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PROFESSIONAL PAPER

The Impact on Mobile Phone use on Pedestrian Road Crossing Behaviour

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Abstract: Mobile phone use at pedestrian crossings has been recognized as a growing problem in the field of traffic safety. The objective of the paper is to analyze the impact of mobile phone use at pedestrian crossings considering specific territory. Signalized and unsignalized intersections are observed in the study. Several factors having the impact on unsafe pedestrian crossing behaviour are identified such as: age, location and the type of mobile phone using. The model of unsafe pedestrian behaviour based on displayed mobile phone use while crossing the intersection is constructed. It has been shown in this research that talking and texting on mobile phone distract pedestrians. Listening to music does not affect pedestrians to behave unsafely because it requires less cognitive activity than talking or texting. Also, location affects the pedestrian crossing behavior. The results of this research can serve the purpose of preventing the mobile phones use and reduce the negative impact on pedestrian crossing behavior.

Keywords: mobile phone use, pedestrian crossing, unsafe behaviour.

INTRODUCTION

The number of mobile phones is increasing, both in everyday use and in traffic, therefore it is unsurprising that the prevalence of pedestrian distraction by handheld technologies devices appears to be increasing. Nowadays, more than half of drivers use mobile phone as one of the most ubiquitous devices while driving. Besides motorists and cyclists, cell phones are increasingly used by pedestrians, which poses a significant traffic risk. At the same time, public concern is growing about their potential negative impact on traffic safety. At some point in the day, everyone is a pedestrian, and unfortunately pedestrian fatalities remain high. Pedestrian distraction is becoming a growing road safety concern worldwide and a great deal of research has been addressed to the impact of mobile phone use while driving or crossing the street.

Pedestrians' mobile phone use behaviour while crossing is a multi-tasking activity because it requires them to complete two tasks simultaneously resulting in walking errors. First, to observe the surrounding traffic environment carefully such as vehicles, traffic signs and signals. Second, pedestrians are compelled to pay visual, auditory and cognitive attention to check and operate their mobile phones to keep in touch with their social circle.

The aim of this study is to determine the percentage of pedestrian's mobile phone use at signalized and unsignalized intersections and to determine the impact of mobile phone use on pedestrian crossing behavior aiming to prevent its negative impact. The independent variables are defined in order to determine the output model of unsafe pedestrian behaviour. The rest of the paper is organized as follows. A brief review on related work is presented in second section. Third section provides the methodology used for obtaining the results. Results are presented and discussed in fourth section while fifth section concludes the paper.

RELATED WORK

So far, there is a significant number of studies considering mobile phone use and crashes among pedestrians. Crossing or walking along roads makes a minor part or total walking but presents the highest risk because of the potential interaction with motor vehicles. Mobile phone use among pedestrians leads to increased cognitive, physical, visual and auditory distraction, reduced situation awareness and increased unsafe traffic behaviour (Hatfield and Murphy, 2007; Neider et al., 2010; Lamberg and Muratori, 2012; Schwebel et al., 2012). The study in Russo et al., 2018 showed that talking or texting on a smartphone may not be significantly associated with walking speed, but pedestrians who were texting were more likely to commit crosswalk violations. Compared to the pedestrians that were not using mobile phones while crossing, pedestrians distracted by mobile

phones are shown to walk more slowly (Schabrun et al., 2014), change directions more often (Hyman et al., 2010), take longer and miss safe opportunities to cross (Byington and Schwebel, 2013) and usually make more errors (Pešić et al., 2016).

The study conducted by Lennon et al., 2017 demonstrated that attitudes and norms strongly influence pedestrian intentions to use a smart phone while crossing, particularly for younger pedestrians. Compared to non-smartphone users, the pattern of critical events was different for smartphone users as shown in Horberry et al., 2019. In order to suggest solutions for pedestrian distraction, Larue et al., 2020 analysed whether distracted pedestrians were able to detect the activation of lights as a warning. It has been shown that pedestrians are able to detect the activation of LED lights while performing a distraction task on their smartphone and that lights can be detected without the need to look directly at them. It should be included in the future studies and research.

Therefore, as pedestrians make the largest group of road users, their distraction due to mobile phone use is getting more attention and requires solving the problem. It is not possible to simply expect pedestrian to never become distracted. The results of this work will offer a profile and attitudes of pedestrians who use mobile phone and to better understand the incidence and severity of pedestrian mobile phone distraction. It will be one step toward and input to develop strategies and other countermeasures that minimize the impact of distraction on road safety, rather than attempt to eliminate it al together.

