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Adolescents' Mobile Phone Use While Crossing the Road

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Abstract: Phones and other portable technology can be a distraction for pedestrians, affecting their ability to cross a road safely. This study focused on adolescents and investigated whether using a phone distracts attention while crossing the road. A field observation outside a secondary school in the north of England was carried out over a four-week period in 2018 with permission from the school. Observations included recording what accessories the pedestrian was carrying (phone, headphones or another electronic device) and their associated action (whether they were holding the device, speaking into a phone, looking at it, holding it to their ear or interacting with it manually). We observed whether the pedestrian looked (or failed to look) left and right before crossing the road, whether they crossed when the pedestrian light was on green or red, and whether they crossed within the cross-walk. We found that 31.37% of road crossings were made by adolescents with a phone or other device. They looked left and right before crossing less frequently when they had an electronic device with them, when looking at the screen and when texting or swiping. In conclusion, the safety of adolescent pedestrians is affected by mobile phones and music players.

Keywords: adolescent; pedestrian; road safety; mobile phone; cell phone

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1. Introduction

Pedestrian deaths and injuries are a global problem. The World Health Organization [1] reported that 23% of the 1.35 million global road traffic deaths in 2016 were pedestrians. In the UK, 25% of all road deaths reported in 2014 were pedestrians [2]. Also, 28.65% of pedestrian casualties in 2017 were to those younger than 17 years of age [2,3]. In cases where the pedestrian was noted as a contributory factor to a traffic collision, 'the pedestrian failed to look properly' was the most frequent cause of pedestrian death or injury, accounting for 49% of all such cases. In addition, the pedestrian failing to look properly was a contributory factor to road accidents in 39% of cases in which the pedestrian was not injured [4]. The pedestrian failing to look properly may be caused by distractions. A growing cause of distraction for pedestrians is the use of mobile technology, such as mobile phones, smartphones, and music players. Research has established that mobile phones can cause a dangerous distraction to drivers [5–7] and legislation against using a hand-held phone while driving exists in 139 countries [1]. However, the distractions of mobile phones to other road users, such as pedestrians, has not received as much research attention.

Safely negotiating traffic as a pedestrian requires a range of cognitive and perceptual skills including visual search, auditory localisation and attention. Attention in pedestrian contexts involves the ability to focus on relevant information, sustaining attention to traffic, switching attention, and ignoring distractions. Phones and other portable technology can be a distraction for pedestrians, affecting their safety. Mobile phone use was cited as an increasing cause of injuries requiring hospital treatment, especially for males and for pedestrians younger than 31 years [8]. For example, rates of injuries specifically due to pedestrians' mobile phone use increased steadily from 0.36% in 2005 to 3.67% in 2010 [8], indicating that rates multiplied by ten in only five years. Field studies of pedestrian behaviour in several countries (e.g., Australia, Serbia, USA) have found that pedestrians who were texting or talking on a phone looked for traffic less frequently than non-users and this occurred more frequently among women than men [9–12]. Studies using an immersive laboratory road-crossing simulation found that pedestrians walked slower when talking on a mobile phone [13], paid less attention to traffic, allowed less time to cross before an oncoming vehicle and had more road traffic hits and near misses when using a mobile phone [14–16].

Most of the above research involved observing the behaviour of adults. Distraction may affect adolescents more than adults due to brain development. Adolescence is a period of substantial brain development that affects attention and other executive functions as well as social behaviour [17–19]. For example, a gradual increase in attention capacity and processing speed through adolescence [20] could affect the ability to inhibit distractions in a pedestrian environment. Given that mobile phones may be sources of distraction and adolescents are frequent users of mobile technology [21], more research on this age group of pedestrians is needed.

