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Pedestrians' Safety Perception at Signalized Intersections in Shanghai

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Abstract

Pedestrians are the most vulnerable users at signalized intersections, and their incorrect behaviors such as signal violation, and not crossing at crosswalks etc., which is greatly determined by their safety perceptions, makes the situation even worse. To understand pedestrians' perception can help traffic engineers to improve facility planning, design and operation so as to provide better experiences of pedestrians crossing at signalized intersections. The study conducted intercept survey at 32 crosswalks in Shanghai, 1286 pedestrians were asked to rate their safety perception from 1 to 5. Pedestrian behavior types have been categorized into three types according to the signal indications when they enter crosswalk, namely Green walkers (GW) who enters in green, Late walkers (LW) who enters in flashing green, and Red walkers (RW) who enters in red. A random-effects ordered logit model has been developed and estimated, the results showed that the refuge island settings and being involved in conflicts had significantly impacts on pedestrian perceptions. All types of pedestrians are in favour of the presence of refuge island, however, LW feel safer if they can stop at refuge island, while the RW perceive less safe. Some recommendation on crosswalk design and operation are proposed based on the conclusions.

1. Introduction

Pedestrians are the most vulnerable road users on urban streets, accident statistics indicate that pedestrians accounted for 30 percent of total traffic fatalities in China in 2011, however, not only in China, but worldwide, pedestrian safety has become a major concern in recent years. Compared with motorized vehicles, pedestrian

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behaviours are much more flexible and violations can be frequently observed, such as crossing on red, or crossing not at crosswalks.

Behavioural models such as "Health Belief Model (HBM)" and "Theory of Planned Behaviour (TPB)" have been proposed that perceptions/perceived control play an important role on behaviour (Rosenstock et al., 1988, Ajzen, 1991). To be more specific, for a pedestrian, a trade-off between perceived benefits (e.g. time saving, or preventing boredom and inconvenience etc.) and perceived barriers, mainly referring to their perceived collision risks, determines their final behaviour to some extent. Therefore, to understand pedestrians' perception and behaviour is a more direct way to help traffic engineers to get to know road user' acceptance of the facilities, thus to improve facility planning, design and operation so as to provide better experiences of pedestrians crossing at signalized intersections.

A pedestrian signal including three indications in a cycle, green, flashing green (used in most part of China during pedestrian clearance interval), and red. According to the signal indication when a pedestrian enters crosswalk from curbside, pedestrian behaviour types are categorized into three types: Green walkers (GW), Late walkers (LW) and Red walkers (RW). The study aims to survey safety perceptions for the above three types of pedestrians and find out key influencing factors on pedestrian perceived safety, respectively, and propose corresponding suggestions on facility planning, design and operations.

2. Literature Review

Perception, closely related to behaviour of pedestrian safety, could be seen as a vital indication of level of service at a pedestrian street-crossing. In actual research, the pedestrians' perception data can be obtained through various investigation methods, such as interviews with questionnaires surveys, observational method, simulation studies, or through more integrated methods, more details can be found in Table 1. However, majority of researchers use questionnaires surveys to acquire data regarding attitudes and behaviour. The influencing factors can be summarized into the following three categories, i.e. the individual demographic characteristics, situational conditions, and environmental conditions.

2.1. Individuals' Demographic Characteristics

Personal characteristics such as gender and age have been shown to be crucial contributing factors to impact pedestrian perception, gender has been paid more attention to than age. Papadimitriou et al. (2013) found that gender has the most significant effect on the pedestrians' perception by PCA and Cluster analysis. Other research pointed out that male pedestrians are more impatient in traffic activities than female pedestrians (Ren et al., 2011). In the contrast, Yagil (2000) shows that women's perception of their sensibility to an accident resulting from an unsafe crossing is higher than that of men. Age is another major factor influencing perception to be studied. Different age groups have different walking needs, like younger pedestrians being more willing to tolerate pedestrian congestions while older pedestrians needing more walking space to have the same perception of comfort (Kang et al., 2013).

2.2. Situational Conditions

If pedestrian demographic characteristics are related to perception, the specific situational conditions in which pedestrians cross the street may do so even more. Factors like group size, traffic volumes of pedestrians or vehicles, conflicting motorized and so on would influence pedestrians' perception. For instance, HCM (2010) pointed out that the pedestrian LOS is moderately sensitive to sidewalk width, and highly sensitive to curb lane traffic volume. Moreover, Bian et al. (2009) presented that pedestrians' perceptions of comfort and safety are connected to traffic conflicts, crossing facilities, and delay by Pearson Correlation analysis and regression analysis. In another more complete study, safety and comfort of pedestrians are fairly high when pedestrians cross in groups. Since motorized vehicles often find it difficult to push through groups, they tend to yield to pedestrians.