ORIGINAL ARTICLE

THE EFFECTS OF MOBILE ELECTRONIC DEVICE USE IN INFLUENCING PEDESTRIAN CROSSING BEHAVIOUR

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ABSTRACT

Mobile phone distraction is a global issue in road safety perspective especially involving the pedestrians. A lot of research findings had suggested that the use of mobile phone increase the risk for pedestrians while crossing the road, but there have been very few studies that could explain the said threat in Malaysia's situation. This study aims to identify the distracted pedestrian behaviour via the video recording method. More than 300 samples were observed as involved in mobile phone distractions while crossing the roads from a total of approximately 1,500 analysed samples. The study also found that the highest mode of distraction observed among pedestrians was the "handheld usage" (conversing) as compared to the "hands-free" and "application usage" modes. In addition, the distractions had significantly affected the time to cross and the observed road users who were involved in "application usage" took longer time to cross. These results provide a prevalence material that may be useful in the development of countermeasures.

Keywords: *distraction, crossing, pedestrian, mobile phone*

INTRODUCTION

In the developed countries, pedestrians and other vulnerable road users (VRUs) account for almost half of the road traffic deaths[1,2]. Furthermore, the pedestrians are suffering from the today's "first world" problems that can be highly attributed to the usage of mobile devices, especially the mobile phones that have the combined abilities of many devices. In the United States, for example, more than 1,500 pedestrians' casualties were recorded in a year as a result of the mobile phone distractions[3].

Whereas in Malaysia, the casualties of pedestrian in road traffic accidents may be overlooked by many since the focus is more towards the motorized two- and four-wheelers. Though the number of deaths has been consistently high at between 6,000 and 7,000 a year for all types of road users, the cases related to pedestrians are also at a constant rate i.e. more than 500 fatalities per year and ranked third after the motorcyclists and passenger car occupants. It is more worrying when the statistics show that the fatality rate among the elderly (more than 60 years old) has soared to 44.2% in 2013, as compared to 24.4% in 2006. Furthermore, approximately 36% of the pedestrian fatal cases occurred at urban areas. On top of that, more than 60% of the cases happened on straight roads[3].

The pedestrian-related issues receive a substantial amount of attention among researchers around the world in order to primarily understand the situation and the associated factors. A review by Zegeer et al. had analysed more than 200 pedestrian safety studies that were published between the year 2000 and 2010 from various reputable journals (e.g. Transportation Research Records; Accident Analysis and Prevention) and reports. Their study had classified the pedestrian related accidents into five main categories: (1) Driver factors; (2) Pedestrians factors; (3) Vehicle factors; (4) Roadway/Environmental factors; and (5) Demographic/Social/Policy factors. Thus, this paper would like to put a special focus on the pedestrian factors, namely the emerging issue of distractions among the pedestrians[4].

The distractions that cause the pedestrians losing their invaluable attention while being on the road are becoming more complex in the era of modern communications when people pay more attention to listening music (wearing headphones), as well as using the mobile phones to chat, text, handle apps and play games. These are the relatively new threats to road safety with regard to the pedestrians, besides the so-called "traditional" distractions such as eating or drinking, smoking and talking with another pedestrians as they cross the streets.

Distracted pedestrians are presumably at high risk considering the process of crossing the

roads, for example, needs cognitive attention (e.g. more focus on phone conversation rather than the walking activity), cautionary behavior (e.g. looking before crossing the road), auditory cues (e.g. listening to the music using headphones), as well as motor coordination judgment to minimize the risk[5].

A number of studies have also investigated the impact of distraction on pedestrian safety through the analysis of injury and crash data based on existing databases, naturalistic observations and computer-aided simulations. One of the naturalistic observations in the United States had assessed the distracted pedestrians' behaviour with various types of distractions. The result shows that 5.7% pedestrians are distracted with the use mobile phones either by conversing or texting[6]. Other research revealed that 29% from a pool of 1,102 observed samples were distracted by the usage of mobile phones[7].

On the other hand, the computer-aided simulation is done in a controlled environment in order to eliminate the unnecessary risks to the experimental subject if it is done in a real setting. One of the studies revealed that children are at higher risks while engaged in mobile phone conversations[8]. Moreover, in another study by Schwebel et al. in 2012, the distracted pedestrians who are listening to music and texting are more likely to be struck by a virtual vehicle than those undistracted participants[9].

To the best of the authors' knowledge, there has been inadequate research being conducted in the subject of discussion to explain the status quo in Malaysia's environment. A study by Hanan et al. in 2015 had assessed the factors that influenced pedestrian intention to cross the road while using mobile phone based on the theory of planned behaviour (TPB) – in domestic environment. From their result, it shows that the subjective norm (SN) and perceived behavioural control (PBC) significantly influenced the intention to cross a road when using mobile phone, and they called for the actions from the relevant stakeholders to response on this growing issue among the road users[10].

Therefore, this study aims to determine the magnitude of the mobile phone distraction among the pedestrians in Malaysia. This is done through an observational study that had investigated the rate of distraction while crossing for both signalised and non-signalised crosswalks.

