Transportation Research Part F 42 (2016) 456–467

Contents lists available at ScienceDirect

Transportation Research Part F

journal homepage: www.elsevier.com/locate/trf

Pedestrian compliance and cross walking speed adaptation due to countdown timer installations: A self report study

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ARTICLE INFO

Article history:
Received 1 October 2014
Received in revised form 1 May 2015
Accepted 8 July 2015
Available online 21 July 2015

Keywords:
Pedestrians
Crossing behaviour and compliance
Countdown timer
Binary and ordinal regression model
Walking speed adaptation

ABSTRACT

Although they are aware of the possible risk, a high number of pedestrians still violate the red light indication and cross the road illegally. This hazardous behaviour may cause incidents between them and the road vehicles. In order to reduce this illegal behaviour, the traffic signals are equipped with countdown timers, in order to provide more information and decrease pedestrians' noncompliant behaviour. The main purpose of the present paper is to investigate the influence of countdown timers on pedestrians' compliance regarding their crossing behaviour at intersections as well as to examine the parameters affecting walking speed adaptation. In the context of this analysis two regression models were developed. The first model is a binary logistic regression model which examines pedestrians' self reported compliance. The results showed that the gender, the age, the perceived comfort and the seconds remaining for the onset of red light are the main parameters that affect compliance. The second model is an ordinal regression model which examines the factors that make pedestrians adapt their walking speed as they are crossing the road and are informed by the countdown timers about the second remaining for the termination of the green phase. The results of the second model revealed that the age, the compliance and the perceived assistance that the countdown timer provides for the walking speed adaptation affect the minimum remaining time before a pedestrian accelerates.

1. Introduction

According to the World Health Organization (World Health Organization, 2013), the majority of fatalities amongst the road users are pedestrians; the percentage for the US is 16% (e.g. 16% of the total road fatalities are pedestrians), for the EU states is 20% whereas the respective percentage for the CIS states (Commonwealth of Independent States) is 33%. In the cases of accidents where pedestrians are involved, they are the road users who suffer more since they are vulnerable against any other vehicle (car, bicycle, bus etc.). This fact should not absolve them from their responsibilities as they do not always have compliant behaviour, especially when they are crossing intersections. According to Preusser, Wells, Williams, and Weinstein (2002) and a more recent research study undertaken by Ulfarsson, Kim, and Booth (2010), pedestrians may be the main responsible for crashes that happen at signalized intersections, because of an illegal attempt

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http://dx.doi.org/10.1016/j.trf.2015.07.010
1369-8478/

of crossing; they found that some pedestrians tend to violate the indications of traffic lights when they reach the curb and need to cross the road. The decision making for crossing or not the road follows the procedure perception–judgment–decision–action as it was found by Guo, Wang, Guo, Jiang, and Bubb (2014).

The main purpose of the present paper is the examination of pedestrians' behaviour at the crossing facilities, in the presence of countdown timers. The paper is divided into seven sections, including the present introductory part. The second part presents a literature review regarding pedestrians' behaviour at intersections equipped with conventional signals and countdown timers. At the third part the undertaken research is described in detail. The fourth part includes the descriptive and inferential statistics that derived from the analysis. The following two parts include the regression models developed into the context of the analysis whereas at the last section the main conclusions of the study are presented and commented.

2. Literature review

There are several researches that have investigated pedestrians' behaviour at signalized intersections. According to Koh and Wong (2014) the decision for illegal crossing is related to the headway gap between the passing vehicles. In this study, video observations used for the development of a logistic regression model, to investigate the acceptance, or not, of a gap. The issue of gap acceptance is also included in a questionnaire survey that was conducted into the framework of a research by Sisiopiku and Akin (2003). A percentage of 45.2% of pedestrians admitted that they would cross the street, if they consider a sufficient gap. A same percentage stated that they would wait first for traffic to clear and only 9.6% of the respondents stated that they would wait for the green light. According to the same research, the crossing distance is also an influential factor for taking the decision to cross the road or not. Pedestrians' crossing behaviour is also affected by various endogenous characteristics of the pedestrians' own selves (Guo et al., 2014). Pedestrians who perceive convenience and time saving as more important priorities tend to violate more the traffic lights indications. On the other hand pedestrians who perceive safety as first priority are more compliant. The same study also revealed a positive correlation between detour distance until the crossing facilities and the possibility of crossing the intersection.