Mobile phone ownership is common among UK adolescents with estimates of more than 75% of 12–15-year-olds owning a phone [21,22]. Also, UK mobile phone use was found to be highest among 16–24-year-olds [23]. However, there is a scarcity of data available on whether phones are used by young people when negotiating road traffic. Field observations of pedestrians crossing the road have found varying rates of mobile phone usage. For example, researchers have observed that 8% of pedestrians they observed crossing an urban intersection were using a digital device, and 9% were using earbuds/headphones [24]. Also, 27.8% of pedestrians were observed crossing at intersections on a 'Walk' signal and 42% crossing on a 'Do not Walk' signal when wearing headphones, talking on a mobile phone or looking down at an electronic device [25]. However, neither of these studies reported the estimated age group of the pedestrians that they observed. Phones may be used by young people more often than older people in traffic. For example, cyclists aged 12–17 years have been reported to use hand-held electronic apparatus, including phones, more often than those aged 35–50 years around moving vehicles [26]. Less is known about young people's phone use when walking among road traffic.

The aim of this research was to investigate adolescent pedestrian behaviour when using portable electronic devices, such as a mobile phone. We focused on adolescents because they are considered to engage in riskier behaviour than other age groups [18], they are regular users of mobile phones and electronic technology, they may be susceptible to distractions, and they are within the high-risk age group for road traffic injuries. The first phase of data collection aimed to ascertain how many adolescents crossed the road with a phone or another electronic device. This involved a simple frequency count. The aim of the second phase of data collection was to conduct a more detailed observation of road-crossing behaviour in relation to using a mobile phone or another device.

2. Materials and Methods

2.1. Study Site

Permission was obtained to observe school students crossing a road near their school. The crossing site was a signalised ('Pelican') crossing with traffic lights to stop vehicles and displayed a red or green person to indicate when the pedestrian should or should not cross (see Figure 1). The UK government Department for Transport advice for crossing a road at a signalised pedestrian crossing is in the form of a series of rules. To the best of our knowledge, it is not illegal to cross on a red (do not walk) signal, but it is illegal to loiter on any form of crossing. Traffic travelled in two directions. The road had several lanes for mixed traffic. Two lanes were for general vehicle use, one lane was reserved for public transport, such as buses and taxis, and another lane was reserved for bicycles. The school was located in a large city in the north of England. The age range of students attending the school was that of high school students in the UK, between 11 and 18 years. The most recent UK Office for Standards in Education (Ofsted) report graded the school as outstanding. It also indicated that there was a higher than average number of students from 'financially deprived backgrounds'. The report described the school as a multicultural community. This is fairly typical of urban schools in the UK and in this respect we considered the sample to be representative of UK urban adolescents. Observations were done in the morning before school opening time and in the afternoon at school closing time over a four-week period in late spring to early summer in 2018. The majority of observations were made in dry weather conditions (sunny conditions = 42.8%, cloudy conditions = 39.6%, rain = 2.0%), and temperatures varied between 8.5 °C and 27 °C over this period.

Street view Pedestrian perspective

Figure 1. Views of the road crossing site.

2.2. *Sample*

2.2.1. Phase 1 Observation

A total of 3442 road crossings by school students were observed for two days each week for four weeks.

2.2.2. Phase 2 Observation

A total of 795 road crossings by school students were observed for two days each week for four weeks in 2018. Phase 2 data were collected on different occasions to phase 1, so in this respect, they were independent of phase 1 data. For comparison purposes, we attempted to more closely match the number of pedestrians with and without a phone. Consequently, 369 road crossings in phase 2 were made with a phone or other electronic device visible and 426 were without a device visible.

2.3. *Procedure*

Ethical approval was obtained from the University of Lincoln Research and Ethics Committee, and the British Psychological Society's ethical guidelines were followed. Permission was obtained from the school to conduct the observation near school premises. Before commencing the observation, pilot studies were carried out by two observers for refining the coding categories and for calculating observer reliability analyses. The two observers agreed on 89% of road crossings. Subsequently, following further pilot studies, observations were carried out by a trained observer standing near the kerb edge facing the pedestrian.

