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# The effects of mobile phone use on pedestrian crossing behaviour at unsignalized intersections – Models for predicting unsafe pedestrians behaviour

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ABSTRACT

With the rapid rise of the use of mobile phones worldwide, the traffic safety experts have considered effects of mobile phone use on pedestrian crossing behaviour. This study sought to find out how the use of mobile phones (talking, texting and listening to music) affects the behaviour of pedestrians while they are crossing the street. Using field observation the data have been collected concerning the demographic characteristics and behaviour of the pedestrians from the target group (the pedestrians who use mobile phones) and from the demographic-matched and time-matched control group (the pedestrians who did not use mobile phones). For predicting the unsafe types of behaviour the logistic regression models were constructed and it included the next predictor variables: gender, age, number of accompanying pedestrians, the manner of using mobile phones and location of intersection. The results of the research have shown that the pedestrians who use mobile phones while crossing the street behave less safely than the pedestrians who do not use mobile phones and that their safety depends on the way they use mobile phones. Mobile phone talking has the greatest effect on the unsafe behaviour of pedestrians; texting/viewing content on mobile phone also influences the pedestrians' behaviour though less than speaking, while listening to music has the smallest impact.



## 1. Introduction

The expansion of mobile phones has brought to the rising number of pedestrians who use mobile phones in daily traffic activities. Numerous studies have examined the effects of mobile phone use on the behaviour of drivers, while just a few studies have dealt with the effects of mobile phone use on the behaviour of pedestrians.

A recent research, conducted by Nasar and Troyer (2013), showed that in 2005 in the USA 256 pedestrians had been hospitalized because of the injuries obtained due to using mobile phones. This number has been constantly increasing since then and in 2010 it was six times bigger than in 2005. The research also pointed out that the risk of injuries due to the distracted walking was significantly higher with young people and that both pedestrians and drivers had more injuries connected to mobile phone talking than to texting. Regarding pedestrians, mobile phone talking caused about 69% of the estimated injuries, while texting brought to 9.1% of the injuries (Nasar and Troyer, 2013).

Two separate studies carried out by Nasar et al. (2008) researched the distraction of pedestrians due to mobile phone use. In the first study, 60 participants were walking along a specific path while a half of them were talking on mobile phones and the other half were holding a phone in their hands waiting for a call that was never made. At the end of the walk, the participants were asked to remember the things they had noticed along the road. The analysis showed that the pedestrians who had not been talking on mobile phone had noticed a significantly greater number of objects than the pedestrians who had been talking on their mobile phones. These results showed that the lower awareness of the situation was related to mobile phone conversation, which was in accordance with the findings of fixation or reduced visual scanning among drivers with a high workload (Harbluk and Noy, 2001). The study tried to determine whether the pedestrians who used mobile phones while crossing the ştreet demonstrated unsafe behaviour more often than those who listened to music on iPod players and those who did not use mobile phones while crossing the street. The results of this study showed that the rate of unsafe behaviour was significantly higher with the users of mobile phones

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than with the users of iPod players, as well as than with those who used neither mobile phones nor iPods.

Hatfield and Murphy (2007) found out that the mobile phone use while crossing the street could lead to some unsafe types of behaviour which are gender-specific to a large extent. The results of this study showed that mobile phone talking threatened some types of behaviour which were of great significance while crossing the street safely, especially among women. Specifically, the results showed that female pedestrians paid less attention to the traffic before and during street crossing (a similar result model was also for men at unsignalized intersections, which could have been significant if the sample had been bigger), and that mobile phone talking was related to the lower street crossing speed by women at signalized intersections and by men at unsignalized intersections. These findings are in accordance with reducing the speed of driving while using mobile phones, as noticed by several studies (Brown et al., 1969; Haigney et al., 2000; Burns et al., 2002; Jenness et al., 2002; Tornros and Boiling, 2005), but reducing the walking speed can reflect a similar mechanism, too.

In a study carried out by Neider et al. (2010), 36 students were directed through a series of unsignalized intersections by walking on a manual treadmill in the virtual environment. While crossing, participants were undistracted, engaged in a hands free cell phone conversation, or listening to music on an iPod. Pedestrians were less likely to successfully cross the street when talking on a mobile phone than when listening to music, even though they took more time to initiate their crossing when talking on a mobile phone ($\sim$1.5 s). These results point out that the pedestrians who talk on a mobile phone while crossing the street are less likely to recognize and react to the possibilities of crossing the street.