Zhou, Ren, Wang, Zhang, and Wang (2011) report that crossing behaviour can be affected by the different movement patterns of pedestrians and also by the pedestrian gathering before crossing. Regarding the first case, pedestrians, when crossing, are categorized in "walkers" and "runners". According to the authors, the latter group is more possible to violate the traffic light indications. In the same study it is reported that the gathering of pedestrians at a road curb may also cause violations. The results showed that if a pedestrian crosses illegally the road some of the rest may imitate him and also cross the road illegally. Contrary to this finding, Rosenbloom (2009) found that pedestrian gathering increases compliance, in comparison with standing-alone pedestrians. The same author reports that the illegal crossing of an individual pedestrian does not affect the behaviour of rest group. Koh, Wong, and Chandrasekar (2014) used video observations to develop a logistic regression model to estimate the probability of signal violation. The results of the model included the following factors: number of crossing lanes, being accompanied or not, gender, crossing length, accepted waiting time, standing position of subject, number of passing vehicles and number of violating pedestrians as the more influential.

The social characteristics of pedestrians are also found to affect compliance. Risk taking is associated with the gender of pedestrians in several studies (Koh et al., 2014; Li, 2014; Rosenbloom, 2009; Tom & Granié, 2011). Men are considered as more risk takers and undisciplined, regarding the indications of traffic lights. Tom and Granié (2011) explain this finding by the different type of visual search, between men and women, before and during crossing. They report that men are paying more attention to the passing vehicles while women look more at the traffic lights and the other pedestrians. Contrary to this outcome, Zhou et al. (2011) found that men tend to be more compliant than women. Several reasons are considered for this finding as, the local characteristics, women lower walking speeds that force them to still cross when the light turns red and women lack of driving experience. This latter outcome is also reported by Hamed (2001). In this research, it is stated that pedestrians with access to private vehicles are less risk takers and more careful. The age of pedestrians is also considered a characteristic that influence behaviour (Li, 2014; Zhou et al., 2011). Researches revealed that the elder pedestrians (more than 60 years old) are less risk takers and more aware compare to the young and middle age pedestrians who behave more hazardous. Not all studies agree with this outcome as Rosenbloom (2009) did not conclude any important difference amongst the users of the various age intervals.

Risk taking and illegal crossing is also related to the waiting time needed for the green light. Guo et al. (2012) suggests that crossing behaviour is positive dependent with the waiting time. Therefore, as the waiting time increases, the probability of a pedestrian violation increases too. The authors also focused on two crucial time values: 3 s and 50 s. The first value indicates the shortest duration until a risk taker start crossing the road. The second value is the patience level of most pedestrians. Li (2013) developed a waiting-time model. According to this model waiting time influence different the various age intervals. The general outcome was that older pedestrians intend to wait more that younger. An interesting outcome, regarding waiting time, derives from Xiong, Xiong, Deng, and Wang (2014) study. Pedestrians were questioned about their maximum accepted waiting time. A percentage of 41% of the respondents stated 60 s as the maximum waiting time before becoming impatient while almost 40% stated 120 s. However, Keegan and O'Mahony (2003) observed that pedestrians' perceived waiting time is usually higher compared to the duration the actually wait. Finally, Hamed (2001) reported that pedestrians who are frequent users of certain crossing facilities and live nearby the intersection, tend to be more risk takers, as they are less willing to wait. On the other hand, pedestrians who experienced a traffic accident are more willing to wait for the green light onset.