

Analysis of Pedestrian Crossing Behavior Characteristics Based on Cognitive Psychology

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ABSTRACT

From the perspective of psychology, this paper studies the pedestrian crossing behavior and characteristics at the intersection of Nanjing Road and Gongqingtuan West Road, aiming to establish a pedestrian crossing cognitive model to analyze the relationship between pedestrian crossing behavior and psychology. This paper mainly uses UAV to collect pedestrian crossing video, and uses Kinovea software to extract pedestrian crossing speed and walking track in the video to obtain the behavior characteristics of pedestrians at the intersection. On the basis of certain data, a pedestrian cognitive model is constructed, and the effectiveness of the model is verified by combining the pedestrian crossing behavior and physiological and psychological characteristics with quantitative and qualitative analysis methods. Finally, based on the research on the cognitive psychology of pedestrians crossing the street, the author fully adopts the suggestions of pedestrians in the questionnaire survey to put forward constructive suggestions on the traffic optimization of the intersection from two aspects of pedestrian traffic behavior norms and supporting traffic facilities optimization, so as to provide practical basis for improving road traffic safety.

Keywords: pedestrian; crossing behavior; cognitive psychology; cognitive model; traffic safety

INTRODUCTION

The rapid development of China's economy has led to a sharp increase in the number of motor vehicles and pedestrians, so the competition for space resources between motor vehicles and pedestrians has become increasingly fierce, which is also the reason why the problem of traffic safety has become increasingly prominent. In order to improve the traffic capacity of roads and solve various problems such as frequent traffic accidents and traffic congestion in urban traffic, previous studies mostly focused on vehicles and roads. Although pedestrians are one of the important participants in road traffic, their existence is often ignored, which leads to frequent traffic problems such as pedestrians' violation of traffic rules and conflicts between motor vehicles and pedestrians at intersections, and does not really improve the service level of the road. Because pedestrians often have different traffic characteristics and complex psychology, pedestrian crossing is more flexible and difficult to predict than motor vehicles. Therefore, it is of great significance to fully study the relationship between the physiological and psychological characteristics of pedestrians and traffic behavior, improve the comfort and safety of pedestrians crossing the street, and promote pedestrians' conscious compliance with laws and regulations, so as to improve road traffic design, improve road safety, and improve the level of road traffic.

Data Acquisition

In order to investigate the cognitive psychology of pedestrians when they cross the street, this paper adopts the method of questionnaire distribution to investigate the psychology of pedestrians when they cross the street.

At the same time, eye movement data are recorded by eye movement meter to analyze the psychological changes of pedestrians when they cross the street. The typical pedestrian secondary crossing intersection Nanjing Road and Gongqingtuan road was selected at the survey intersection. The intersection is a T-shaped intersection with unobstructed field of vision, and the geographical conditions and geometric shape meet the road design specifications, which is convenient for the investigation. At the same time, in order to ensure the reliability and effectiveness of the survey results, the survey method of random sampling of pedestrians at intersections is selected.

To obtain the psychological data of pedestrians, we need to conduct a rigorous survey. This paper adopts a combination of questionnaire survey and interview to collect the data about the psychological characteristics of pedestrians. The questionnaire is anonymous. The question setting adopts a combination of open questions and closed questions. There is a logical relationship between multiple questions. The purpose is to obtain the psychological and visual changes of pedestrians when crossing the street.

Data Statistics and Analysis

A total of 75 valid questionnaires were collected in this survey. The questionnaire data will be classified and analyzed as follows:

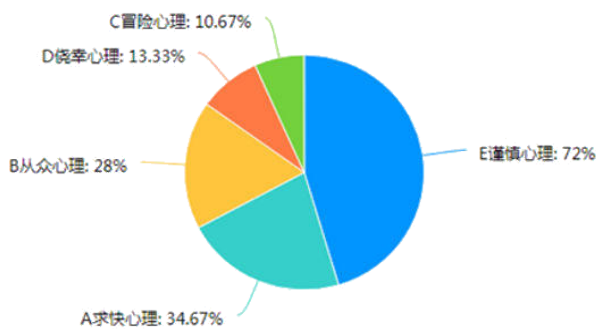


FIGURE 1: Summary of pedestrian psychology.