For the first phase of data collection (phase 1), we were interested in how many adolescents crossed the road with a phone or another electronic device. For phase 1, observations involved a basic frequency count of adolescent pedestrians crossing the road. Two categories were used: (1) pedestrians carrying an electronic device (mobile phone, headphones or earplugs) visible to the observer, (2) no device visible to the observer. Observation for each pedestrian began when the pedestrian stepped off the pavement into the road and ended when they left the road and stepped onto the pavement.

As the aim for phase 2 was to observe specific pedestrian behaviours when using a mobile phone or other device, behaviours were observed as follows. Safe road-crossing behaviours observed were (1) looking left and right before crossing (indicated by head movements), (2) crossing on a green person, (3) crossing within the cross-walk and taking the shortest route, not diagonally. Technology use was categorised as (1) mobile phone or other device visible to the observer, (2) no device, (3) holding device, (4) holding device to ear, (5) texting/swiping, (6) looking at device. Pedestrian characteristics noted were gender, and whether the pedestrian crossed alone or with others. Crossing with others was defined as crossing together, looking at or talking to each other. Also, a member of the school staff stood outside the school near to the crossing point at school closing time for 15 min. Whether this adult was present, the time of day, and weather conditions were noted.

2.4. Data Analysis

We treated the data as observations of independent crossing events rather than observations of individual pedestrians. For phase 1 data, frequencies and percentages were calculated to ascertain the amount of road crossings with or without a mobile device. For phase 2 data, chi-square tests were used to analyse associations between technology use and road crossing behaviours [27]. To avoid Type 1 errors, Bonferroni corrections were applied to p values where multiple chi-square tests were calculated (Tables 1–3).

3. Results

3.1. Phase 1 Observation

A total of 1080 pedestrian road crossings were made with an electronic device visible to the observer (31.37%) and 2362 without an electronic device (68.62%).

3.2. Phase 2 Observation

Out of the total of 795 pedestrians observed crossing in phase 2, 378 (47.55%) were male pedestrians and 417 (52.45%) were female pedestrians, and 65.40% were observed in the morning between 8:00 and 8:45 am and 34.6% were observed between 3:05 and 3:40 pm. Approximately half of the road crossings were made by pedestrians who looked left and right before crossing (51.40%), 65.3% by pedestrians who crossed on the ‘green person’ and 57.6% by those who walked straight across the road within the cross-walk. Also, 369 (46.41%) road crossings observed in phase 2 were made with a phone or other electronic device visible and 426 (53.58%) were without a device visible. More females than males were observed with a device (female n = 242, 58.03% of female pedestrian road crossings; male n = 127, 33.59% of male pedestrian road crossings), holding a device (female n = 172, 41.25%; male n = 67, 17.72%), texting/swiping (female n = 37, 8.87%; male n = 20, 5.29%) and using headphones (female n = 138, 33.09%; male n = 84, 22.22%). More females than males failed to look left and right before crossing (female n = 217, 52.04%; male n = 169, 44.71%). Tables 1–5 present the data from the phase 2 observations.

3.2.1. Effects of Electronic Devices on Pedestrian Behaviour

As can be seen in Table 1, road crossings made by pedestrians with a phone or another device more frequently involved failing to look left and right before crossing than those without a device. Also, those holding a phone or engaging with the device by looking at the screen or texting/swiping were subsequently less likely to look left and right before crossing. However, other behaviours with a mobile phone such as speaking and/or listening (either by holding the phone to the ear or using headphones) did not affect looking left and right. Also, although road crossings made by females were less likely to involve looking left and right before crossing, there were no statistically significant gender differences with regards to the association between mobile phone-use behaviour and looking behaviour.

Table 1. Use of electronic devices in relation to road-crossing behaviours—looked before crossing (number of road crossings).