METHODOLOGY

Procedure

In order to obtain the model of unsafe pedestrian behaviour the observation method was used in this research. Four observers participated, each of them with defined task. The observers were so located that they could determine and enter into the survey form all those basic features of significance for the research. They noted the pedestrian crossing behaviour in both directions and recorded the total number of pedestrians and those who used mobile phones. The manner of using mobile phone was related to texting, talking or listening to the music and if any of these was used by pedestrian while crossing, the behaviour was assumed to be unsafe. The behaviour of pedestrians who used mobile phones was classified into two categories: those who pay attention at traffic or traffic lights before crossing (traffic environment) and those who did not. Crossing types were treated separately for most analyses because behaviours have differential relevance at signalized versus unsignalized crossings. A logistic regression was used to define the model of unsafe behaviour as the outcome. Logistic regression allows testing the models to predict categorical outcomes with two or more categories.

Participants

The research was conducted in Republic of Srpska (entity of Bosnia and Herzegovina). Data were collected in six locations in the city of Doboj, Republic of Srpska. Three signalized and three unsignalized intersections were selected based on their most common type (four-leg intersections with one traffic lane in each direction) and reasonably heavy pedestrian traffic (see Figure 1). During the period of research, the behaviour of 10280 pedestrians was recorded. 753 pedestrians used mobile phones. Speed limit at these locations is general speed limit in urban areas in Republic of Srpska, 50 km/h (Law on Road Safety).

Figure 1. The considered research locations

According to this law, both drivers and pedestrians have some obligations related to crossings and there is a predicted penalty for using mobile phones while crossing. The observation was carried out on a daily basis, on workdays (Tuesday and Thursday) in December, during one-hour period of the day- morning and afternoon. The pedestrians' age was estimated and classified into several different age groups (< 20, 21-30, 31–50, > 50). The structure of the sample is given in Table 1. The variables chosen to be independent are: age, gender, the location of intersection and the manner of using mobile phone.

Table 1. The structure of the sample

	Signalized	Unsignalized
Total number using mobile phone	375	368
Gender	Male- 148 Female- 227	Male- 149 Female- 219
Age	< 20- 164 21-30 - 117 31-50 - 77 > 50 - 17	< 20- 95 21-30 - 112 31-50 - 122 > 50 - 39
Total number of pedestrians observed	5587	4693

Coding and statistical analysis

After the field research was completed, obtained results were entered in the Excel table and processed. Methods of comparative statistical analysis, binary logistic regression using the SPSS 17.0 software, were used for a detailed analysis of results obtained in the field survey. The binary logistic regression was used in order to estimate the influence of several factors on the dependent variable and to predict the outcome variables (unsafe type of behaviour). All independent variables are classified as dichotomous (coded with 0 or 1 in SPSS) except the age variable which has been treated as ordinal. The threshold of the statistical significance has been set up at 5%.

RESULTS AND DISCUSSION

We constructed the model of unsafe pedestrian behaviour based on displayed mobile phone use while crossing the intersection. The model included the following predictor variables: gender, age, the manner of using mobile phone and location of intersection. At the signalized intersections 6.71 % of total pedestrians used mobile phone, while at the unsignalized intersections 7.84 % used mobile phone. At the signalized intersections 64.3 % of pedestrians were texting, 18.4 % were talking and 17.3 % were listening to music. At the unsignalized intersections 48.6 % were texting, 36.1 % were talking and 15.2 % were listening to music (see Figure 2).

The whole model with all the predictors was statistically significant: $\chi 2$ (9, N = 753) = 223.118 (Chi-square), $p < 0.001$. As shown in Table 2, three independent variables made a statistically significant contribution to the model: age, the manner of using mobile phone and the location of intersection.