Stavrinos et al. (2011) carried out two experiments using an interactive three-dimensional virtual environment. The results of both experiments point out that mobile phone talking distracts student pedestrians. Experiment 1 points out that distraction affects all students, not only inexperienced pedestrians, inexperienced mobile phone users or those with weaker attention or information processing abilities. Experiment 2 shows that the content of the conversation does not play a major role in distraction. On the contrary, all mobile phone talking, regardless of the level of its cognitive complexity, distracts students while crossing the street. These results support the previous findings that the natural limitations of human performance make the distraction inevitable, which brings to lowering almost everyone's performance to a certain extent (Yee and Vaughan, 1996; Kannass et al., 2006; Forster and Lavie, 2009; Neider et al., 2010).

A study conducted by Schwebel et al. (2012) was designed to determine how mobile phone talking, texting and listening to music could influence the safety of college age students. In the virtual environment, the participants were at random attributed one of the four conditions: distraction by listening to music, distraction by mobile phone talking, distraction by texting or the control group (no distraction). The participants who were listening to music or texting while crossing the street had more collisions with the vehicles in the virtual environment than the participants who were not distracted. The research also showed that all three groups of the distracted pedestrians had looked away from the street environment while crossing the street more often than the pedestrians who were not distracted. Generally speaking, the results of this study show that distraction can have small but significant influence on the safe behaviour of college age students.

None of the mentioned field studies determined the percentage of pedestrians' mobile phone use. Furthermore, each of the referred studies considered only some of the aspects of the influence of mobile phone use on pedestrians' behaviour (e.g. the influence of mobile phone use on the behaviour of a male pedestrian as opposed to the influence on the behaviour of a female pedestrian, the influence of mobile phone use on the behaviour of a student pedestrian, the influence of talking on the mobile phone, etc.).

Therefore, the aim of this research was to determine the percentage of pedestrians' mobile phone use at unsignalized intersections (in the city centre and on the outskirts; on workdays and on weekend), then to determine the influence of mobile phone use on pedestrian crossing behaviour (pedestrians of all ages) and finally to predict the unsafe pedestrian behaviour using the following predictor variables: gender, age, number of accompanying pedestrians and the manner of using mobile phones.

## 2. Material and methods

### 2.1. Design

According to the design this study belongs to the cross-sectional studies of observational type.

The method of scientific observation was used in this research and the observation was performed directly. The method of scientific observation contributes particularly to the estimation of traffic safety in the situations when there is insufficient information. This is the method of collecting facts which are most frequently related to behaviour. Scientific observation has to be well conceptualized, pre-planned and conducted systematically and purposefully. Prior to observation, it is significant to determine the time, place and way of observation. Observation can be indirect and direct. It is of utmost importance that the observer does not influence the observed phenomenon.

Namely, six observers participated in the research, two of them noted the behaviour of pedestrians in one direction, two did the same in the other direction, and the last two observers' task was to count the pedestrians who used the pedestrian crossing (one in one direction and one in the other direction) at the analyzed intersection during the period of observation. One observer noted the behaviour of the pedestrians who used mobile phones (the reference group), and the other observer noted the behaviour of the first pedestrian who passed after the pedestrian using the mobile phone and who did not use the mobile phone (the time-matched control group) and the behaviour of the pedestrian who did not use the mobile phone but who was of the same gender and age as the pedestrian using the mobile phone (the demographic-matched control group). The same method was used for both directions of pedestrians' crossing.

The authors distributed counting forms to the observers and explained their tasks thoroughly. Since the observers were to classify particular pedestrian behaviours in the specific manner, the authors used a video recording, which had previously been made at the observed intersections, to show the observers, on the specific examples, which pedestrian behaviours to record and how to classify them.

Observers were in charge of observing the gender, age, the number of accompanying pedestrians, whether the pedestrian used a mobile phone and if so, in what manner (talking on mobile phone, texting or viewing the contents on the mobile phone or listening to music) as well as the following five behaviours of pedestrians: whether the pedestrian looked at traffic before crossing, whether the pedestrian waited for traffic to stop before crossing, whether the pedestrian looked at traffic while crossing, whether the pedestrian started the crossing at the marked pedestrian crossing and whether the pedestrian finished the crossing at the marked pedestrian crossing.

It should be pointed out that observers did not record the number of times the pedestrian looked at the traffic before crossing or the number of times the pedestrian looked at the traffic while crossing the street; the pedestrians who at least once looked at