Phone/Device Use	Looked Left and Right before Crossing	Did Not Look Left and Right before Crossing	χ^2
Phone/other device visible	165	204	12.490 *
No phone or other device	244	182	
Holding phone	92	147	22.953 *
Not holding phone	317	239	
Speaking into phone	12	16	0.857
Not speaking into phone	397	370	
Looking at screen	26	48	8.691 *
Not looking at screen	383	338	
Texting/swiping	19	38	8.065 *
Not texting/ swiping	390	348	
Holding device to ear	7	19	6.471
Not holding device to ear	402	367	
Head/ear phones	110	112	0.444
No head/ear phones	299	274	

Table 2. Use of electronic devices in relation to road-crossing behaviours—walk signal (number of road crossings).

Phone/Device Use	Crossed on Green (Walk Signal)	Crossed on Red (Do Not Walk Signal)	χ^2
Phone/other device visible	270	99	18.904 *
No phone or other device	249	177	
Holding phone	179	60	13.932 *
Not holding phone	340	216	
Speaking into phone	25	3	7.377 *
Not speaking into phone	494	273	
Looking at screen	60	14	8.985 *
Not looking at screen	459	262	
Texting/swiping	45	12	5.058
Not texting/ swiping	474	264	
Holding device to ear	21	5	2.844
Not holding device to ear	498	271	
Head/ear phones	158	64	4.712
No head/ear phones	361	212	

Table 2 shows that the majority of pedestrians crossed on a green (walk) signal; however, for those who crossed on a red (do not walk) signal, most did not have a mobile phone or other device with them, were not holding, speaking or looking at the screen. All other associations were nonsignificant. There was no statistically significant association between crossing within the cross-walk and phone/device use (Table 3).

3.2.2. Effects of Other People and Time of Day on Road-Crossing Behaviours

Compared to when crossing the road with peers, those crossing the road alone were more frequently observed looking left and right before crossing, crossing on a green signal and walking straight across the road within the cross-walk. However, only looking left and right was approaching significance (p = 0.053). Differences for crossing on green and crossing by the shortest route were statistically nonsignificant (see Table 4). The presence of an adult school staff member in the afternoons did not affect looking behaviour or crossing within the cross-walk, but significantly increased the frequency of crossings on a green (walk) signal (see Table 4).

Table 3. Use of electronic devices in relation to road-crossing behaviours—cross-walk (number of road crossings).

Phone/Device Use	Cross within the Cross-Walk	Crossed outside the Cross-Walk	χ^2
Phone/other device visible	218	151	0.608
No phone or other device	240	186	
Holding phone	136	103	0.070
Not holding phone	322	234	
Speaking into phone	18	10	0.530
Not speaking into phone	440	327	
Looking at screen	46	28	0.692
Not looking at screen	412	309	
Texting/swiping	36	21	0.774
Not texting/ swiping	422	316	
Holding device to ear	14	12	0.156
Not holding device to ear	444	325	
Head/ear phones	137	85	2.122
No head/ear phones	321	252	

For Tables 1–3, Bonferroni corrections were applied (p = 0.05 / 7 = 0.007) due to multiple phone-use comparisons (7) made for each type of road-crossing behaviour, and * indicates significance at p = 0.007.

Table 4. Effects of other people on road-crossing behaviours (number of road crossings).

	Looked Left and Right before Crossing	Did Not Look Left and Right before Crossing	χ^2	Crossed on Green (Walk Signal)	Crossed on Red (Do Not Walk Signal)	χ^2	Crossed within the Cross-Walk	Crossed outside the Cross-Walk	χ^2
Student alone	314	273	3.759	376	211	1.494	332	254	1.113
Student with peers	95	113		143	65		126	81	
School staff present **	63	77	0.444	110	30	4.167 *	71	69	0.043
No school staff present **	39	57		64	32		50	46	

* $p < 0.05$, ** pm only.

