common distraction (20.4% of pedestrians) across both sites, followed by texting (8.4% of pedestrians) and talking on the phone (4.4%). Use of headphones and eating/drinking were somewhat more common at ODU and texting was somewhat more common at UAB.

Discussion

Over 35% of the pedestrians we observed on urban college campuses were crossing the street while distracted, almost always by handheld mobile devices. Observational studies of pedestrian distraction in the past 5 years show similar or slightly lower rates of distraction in other U.S. urban non-campus centers [7,8] suggesting distracted pedestrian behavior is not only a significant issue nationally, but may either be increasing in frequency and/or is more common in pedestrian settings dominated by young adults like college campuses. One study near a college campus from the early 2000s observed far fewer distracted pedestrians [9].

Across both campuses we observed that wearing headphones was the most prevalent distracted pedestrian behavior. While some pedestrians may not perceive headphone use as distracting or dangerous, available evidence suggests aural cues are integral to pedestrian safety. In fact, unlike the situation for automobile drivers, distance perception and speed estimation required to be a safe pedestrian may be altered drastically by the constant auditory disruption of wearing headphones [13, 15, 16].

Talking on the phone and texting while crossing the street, both of which we also witnessed frequently, create cognitive distractions; texting or using apps also introduces visual distraction and motor behavior changes such as slowed walking pace and changes in gait [5, 10, 13]. In this study, we found that pedestrians who were talking on the phone were much less likely to look toward oncoming traffic, an indication perhaps of their cognitive distraction away from the pedestrian task. Interestingly, distracted pedestrians (regardless of distraction) seemed to cross with the walk sign at similar or slightly higher rates than undistracted pedestrians. This may reflect compensatory safety strategies— the pedestrians recognized they were distracted and therefore waited for a legal walk signal, or followed a crowd across the street when the light changed, rather than taking a riskier crossing. Similar compensatory behavior has been reported among distracted drivers [17].

We discovered comparatively few gender differences in the rate of distracted pedestrian behavior, although women were more likely to be engaged in social distractions like talking on the phone and texting, whereas men were more likely to engaged in individualized distraction, such as wearing headphones.

Like all research, this study had limitations. Our two strategies of observation – looking at "randomly-chosen" individual pedestrians versus trying to capture all pedestrians crossing the street – yielded slightly different rates of distracted pedestrian behavior (41.2% vs 36%). This may be a veridical finding, but more likely is the result of methodological limitations. Our attempts to code individual pedestrians at random may have involved some bias and/or our coders, despite careful training, may have experienced difficulty identifying the behavior of every pedestrian in large groups of pedestrians crossing simultaneously due to obscured vision. Additionally, our study included two urban college campus intersections but is not fully representative of campuses across the country. We also focused only on crossings at signalized locations with substantial traffic; our results may not generalize to other types of crossings. Finally, we coded from early morning through early evening but did not code during darkness. Given epidemiological data on the frequency of pedestrian crashes at night [3, 18], late-night distracted pedestrian behavior might be considered in future research.

Experts agree handheld device use is likely to increase in coming years [3, 6]. Thus, effective strategies to reduce distracted pedestrian behavior are urgently needed. Some policy changes have focused on changing distracted and/or unsafe driver behavior to reduce pedestrian-motor vehicle crashes; such policy initiatives have been effective in changing driver safety and behavior but have not shown spillover effects in increasing pedestrian safety [19]. Laws prohibiting distracted pedestrian behavior have been suggested but rarely implemented, enforced, or evaluated [18, 19, 20]. Structural changes to the built environment that protect pedestrians like pedestrian overpasses, pedestrian malls, or fences along roadways, may be beneficial but are not always feasible or affordable, especially in crowded urban campus environments. Behavioral prevention strategies show promise in initial testing [21] and should continue to be explored. Ultimately, multi-faceted and coordinated efforts between policy makers, engineers and city planners, and behavioral interventionists are likely to be most successful.

