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Based on prospect theory of pedestrian impact analysis

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ABSTRACT
Crossing the street is the important behavior of pedestrian traffic system, the type of crossing facilities will directly affect the choice of the ways of pedestrians to cross the street. On the analysis of the characteristics of pedestrian crossing facilities and the factors influencing the choice of the ways of pedestrians to cross the street, on the basis of combination of the specific case of crossing facilities installed on xuefudadao road , the investigation and analysis in the choice of pedestrians to cross the street and utilization of existing crossing facilities , and thus put forward suggestions to set up crossing facilities space location.
Keywords –Crossing facilities、Pedestrian traffic、Prospect theory、The traffic safety.

I.   Introduction

Statistics show that in the traffic accidents in China, the accidents caused by pedestrian violation are about 15% [1]. But in the traffic accident caused by the injured, the traffic way for the walk accounted for 17.21% . In pedestrian traffic accident, the illegal crossing is the main cause of the accident. Therefore, setting the pedestrian crossing facilities can provide a safer crossing for pedestrians, and reduce delays and improve the capacity of the road. How to set reasonable crossing facilities, ensure the safety of pedestrians and avoid the waste of resources has become an urgent problem.

II.   Cumulative prospect theory

Relative to the utility theory, Under the condition of gain and loss, the prospect theory can describe the risk decision of the main body, expect utility theory describes the characteristic of rational behavior, While the prospect theory describes the actual behavior. Based on the assumption of bounded rationality behavior subject, prospect theory has the following three basic views:

（1）Reference Dependence：The value of the vector is defined relative to a reference point "loss" or "gain" .

（2）Lose Aversion：The same amount of loss than the same amount of gain. Loss aversion and Endowment effect is mutually. The endowment effect, refers to the people for what they have really cherish, let them give up their goods need to pay a big price.

（3）Diminishing Sensitivity: Gain or loss, the marginal value decreases with the increasing.

2.1 The value function

In prospect theory, there is a classic value function is as follows:

$$\phi(x) = \begin{cases} (x - x_0)^\alpha & , x \geq x_0 \\ -\eta(x_0 - x)^\beta & , x < x_0 \end{cases}$$

x_0 is the reference point, parameter $0 < \alpha, \beta < 1$ show that decision makers are risk averse when earnings, decision makers are risk preferences when losses, parameter alpha and beta also said diminishing marginal value function sex. Parameter η ($\eta \geq 1$) for loss aversion coefficient, said people are more sensitive to losses than the same benefits.

2.1 decision weighting function

Prospect theory of probability weighting function w (p), corresponding to the probability value p in expected utility theory, probability weighting is decision maker according to the result of events appear almost p make some subjective judgment,
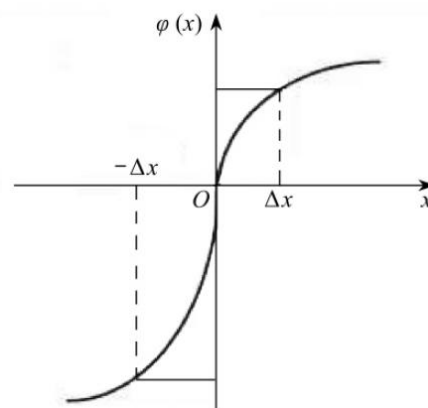

Figure 1 : the value function

it is not a probability, don't follow the axiom of probability theory, can be thought of as the subjective psychological probability of decision makers, The probability weighting function w (P) has the following properties:

(l) w (p) is the nonlinear monotone increasing function of probability p and w(o)=0,w(l)=l, and discontinuous in 0 and l:

(2) For small probability, it will always give too much weight, w (P) > P, While for large probability always give too little weight, or w (P) < P;

(3) The complementary probability events is less than the sum of the weighted function certainty of the weighted function, namely w(p)+w(l-p)<l;

(4) Close to the boundary of the deterministic event, belongs to the scope of the mutation probability evaluation, weighted function is often overlooked or amplifier, this feature can be used to explain the deterministic effect of its general shape as shown in figure2 , w (p) functional form is as follows:

$$W(P_j) = \frac{P_j^p}{\left[P_j^p + (1 - P_j)^p\right]^{\frac{1}{p}}}$$

Thus, future value V can be expressed as type:

$$V(x_1, \ p_1 \ ; x_2, \ p_2...x_n, \ p_n)$$
$$=v(x_1)w(p_1)+v(x_2)w(p_2)+...+v(x_n)w(p_n)$$
$$= \sum_{k=1}^{n} v(x_k)w(p_k)$$

III.   Data and empirical research

3.1 the research methods

Pedestrian crossing facilities selection is on the basis of the psychological characteristics of the pedestrian performance, analysis of the choice behavior can determine the actual behavior of the pedestrian crossing and explain the reasons behind the behavior. Therefore, pedestrian select properties data of tectonic model is very important in practical application. By actual data for the completed choice behavior that choice is the result of the actual choice behavior and impact condition.

Behavior is a typical problem of uncertainty, crossing the street in the transportation system, there are multiple people, each traveler behavior have their own goals and code of conduct. Each traveler's decisions can predict, that is to say, the pedestrian crossing the traffic system of the state is uncertain, and prospect theory is describe uncertainty decision-making under the condition of effective and fit the actual status of the theory.