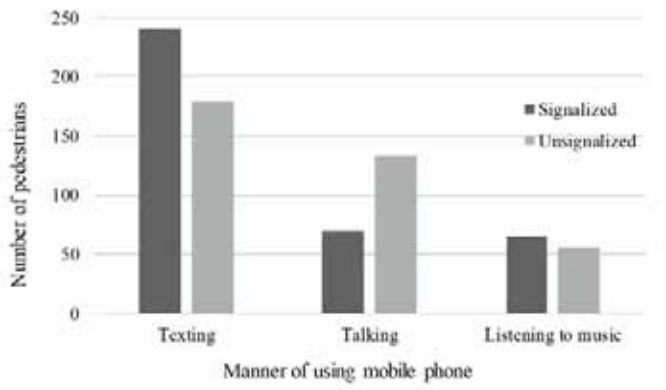

Figure 2. Mobile phone use

The results have shown that gender does not affect pedestrians to behave unsafely ($p = 0.167$). Pedestrians younger than 20 years have 2.7 times bigger chances to behave unsafely while crossing compared to software reference group (> 50 years) while pedestrians aged 21-30 have 1.7 times bigger changes to behave unsafely. Pedestrians from the age group 31-50 do not have statistically significant greater chances to behave unsafely when compared to the reference age group ($p = 0.106$). The pedestrians talking on mobile phones while crossing have 2.8 times bigger chances to behave unsafely than those who do not use mobile phones while for pedestrians texting on mobile phones the chance to behave unsafely rise by 2 times. So, it has been shown in this research that talking and texting on mobile phone distract pedestrians. Listening to music does not affect pedestrians to behave unsafely because it requires less cognitive activity than talking or texting. Also, it could be seen from Table 2 that location affects the pedestrian crossing behavior ($p < 0.001$).

Considering location, two types of intersections were investigated in the paper: signalized and unsignalized. The percentage of pedestrians paying or not the attention to the traffic environment depending of the intersection type is given in Table 3. It could be seen that the number of pedestrians not paying attention at traffic environment is higher on signalized intersections (55.5 %) while the number of pedestrians paying attention at traffic environment when using mobile phone is higher on unsignalized intersections (62.2 %). This can be attributed to the fact that pedestrians feel safer and have more freedom to use mobile phones when there are traffic lights while at unsignalized intersections they have to pay more attention at the coming traffic.

Table 2. Odds ratios for predictors of unsafe pedestrian crossing behaviour

	The model of unsafe behaviour
Gender	0.905 (1.795-2.399) p = 0.167
Age	2.733 (2.016- 3.707) p < 0.001
< 20	1.718 (1.273- 2.319) p < 0.001
21-30	1.276 (0.950- 1.713) p = 0.106
31-50	
The manner of using mobile phone	2.037 (1.610- 2.579) p < 0.001
Texting	2.801 (2.127- 3.688) p < 0.001
Talking	
Location	2.075 (1.795- 2.399) p < 0.001

Table 3. The percentage of pedestrians paying/not paying attention at the traffic environment

	Signalized	Unsignalized
Total number using mobile phone	375	368
Gender	Male- 148 Female- 227	Male- 149 Female- 219
Age	< 20- 164 21-30 - 117 31-50 - 77 > 50 - 17	< 20- 95 21-30 - 112 31-50 - 122 > 50 - 39
Total number of pedestrians observed	5587	4693

It should be noted that some of the limitations of this research are the number of observers (there were not two observers noting the same data), the number of intersections and the time of research. In some future work more intersections and higher number of observers should be included. Also, the percentage of pedestrians who used mobile phones is recorded in December (cold time) and some future work should include the summertime because this number would be probably higher.

This research gives the answers on factors distracting pedestrians in the city of Doboj as well as the locations where pedestrians behave less or more safely while crossing (pay attention or not to traffic environment). This could be the input data for local government to apply some measures such as LED lighting of pedestrian crossing because conflict zones such as pedestrian crossings require greater attention from traffic participants and therefore better lighting than with traffic routes without the danger of collisions. Also, road safety campaigns could be implemented with target aged groups according to the results (< 20, 21- 30 years). The campaigns should make pedestrians to recognize the risk of using mobile phones while crossing.

At the territory of Republic of Srpska (entity of B&H) a national methodology for measurement and monitoring road safety performance indicators at the territory has been defined. According to this methodology there are 4.4 % of drivers who use mobile phones. However, the methodology does not provide the measurement of pedestrians using mobile phones or other mobile devices. We think these data should be included because drivers and pedestrians are two different categories and the behaviour of both differs when using mobile phones.

CONCLUSION

The decrease in prices and the development of technologies brought a widespread use of mobile phones and its significant impact on pedestrian traffic safety. The negative impact of using mobile phones must be considered and researched separately for drivers and pedestrians because of two different tasks that require visual and cognitive perception. The results of this research can serve the purpose of preventing the mobile phones use and reduce the negative impact on pedestrian crossing behavior.

It has been shown that many pedestrians in the city of Doboj use mobile phones while crossing (about 7 %) and it is intuitively expected that this number should be even higher in the summertime. Texting and talking, pedestrians up to 20 years old as well as 21-30 years are the main factors that are identified to have the impact on unsafe pedestrian behaviour. Also, the type of intersection influences different the pedestrians' attention while crossing and that is why signalized and unsignalized intersections are treated separately.

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