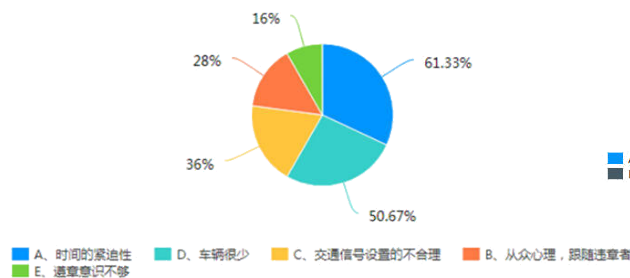


FIGURE 2: Summary of pedestrian violations.

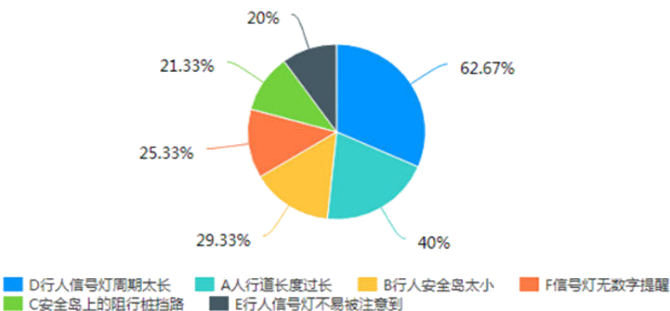


FIGURE 3: Summary of comments.

As shown in Figure 1, pedestrians mainly have caution, quickness and conformity when passing the intersection, accounting for 72%, 34.67% and 28% respectively; As shown in Figure 2, the main reasons for pedestrians' illegal crossing at this intersection are the urgency of time, few vehicles and unreasonable traffic signal settings, accounting for 61.33%, 50.67% and 36% respectively; As shown in Figure 3, pedestrians believe that the main problems of the intersection are the long cycle of pedestrian lights, the long length of crosswalk and the small safety island, accounting for 62.67%, 40% and 29.33% respectively.

Through comprehensive analysis of the above three kinds of data, we can know the psychological changes of pedestrians when crossing the street: the questionnaire data shows that the main problem of the intersection is that the pedestrian crossing distance is too long, but the unreasonable signal timing leads to insufficient crossing time. The time for pedestrians to wait for crossing the street has exceeded their tolerance limit. At this time, pedestrians are anxious and have the idea of crossing the street illegally. Therefore, the psychological state changes to cautiously looking for the opportunity (i.e. when there are few motor vehicles at the intersection), or following the crowd (it is safer to cross the street illegally when there are many people) and crossing the street quickly.

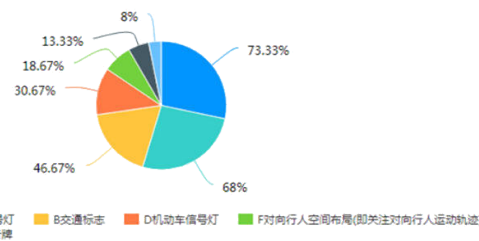


FIGURE 4: Summary of concerns for crossing the street in compliance with regulations (Direction from aulante to East Gate).

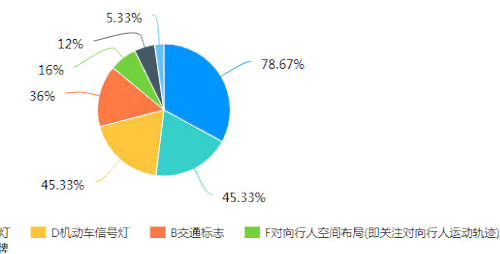


FIGURE 5: Summary of points of concern for illegal crossing (direction from aulante to East Gate).

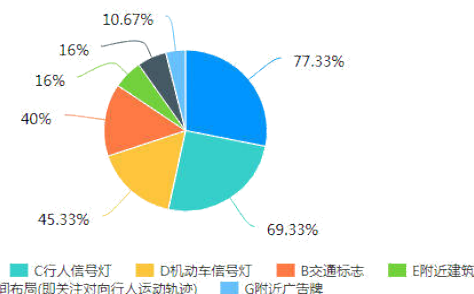


FIGURE 6: Summary of points of concern for crossing the street in compliance with regulations (East Gate to aulante direction).