3.2 Crossing facilities preference analysis

Through the survey, The choice of pedestrian crossing facilities on three main tend to be overpasses (the proportion of 42.1%)and pedestrian crossing (the proportion of 35．6%)，The popularity of the lowest underground channels. Mainly because of pedestrian crossing facilities in safety factor on the choice of the main (the proportion of 57．4%)，And bridge by implementing a spatial separation between pedestrians and motor vehicles to ensure the safety of the pedestrians crossing the street to provide security than pedestrian crossing pedestrians, and therefore bridge relative to the pedestrian crossing with more choice.
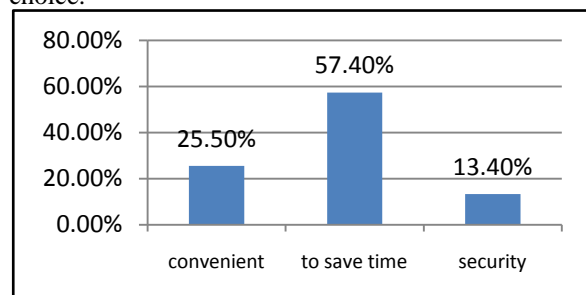

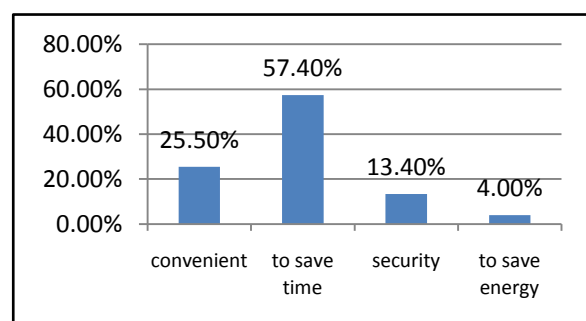**figure 2 : Choice tendency for pedestrians distribution statistics**

figure 3 : Select reason for pedestrians survey statistics

In addition, bridge and tunnel crossing the street while the basic spatial structure is relatively close, and the safety factor can be considered to be the same, but the choice of bridge proportion is much higher than that of underground tunnel crossing the street because of underground tunnel ventilation, lighting condition is bad, can't satisfy the requirement of the pedestrian comfort, moreover underground passage potentially unsafe factors, and guidance, this is also the pedestrian are reluctant to use one of the reasons. The survey data and selection for pedestrians reason data see figure 2 and figure 3.

3.3 behavior empirical research crossing the street

Combined with the instance: The starting point to the crosswalk and distance apart is exactly equal to the

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length of bridge（the maximum wait time of red light is 60s）.

（1）Set for commuter travel purpose， the constraints of time is 30、40、50 and 60s，People's choice of pedestrian crossing, overpasses is shown in table 4, by table 4 can be jumping to conclusions:

A:Under the condition of different constraints of time, people in the path selection, shows people in decision-making is a reference point dependent

B:When the constraints of time is 30s, the constraints of time less than the predicted travel time expectation (the mean 35s), and the constraints of time less than through overpasses the shortest time, people clear preference crosswalk, when people in the face of the loss risk pursuit;

C:When the constraint of time is 40s, equal to the shortest time of overpasses, people clear preference overpasses, rather than choose crosswalk, adventure to get more profits, to show that the traveler earnings risk aversion;

Constraints of time(s)	travel purpose	Surveyed quantity (people)	Pedestrian crossing （20s-60s）	overpasses （40s-50s）
30	commuting	50	41	9
40	commuting	50	6	44
50	commuting	50	4	46
60	commuting	50	7	43

table 4:the choice of overpasses

D:When the constraint of time is 50s, equal to the predicted travel time expectation, People prefer the flyover，and violates the choice results of expect utility theory assumes. Because the time of variance is smaller than pedestrian overpasses, choose losses will be less than pedestrian overpasses, thus proves the prospect theory of loss aversion principle.

Constraints of time change	Travel purpose	the change rate of crossing the choice
30→40s	commuting	52.31%
40→50s	commuting	24.01%
50→60s	commuting	18.85%

table 5:the choice of overpasses

（2）Travel purpose, alternate path conditions remain the same，when the constraint of time change, respectively from the 30s to 40s, respectively from the 40s to 50s and respectively from the 50s to 60s, people's choice of pedestrian crossing, overpasses is shown in table 5.

By table 5 can be jumping to conclusions: when the constraints of time change, people crossing the choice behavior will change. When the constraint of time varying from 30s to 40s, People choose path change rate of 52.31%, greater than the rate(24.01%) of change that the constraints of time varying from 40 minutes for 50 minutes，show that travelers choose path more sensitive to losses than gains.

IV. Conclusion

The data of investigation on characteristics of pedestrian crossing facilities selection, analysis and empirical research, By the prospect theory, studies have shown that: In the various factors affecting pedestrian choice crossing facilities, Facilities itself characteristics determined by the factors such as safety, saving energy has a little influence, the main factors is the nature of the traveler.

Analyze and demonstrate of the author better reflect the current situation of the pedestrian crossing, But further studies need to research the specific characteristics of crossing facilities,and the pedestrian characteristics factors are more comprehensive consideration ;In addition, besides overpasses and pedestrian crossing, also underground passage as the main crossing facilities should be considered.

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