A Review: Researches on the Effects of Pedestrian Crossing Intersections

Yuanyuan HE

The Institution of Traffic and Transportation, Chongqing Jiaotong University, Chongqing, CHINA

Abstract: Pedestrians crossing the street is one of common phenomena in urban traffic, and it has a large significance to research the behaviors of human and vehicle based on pedestrians crossing streets. When vehicles run in the process of traffic caused disturbances by pedestrians crossing the street, vehicles' behavior can change according to the different locations .At the same, when the pedestrians crossing the street are disturbed by motor vehicles, pedestrians tend to be affected by the psychological factors, such as the decision to adapt themselves to the traffic environment. According to the reasonable analysis about the pedestrian traffic behaviors, we can provide the theoretical foundation to solve the problems of the traffic efficiency and the safety evaluations. Through querying the literature, this paper summarized the recent domestic and international research status on the behavior of pedestrians crossing the street, and mainly summarized the research level and the research methods of model.

Keywords: Pedestrians crossing the street; Intersections; Pedestrians' psychologies; Conflicts of pedestrians and vehicles; Building models

1. Introduction

With the gradually popularity about scientific development concept of "people-oriented", Urban pedestrian traffic is no longer be ignored. Such as pedestrians travel safety, efficiency, comfort level and so on, which are the important factors to deal with the urban traffic problems. The analysis of traffic behavior crossing is an important part of urban pedestrian traffic, and is also important to solve the city traffic problems of the influences of pedestrian crossing traffic. Domestic and foreign scholars researched on the influences caused by pedestrians to obtain abundant research results. This paper introduces the research status at home and abroad from the following aspects: pedestrians' traffic characteristics, conflicts of pedestrians and vehicles, the delay of pedestrians' crossing the streets.

2. The Research on the Psychological and Behavioral Characteristic Theory of Pedestrians Crossing the Street

2.1. The analysis of pedestrians' psychologies

Fan Hongwei, a lecturer in energy and safety engineering institution of China University of Mining and Technology, researched on urban pedestrians' unsafe traffic behaviors based on the principle of traffic psychology [1]. He analyzed the relationship between pedestrian travel cognitive psychology and behavior, and built a concept model of the process of pedestrian dealing with information. And then, he pointed out that the cognitive psychology of pedestrians was closely related to traffic accidents.

With the method of qualitative analysis, he summarized pedestrian unsafe behaviors into two categories: intentionally and unintentionally. Consequently, he analyzed on pedestrian psychology influences to unsafe behaviors from the aspects of subjective and objective.

Yang Yan and etc, the professor of Tongji University, in order to have a further understand about pedestrian illegal behaviors crossing the intersection. They studied the reason of influencing pedestrian psychologies , which caused to the pedestrian illegal behaviors crossing the street. By adopting the theory of planned behavior (TPB), they formulated the pedestrian psychological behavior questionnaire of illegal behavior crossing the street [2].According to the questionnaire, they viewed on Shanghai residents crossing the street with Illegal behaviors. As a result, they get 250 effective samples of various ages. The structure of the TPB model is shown in Figure 1.
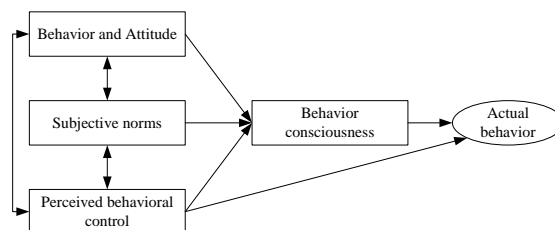

Figure 1. Structure of TPB

Besides, through a questionnaire composed of nine questions, they collected a index α based on Cronbach reliability . Because the questionnaire scored by the way of

HK.NCCP

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 5, Issue 4, August 2016

Integer ladder, the spearman correlation coefficient is regarded as the internal related degree of the specific quantitative values, which can describe the correlation between the parameter variables. The result is shown in Figure 2.
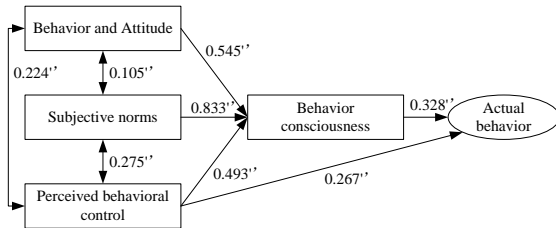