Pedestrians crossing the road in the morning more frequently looked in both directions before crossing than those crossing in the afternoon after school who looked less frequently (p = 0.007). Although the majority of road crossings were with pedestrians crossing on the green person signal, a higher proportion of road crossings were made during the red person signal in the morning (39.62% crossed on red, 60.38% on green) than in the afternoon (25.5% crossed on red, 74.5% on green) ($p < 0.001$). Also, although the majority walked within the cross-walk, a higher proportion did so in the afternoon (81.03% within the crosswalk, 19.07% outside) than in the morning (61.08% within, 38.02% outside). The morning period was divided into three time periods according to whether it was comfortably before expected school arrival time (before 8:15 am), during the peak arrival time (8:15–8:30 am), or when the school gates were about to be closed and the student would be late for school (after

8:30 am). We expected that pedestrians would take more risks when they were about to be late for school. There was a relatively higher frequency of failing to look left and right before crossing after 8:30 am, although this did not reach statistical significance. This did not occur at the earlier or peak arrival times (see Table 5). The majority of road crossings were made by pedestrians who crossed on green at all three time periods. Significantly more road crossings were outside the cross-walk than inside after 8:30 a.m. This did not occur at the earlier arrival times.

Table 5. Safe behaviour associated with time of day (number of road crossings) * $p < 0.01$.

Time of Day	Looked Left and Right before Crossing	Did Not Look Left and Right before Crossing	χ^2	Crossed on Green (Walk Signal)	Crossed on Red (Do Not Walk Signal)	χ^2	Crossed within the Cross-Walk	Crossed outside the Cross-Walk	χ^2
Going to school (am)	286	234	7.599 *	314	206	15.915 *	317	203	6.914 *
Return home (pm)	123	152		205	70		141	134	
Going to school before 8:15	38	37	2.943	47	28	3.233	57	18	9.225 *
Going to school 8:15 to 8:30	224	164		227	161		224	164	
Going to school after 8:30	23	49		35	14		32	49	

* $p < 0.01$.

4. Discussion

Almost a third of road crossings by school students on the route to and from school were made while using a mobile phone or music player. They were observed holding and interacting with these devices in a variety of ways while crossing, including speaking, texting or swiping, as well as listening. Regardless of whether a phone or device was in use, unsafe pedestrian behaviours were frequently observed. Mobile phones and other portable digital devices distracted adolescents' looking behaviour at the roadside, especially when visual attention to the device was required. This supports previous observations of adults and young people [12], as well as the results of pedestrian simulator studies [28]. The detrimental effects of visual distractions (looking, texting and swiping behaviours) compared to auditory distractions (listening, using headphones) supports the results of previous research on visual and auditory distractions among young people [29]. For example, [29] found that adolescents were more sensitive to distractions than adults and that stimuli were more distracting for adolescents when in the same modality as the task. Similarly, in our study, visual attention to the mobile phone affected looking left and right, but listening behaviour did not.

When compared to previous research [24], our results indicated that adolescents used mobile technology more frequently than adults while interacting with road traffic. Compared to 31.37% of adolescents observed in our study, [24] observed 17% of pedestrians in total using portable technology while crossing a road. The rates of unsafe behaviours while using phones and other electronic devices were similar to previous studies. For example, [25] reported that 42% of pedestrians they observed crossing at intersections on a 'Do not Walk' signal were wearing headphones, talking on a mobile phone or looking down at an electronic device. In our study, 35.87% of pedestrians crossing on a 'do not walk' signal were observed with a phone or other device. Also, the majority of road crossings were on a green (walk) signal. However, most road crossings on a red (do not walk) signal did not involve the pedestrian having or using a mobile phone. Research with adult pedestrians has found similar results for crossing on a 'walk' signal. For example, [11] noted that most pedestrians obeyed the lights, and that distracting behaviours, including texting and using a phone, were not associated with obeying lights. It is not clear why safer behaviour is associated with mobile phones for this behaviour category; consequently, further research is needed to investigate possible reasons. Perhaps pedestrians tend to cross on red due to impatience when waiting for the light to change. If this is the case, then having a phone on hand may give the pedestrian something to do while waiting and, thus, reduce impatient behaviour.