METHODS

This cross-sectional study was conducted in the city of Kuala Lumpur, which has a high density of pedestrian activities. Due to the limited resources and time only, four areas were selected i.e. Central Market and Puduraya for non-signalized pedestrian crossing; Bukit Bintang and Sogo Complex for signalised pedestrian crossing. Surveillance and recording at each point were conducted at two time intervals, namely at 7am-9am and at 12pm-2pm in order to obtain the maximum possible samples.

The observation was performed twice for a period of one week. Prior to the full data collection, a pilot test was performed at the Kajang Train Station to test and confirm the video recording procedures such as viewing angle and height and also the device placement at observation points. This station is located next to the authors' workplace.

During the data collection stage, all pedestrians' activities while crossing the roads at each observation points were captured using digital video recorders, which were strategically place at specific locations to ensure the crossing behaviours were as natural, as much as possible. Two sets of recorders were utilized at each observation point. A team of technicians were assigned to man these recorders.

Upon the completion of the observational recordings, the video records were analysed using a prepared checklist. Each record was reviewed twice in the effort to ensure the data accuracy. Among the variables observed in the video recordings were gender, type of distraction during crossing, time to cross and others. Inclusion criterion was all pedestrians who cross the roads at designated walk path. Pedestrians crossing with walking sticks, crutches and other assisting tools/device were excluded from the data. Pedestrians who walk in groups of three or more were also excluded due to complications or uncertainty in determining the type of distractions. Correspondingly, those who run while crossing was also not accounted for.

The final data was analysed using the SPSS software, in order to run the descriptive analysis and to determine the statistical significance such as the odd ratio.

RESULTS

In average, 1,455 pedestrians were observed crossing the roads from the sampled videos. From that, a total of 375 samples were classified as the "distracted" ones from both the signalized and non-signalized crosswalks - 272 samples were collected at the signalized crosswalk, while the rest, 103 samples were observed at the non-signalized crosswalk. The total of 375 pedestrians in this analysis consisted of 226 (60.3%) males and 149 (39.7%) females, as shown in Table 1.

The most common types of distractions recorded

were the usage of mobile phones (84.8%), "others" smoking and talking (5.9%), reading (4.8%) and drinking or eating (4.5%). Furthermore, 68.3% of the distracted pedestrians were observed using the designated area to cross (zebra crossing).

Table 1 - Pedestrians characteristics

Characteristics	n	%
Gender		
Male	226	60.3
Female	149	39.7
Type of distractions		
Drinking/eating	17	4.5
Mobile phone usage	318	84.8
Reading	18	4.8
Others e.g. smoking, talking	22	5.9
Crossing at designated crossing (zebra crossing)		
Yes	256	68.3
No	119	31.7

As this study was focusing on the mobile phone distractions, the usage of mobile phones were classified in three modes i.e. hands-free, handheld and application usage. A significant difference was found in gender and Table 2 shows the result of mobile phone usage mode by gender.

The result showed that males had a fairly similar rate of distractions in all three usage modes. The females, on the other hand, had relatively lower rates in all three usage modes and only the "hands-free" mode reaches about 50% of the distraction rate.

Table 2 - Usage of mobile phone modes by gender

Gender / Mode of usage	Female		Male	
	Yes	No	Yes	No
Hands-free (conversing or listening to music)	65	63	66	124
Handheld (Conversing)	25	103	62	128
Application usage (texting, gaming etc.)	38	90	62	128

The pedestrian behaviours also have certain association with these three modes of mobile phone usage as shown in Table 3. The result shows that the pedestrians who were involved in "application usage" mode (OR=1.708, 95% CI 1.025 to 2.848) were statistically significant for the behaviour of not observing both left and right prior to crossing (for oncoming vehicles or hazard). The "application usage" mode (OR=1.674, 95% CI 1.039 to 2.697) was also significant for the behaviour of not looking left or right during crossing. The result also revealed that the "handheld" and "application usage" were significantly affecting the gait of the distracted pedestrian (walking straight) while crossing the roads.

Furthermore, Table 4 shows the average of pedestrians crossing time according to the three mobile phone distraction modes. The result shows that those distracted pedestrians who were engaged in "application usage" seemed to have the slowest rate to cross with the average of 15.96 seconds, followed by "handheld" with 14.49 seconds. According to the distracted pedestrians' gender, the females tend to cross faster than the males when engaged in "handheld" and "application usage" but slower than males while in the "hands-free" mode.