Figure 2. Correlation coefficients of pedestrian illegal crossing and psychological factors

2.2. The research on pedestrian behavior studies influenced by pedestrian age and gender

Zeeger found that older pedestrians had slower responses to external stimulus due to physiological reasons, and so that they were often unprepared when they crossed the busy roads and intersections. In addition, older pedestrians have a long time to cross roads, and cannot have enough attentions to the surrounding traffic environment while crossing the street. Usually, pedestrians are lower than motorists' law-abiding rate. The reason is that the traffic environment is based on the characteristics of the motor vehicle drivers [3].

Zhou Ronggang put forward a survey scheme of Chinese pedestrian behavior analysis affected by age, sex and consistent tendency. The survey questionnaire got 426 pedestrians samples. The questionnaire measured both cases for pedestrian behavior being consistent and inconsistent in others' behaviors, behavior consciousness and so on. The study had shown that the intervention should be more focused on raising the dangerous awareness crossing the street. Pedestrians should be aware of that crossing the street together with other pedestrians ignoring traffic signals is unsafe and prohibited [4].

Because pedestrians crossing the street in a city are often involved in danger, Erel Avineri studied on pedestrian crossing speed and the direction of head. At the same time, he researched that the rate of pedestrian bow when crossing the street (without looking at the traffic flow), which had impacts on the traffic accidents. In addition , the study also discussed influence about the pedestrian "fear of falling (fear of falling, ')" crossing the street crowd. The conclusion was that age and gender is the most important influence on the speed of crossing the street. FOF had also an important effect on the proportion of pedestrian bow while crossing the street[5] .

3. Conflicts of Pedestrians and Vehicles

The conflict between pedestrians and motor vehicles crossing the street is a typical conflict. As we all known, the conflict is influenced by many factors between pedestrians and motor vehicles crossing the street. Such as the presence of pedestrian crossing, the location of pedestrian crossing, the presence of signal control. As the flowing, some research results at home and abroad was summarized.

Lars Leden researched on the pedestrian crossing safety assessment parameters based on the related data of nearly 300 intersections in Hamilton city [6]. Blogger Hamed used the way of survival analysis to study pedestrian crossing tolerance time and pedestrian traffic regularity crossing the motor flow [7]. S.Schmidt viewed from two angles of pedestrians and observers to predict pedestrian behaviors. From the perspective of pedestrians, the decision-making of crossing the street was influenced by the distance and the speed of the car. Data analysis found that pedestrians rely mainly on the distance between vehicles to decide to cross the street , but not time. From the perspective of the observers, they presented that what parameters would be used to predict the pedestrian behavior intention [8]. On the basis of predecessors' research and investigation, Mitman analyzed pedestrian behaviors under different conflict conditions [9].

Domestic research also made a lot of progress in this aspect. Yan ping analyzed the conflict phenomenon between right transfer and pedestrians. She built the flow model of the right transfer and phase separation of pedestrian and raised a calculation method of the critical value of phase separate [10]. wang Junhua and Fang Shouen established severity index of pedestrians and vehicle conflict based on traffic conflict theory, and qualitatively analyzed the flight behavioral characteristics between pedestrians and vehicles conflict[11]. Professor Wang Wei of Southeast University used artificial observation method based on video data to acquire conflict between pedestrians and motor vehicles. He based on the analysis of the form and type of conflicts to indexes for traffic conflict characterization, and used FCM clustering analysis method to get the seriousness of each type of traffic conflict and risk [13].

4. Modeling Study of Pedestrians Crossing the Streets

Helbing et al. built the model of social force making remarkable contributions. In the model, pedestrians are seen as self driven particles. In order to represent the interaction between people, people and environment, the concept of the social forces are referenced. And the line in the stream of people recreates the cluster phenomenon [14]. Bandini etc. built a line of crowd evacuation model considering the influences of the pedestrian group. And in the experiment, they used random generation cellular

HK.NCCP

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 5, Issue 4, August 2016

automata to generate the pedestrian group distribution of particles in the crowd [15].

The paper of Tong Weiping, Cheng Lin from Southeast University chose the line flow process as the research object. It analyzed the effect of behavior dynamics of stream of people to establish an extensive line flow field of cellular automata model, which used perception area to present pedestrian perception of the surrounding environment [16].