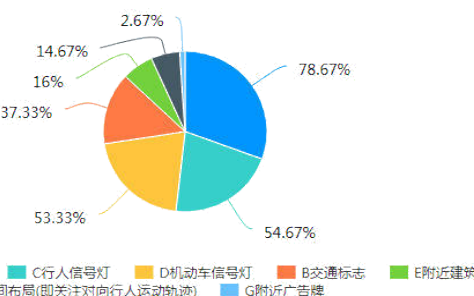


FIGURE 7: Summary of points of concern for illegal crossing (East Gate to aulante direction).

As shown in Figure 4, the main concerns of pedestrians in the process of crossing the street in compliance with regulations (direction from olant to the East Gate) are traffic, pedestrian lights, traffic signs and motor vehicle lights, accounting for 73.33%, 68%, 46.67% and 30.67% respectively; As shown in Figure 5, the main concerns of pedestrians in the process of violation (direction from olant to the East Gate) are traffic, pedestrian lights, motor vehicle lights and traffic signs, accounting for 78.67%, 45.33%, 45.33% and 36% respectively; As shown in Figure 6, pedestrians' concerns in the process of crossing the street in compliance with regulations (the direction from the east gate to olant) are mainly traffic, pedestrian lights, motor vehicle lights and traffic signs, accounting for 77.33%, 69.33%, 45.33% and 40% respectively; As shown in Figure 7, the main concerns of pedestrians' illegal crossing are traffic, pedestrian lights, motor vehicle lights and traffic signs, accounting for 78.67%, 54.67%, 53.33% and 37.33% respectively.

A comprehensive analysis of the above four kinds of data shows the visual changes of pedestrians in compliance with regulations, violations and crossing from different directions: the objects with the highest attention of pedestrians in the process of crossing the street are traffic vehicles, pedestrian lights and motor vehicle lights, among which the attention to vehicles is the highest, indicating that pedestrians are in a weak position in traffic and still have a fear of vehicles in their hearts; Compared with the pedestrian crossing from the east gate to olant, the main objects of concern remain the same, but the degree of concern is different. At the same time, the attention of pedestrians to nearby buildings and billboards in this direction has increased, indicating that these facilities distract the attention of pedestrians and should be improved; Compared with crossing the street in accordance with regulations, pedestrians' main objects of concern remain the same, but their attention to vehicles has increased and their attention to other objects has decreased, indicating that pedestrians' psychological activities at this time are to cross the street quickly while ensuring their own safety, so they pay high attention to the passing vehicles that can threaten their safety but have no time to take into account other traffic information, so their attention to other information has decreased.

Pedestrian Crossing Safety Improvement Measures

- (1) Strengthen pedestrians' learning of traffic laws and regulations, so that they understand that the constraint objects of traffic laws and regulations include not only motor vehicles but also themselves. Through the theoretical study of traffic laws and regulations, pedestrians should make clear which of their behaviors are illegal behaviors when participating in road traffic activities, forming a red line in their brain, so as to restrict their behaviors.
- (2) According to the video analysis, the proportion of pedestrians traveling together at the intersection is high, and the group of pedestrians often has the mentality of conformity. Under the influence of the group, individuals' behavior psychology often has dependence, and their behavior is often different from that of crossing the street alone, and even follow the group decision-making action. In view of this phenomenon of conformity, warning signs can be set up at the places where pedestrians are waiting to cross the street to improve the vigilance of pedestrians.
- (3) Through the investigation and analysis of road traffic safety facilities, this paper analyzes whether the setting of the facilities meets the psychological needs of pedestrians, and whether the setting of the facilities can ensure pedestrian safety and improve pedestrian crossing efficiency.

For example, according to the analysis, for the intersection of Nanjing Road and West Communist Youth League Road, the blocking piles on the safety island not only cannot protect the pedestrian crossing safety, but will affect the pedestrian crossing efficiency and the pedestrian trajectory during the second crossing, resulting in the insufficient utilization of space resources. Such facilities should be removed.

CONCLUSIONS

This article mainly investigates the physiological and psychological data of pedestrians through questionnaire surveys and video recordings, while using eye movement data collected by an eye tracker. The collected data is analyzed using SPSS software to explore the psychological and behavioral characteristics and habits of pedestrians crossing the street at this intersection. On the basis of the research conclusions of this article, the characteristics of the intersection are fully considered, and the issue of balancing the right of way between motor vehicles and pedestrians is also considered. Based on the concept of "people-oriented", practical and feasible improvement measures are proposed to improve the problem of pedestrian crossing at the intersection.

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