Table 3 - Odds of unsafe pedestrian behaviour by type of distractions

Unsafe pedestrians behaviour	OR	95% CI	p-value
Not crossing at designated area:			
Hands-free (conversing or listening to music)	0.876	0.540 to 1.420	0.590
Handheld (conversing)	0.839	0.489 to 1.439	0.523
Application usage (texting, gaming etc.)	0.906	0.542 to 1.514	0.707
Not observe right and left prior to crossing:			
Hands-free (conversing or listening to music)	**0.587**	**0.351 to 0.981**	**0.041**
Handheld (conversing)	1.500	0.882 to 2.551	0.1331
Application usage (texting, gaming etc.)	**1.708**	**1.025 to 2.848**	**0.038**
Not look left or right during crossing:			
Hands-free (conversing or listening to music)	1.078	0.689 to 1.687	0.742
Handheld (conversing)	1.539	0.938 to 2.526	0.870
Application usage (texting, gaming etc.)	**1.674**	**1.039 to 2.697**	**0.034**
Crossing before car completely stop:			
Hands-free (conversing or listening to music)	**0.489**	**0.311 to 0.770**	**0.002**
Handheld (conversing)	0.764	0.446 to 1.253	0.286
Application usage (texting, gaming etc.)	0.785	0.488 to1.261	0.319
Not walk straight during crossing :			
Hands-free (conversing or listening to music)	**0.228**	**0.141 to 0.369**	**0.000**
Handheld (conversing)	**1.871**	**1.132 to 3.092**	**0.014**
Application usage (texting, gaming etc.)	**1.951**	**1.204 to3.161**	**0.006**

**Note: Bold p-values are significant at 0.05 level*

Table 4 - Average crossing time for different type of distractions

Mode of usage	Average time to cross (second)	Average time to cross (second)	
		Male	Female
Hands-free (conversing/listening to music)	14.06	13.66	14.54
Handheld (Conversing)	14.49	14.74	13.88
Application usage (texting, gaming etc.)	15.96	16.46	15.13

DISCUSSION

Though the study cannot be used to represent the entire situation in Malaysia, the results can be considered as the early exploration to the subject of pedestrian distractions primarily due to the usage of mobile phones. Based on the abovementioned result, the rate of distraction in "hands-free" and "application usage" modes were at 41.2% and 31.4%, respectively. This finding is fairly similar with the research done by the University of Washington in 2013 whereby their result shows that the most common instances are those exposed to listening to music (hands-free) while crossing the road[7].

In terms of the distracted pedestrians' behavior while crossing, all the three modes of mobile phone usage are having similar patterns i.e. not walking in a relatively straight path during crossing. In addition, in terms of walking pattern, previous study suggest that texting while walking and/or being cognitively will distracted significantly affect gait characteristics[11].

Moreover, the result shows that pedestrians in "hands-free" and "application usage" mode are more likely to cross without looking both ways – left and right. This is consistent with previous studies whereby the distractions had caused the loss of attentions to traffic both before and during crossing. The distracted pedestrians while talking (handheld) are also exposed to the danger of auditory diversion. It can cause pedestrians to ignoring significant objects in their environment and appear to exhibit unsafe behavior e.g. failure to look right and left, wait on curb for light to turn green before crossing[6]. For pedestrian who are distracted with texting,

gaming or other phone application usage, they are more at risk since texting affects both cognitive and visual distractions especially while crossing[12]. In addition, texting is four times more likely to engage in unsafe street-crossing behaviour as the pedestrians will not put their focus on the moving or oncoming vehicles as well as the surrounding environment[7].

Distracted pedestrians are also showing distinctive pattern in their walking speed while crossing[3,13]. In our study, "application usage" mode such as texting or gaming shows the highest average crossing speed (i.e slowest) as compared to the other mode of distractions, and this is similar to the findings by Thompson[7] and Barkley[14]. Although "hands-free" mode resulted in the lowest average time to cross, the behavior had affected the way the pedestrians crossing the roads. Previous study suggests that pedestrian who are exposed to music may alter their gait speed[15].

Moreover, the injury severity of pedestrian accidents while crossing is very much associated with what will be the opponent(s). During the video analysis, it was observed that there were the incidences of red-light running especially by the motorcyclists. This is basically increase the probability of the pedestrian getting hit by vehicles - with or without the influence of distractions. Earlier report in Malaysia shows that the most prominent red light runners are the motorcyclists[16] and the pedestrian distractions issues will make the situation even more risky.

From this observational study, it seems that the growth of mobile technologies especially the mobile phones have gradually influenced our pedestrians' walking behaviours. In Malaysia, the statistics shows that there are about 27.8 million mobile phone users as per 2015 data[17]. This shows that the situation has the potential to be even worse in the future and the relevant stakeholders must be more proactive to tackle the issue from the early days.

The findings from this study may also be used as the basis for developing proper countermeasures and educational campaigns.

CONCLUSION

Use of mobile phones while crossing the road can be broadly considered as one of the distractions among the pedestrians. Result shows that mobile phone application usage mode has a significant effect in term of crossing speed. Also, it revealed that the mobile phone distractions had caused them to not walk in a relatively straight path and it will pose more risks while crossing. It is hoped that this study may provide valuable insights on the safety impacts of pedestrian distractions primarily while using the mobile phones. Thus, the relevant parties should look into this growing issue among the road users and be proactive in providing the necessary countermeasures and educational campaigns.

ACKNOWLEDGEMENTS

The authors would like to thank the Malaysian Institute of Road Safety Research (MIROS) and the National University of Malaysia (UKM) for providing the platform to conduct this study. Special thanks goes to Zulyahikem Zakaria and other members of the Crash Safety Engineering (CRASE) Unit of MIROS, for their invaluable contributions in completing this paper.

COMPETING INTERESTS

There is no conflict of interest.

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