Chen Xiaoming, Shao Chunfu and etc. from Beijing Jiaotong University used the analysis of flow to set up a model of traffic capacity in conflict point. They used the actual measuring data to calibrate the model parameters, which was advantage to the analysis traffic capacity of signal intersection. The conflict traffic capacity largely depends on the average number of conflictions during effective green light time. This model has a wide adaptability. Above all, the research provides a theoretical basis for the timing design in signal intersections and traffic management [17].

5. Summary

To sum up, researches had achieved certain results at home and abroad on the pedestrian crossing behaviors, but there are also some deficiencies.

(1) Most of the researches focused on the individual factors affecting pedestrian crossing streets. The studies paid more attentions on researching pedestrian factors, instead of considering external traffic elements such as facilities and management schemes.

(2) The researching results had a strong limited applicability. And at present , the result widely used is relatively less.

(3)A lot of traffic behavioral researches were through the questionnaire and other simple ways. Because of the different factors such as region and time, different researches would get a large difference.

(4)Today, the concept of big data is deeply rooted in our hearts, we can use the data to extend the depth of the pedestrian traffic researches.

References

[1] Fan Hongwei. The research of pedestrian unsafe behaviors based on traffic psychology [D].Beijing Jiaotong University, 2007.

[2] YangYan,Sun jian,Li Keping. Virtual reality experiment on pedestrian crossing behaviors at signalized intersections [J].Journal of Tongji University(Natural Science). 2011(04).

[3] WANG X, TIAN Z.Pedestrian. Delay at signalized intersections with a two-stage crossing design[C]. Washington : TRB,2010,CD-ROM.

[4] Tiwari G, Bangdiwala S, Saraswat A, et al. Survival analysis: Pedestrian risk exposure at signalized intersections[J]. Transportation Research Part F, 2007, 10(2): 77-89.

[5] WHITEBREAD D, NEILSON K. The contribution of visual search strategies to the development of pedestrian skills by 4-11 year-old children[J]. British Journal of Educational Psychology, 2000, 70: 539-557.

[6] LAPLANTE J N, KAESER T P. The continuing evolution of pedestrian walking speed assumptions[J]. ITE Journal, 2004, 74(9):32-40.

[7] HAMED M M. Analysis of pedestrians behavior at pedestrian crossings[J].Safety Science, 2001, 38(1): 63-82.

[8] SCHMIDT S, FÄRBER B. Pedestrians at t the action intentions of humans[J]. Transportation Research Part F, 2009, 12:300-310.

[9] MITMAN M F, COOPER D, DUBOSE B. Driver and pedestrian behaviors at uncontrolled crosswalks in the Tahoe Basin recreation area of California[C]. Washington: TRB, 2011, 2198:23-31.

[10] Yan Ping, Zhang Min. The discussion of solving conflicts of right turning flow and pedestrians[J]. East China Highway. 2006,158(2): 87-89 .

[11] Wang Junhua, Fang Shouen. Pedestrian-vehicle conflict observation and characteristics of road section [J]. Journal of Tongji University(Natural Science), 2008, 36(4): 503-50.

[12] Shen Jiajun，Wang Wei. Study on conflict probability model between motor vehicles and Pedestrians at Intersections [J]. Journal of Transportation Systems Engineering and Information Technology, 2011,11(1): 152-156.

[13] Wang Jingyuan, Wang Wei. The researches of signal phases in signalized intersections[C]. Da Lian: Proceedings of the 6th International Conference of Transportation Professionals, 2006.

[14] HELBING D, P MOLNÁR, FARKAS I J, et al. Self-organizing Pedestrian movement[J]. Environment and Planning B: Planning and Design 2001, 28:361-383.

[15] Lee J C, Shavelson R J. My current thoughts on coefficient alpha and successor procedures[J].Educational and Pshychologic Measurement.2004,64,(3):391.

[16] Tong Weiping,Cheng Lin. An extended floor field model based on cellar automata for pedestrian and group behavior[J].System Endineering-Theory&Practice, 2014,09:2386-2391.

[17] Chen Xiaoming，Shao Chunfu. Studies on capacity of signalized inter sections influenced by pedestrian traffic [J]. China Civil Engineering Journal, 2007, 40(3): 92-97, 109.