Gender differences have been reported in young pedestrians' injury rates and unsafe behaviour [8,30] with boys having higher injury rates than girls. Consequently, we were interested in exploring gender differences in phone use and related pedestrian behaviours. Our results found that rates of electronic device use were proportionately higher for female than male pedestrians, with 58.03% of female pedestrians observed with electronic devices compared to 33.59% of males. However, the rates of unsafe pedestrian behaviour in relation to technology use were similar for males and females. This does not support the gender differences noted in field studies of adult pedestrian behaviour [9–12].

The effect of the presence of other people at the roadside depended on who the other person was. The presence of an adult school staff member did not affect looking behaviour or crossing within the cross-walk but did increase the frequency of crossings on a green (walk) signal. Although our findings for the presence of other adolescents did not reach statistical significance, those crossing the road alone were more frequently observed looking left and right before crossing than those crossing with peers. According to Steinberg's dual processing model of adolescent risk taking [19], adolescents would be expected to display more unsafe behaviour when interacting with peers. As peers can have a positive as well as a negative effect on adolescent risk taking [31], more detailed observations of the type of peer interactions are necessary.

Time of day affected safe pedestrian behaviour. Looking left and right was proportionately more frequent in the morning on the way to school and failing to look was more frequent in the afternoon on the way home from school. This reduction in careful looking behaviour might be due to the effect of tiredness at the end of the school day. The role of tiredness in rates of unintentional injuries among adolescents has been noted by previous researchers in several countries, such as China, Korea and the USA [32–34].

However, some of the after-school crossings were safer than morning crossings. For example, although the majority of pedestrians crossed on the green person signal, a higher proportion of road crossings were made during the red person signal in the morning than in the afternoon. Also, although the majority walked within the cross-walk, a higher proportion did so in the afternoon than in the morning. In this respect, our results support previous research of more unsafe behaviours by Chinese urban child pedestrians in the morning than the afternoon [35]. However, our results may have been affected by the presence of school staff members for part of the time in the afternoon. For example, students might be more likely to comply with crossing on green and crossing within the cross-walk in the presence of school staff.

We observed another time of day effect in the mornings. Those who were late to school in the morning (after 8:30 am) crossed within the cross-walk significantly less frequently and they less often looked left and right before crossing the road. This might be related to inattention to safety concerns while hurrying to get to school.

Limitations of the study were that observations were conducted at only one type of pedestrian crossing site at one school location. Also, the road had a slight curve, which may have affected pedestrian behaviour. Further research is needed on adolescent pedestrian behaviour and mobile phone distractions at other types of sites, particularly those with no traffic controls. More observations at different times of day would be beneficial, particularly in the afternoons when students are more likely to be exiting school en masse. As we did not film these young pedestrians for ethical reasons, we made fewer observations in the afternoons because the majority of students left the school premises at the same time making live observations more difficult. In contrast, arrival times were more staggered in the mornings. Also, observations were overt, and the researcher was clearly in view of the pedestrians, which could have affected their behaviour.

A further limitation resulting from the restrictions on filming young pedestrians is that it is possible that the same pedestrian was observed on more than one occasion. Consequently, our data should be interpreted as observations of crossing events rather than the behaviour of individual pedestrians. Although fairly detailed information was obtained about how the adolescent was using the phone or another electronic device, information about safe and unsafe pedestrian behaviour was limited to three categories of behaviour. Other behaviours that could be added to the observation would be waiting time and whether the pedestrian stopped at the kerb before crossing. As the school had a high proportion of students from low-income families, it is possible that our results represent a conservative estimate of adolescent pedestrian phone usage.

In conclusion, adolescent pedestrians are frequent users of mobile phones and music players when crossing the road and this affects their looking behaviour.

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