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Table 1

Pedestrian characteristics, distractions and safe behaviors, detailed observations.

	ODU (n=625)		UAB (n=395)		Combined (N=1020)	
	n	**%**	**n**	**%**	**N**	**%**
Age Group						
Child or Teen	1	0.2	0	0.0	1	.1
Young Adult	568	89.6	328	87.0	896	89.2
Adult	53	8.4	42	11.1	95	9.5
Older Adult	9	1.4	4	1.1	13	1.3
Gender						
Female	327	52.7	179	47.1	506	50.6
Distraction (Any Distraction)	**271**	**43.6**	**142**	**37.3**	**413**	**41.2**
Talking on Phone	25	4.0	22	5.8	47	4.7
Texting	42	6.8	33	8.7	75	7.5
Headphones	128	20.6	62	16.3	190	19.0
Eating/Drinking	21	3.4	5	1.3	26	2.6
Other	5	0.8	6	1.6	11	1.1
No Distraction	350	56.4	239	62.7	589	58.8
Multiple Distractions	50	8.1	14	3.7	64	6.4
Safe Behaviors						
Crosses With Walk Sign	324	52.1	320	83.8	644	64.1
Looks Left Before Entering	411	67.8	139	38.6	550	56.9
Enters in Crosswalk	284	46.5	270	72.8	554	56.4
Looks Right at Median	344	56.7	140	36.8	484	49.0
Exits in Crosswalk	357	58.0	210	55.0	567	56.8

Note: Group sums do not equal total n due to occasional missing data. Percentages reflect proportion of non-missing observations within variables.

Table 2

Engagement in distraction and safety behaviors by gender during detailed observations of pedestrian crossings (N = 1,020).

	Male		Female			
	n	**%**	**n**	**%**	x^2	***p***
Distraction						
Talking on Phone	15	3.0	31	6.2	5.57	.02
Texting	21	4.3	53	10.5	13.84	<.01
Headphones	115	23.4	75	14.9	8.42	<.01
Eating/Drinking	10	2.0	16	3.2	1.38	.33
Other	5	1.0	5	1.0	0	1.0
No Distractions	304	61.8	282	56.0	.83	.38
Multiple Distractions	22	4.5	42	8.3	6.25	.02
Safe Behaviors						
Crosses with Walk Sign	312	63.2	329	65.4	.56	.46
Looks Left Before Entering	283	59.8	265	54.4	2.87	.09
Enters in Crosswalk	261	54.1	290	58.7	2.06	.15
Looks Right at Median	256	53.0	228	45.7	5.25	.02
Exits in Crosswalk	257	52.4	306	61.0	8.50	.01

Table 3

Percentage of distracted pedestrians who engaged in safe pedestrian behaviors (N = 1,020).

	Crosses with Walk Sign	Looks Left When Entering	Looks Right at Median
No Distraction	64.2	58.5	50.7
Talking on Phone	59.6	42.2	29.8
Texting	70.7	48.6	50.0
Headphones	66.8	57.7	53.7
Eating/Drinking	26.9	69.6	38.5
Other	70.0	70.0	45.5
Multiple Distractions	65.6	53.1	38.1

Table 4

Distractions among all pedestrians observed in crosswalk (N = 9,523).

	ODU		UAB		Combined	
	n	**%**	**n**	**%**	**N**	**%**
Distraction						
Talking on Phone	287	4.4	134	4.4	421	4.4
Texting	511	7.9	290	9.5	801	8.4
Headphones	1520	23.5	426	14.0	1946	20.4
Reading	7	0.1	4	0.1	11	0.1
Eating/Drinking	116	1.8	25	0.8	141	1.5
Other	78	1.2	37	1.2	115	1.2
Extent of Distraction						
No Distractions	4175	64.5	2209	72.5	6384	67.0
Two Distractions	211	3.3	75	2.5	286	3.0
Three Distractions	3	0.1	2	0.1	5	0.1