Research on behavior and psychological characteristics of pedestrians in terminal

Bing Li, *, Ying-hui Wang

Institute of Transportation, Inner Mongolia University, #24 Zhaojun Road, Hohhot, 010070, P.R.China
School of Traffic & Transportation, Beijing Jiaotong University, Haidian District, Beijing, 100044, P.R.China

Abstract

Terminal is the crowded place of human traveling activities; the security issue has been the top priority of the operation and management in terminals. Pedestrians constitute the absolute subject of various activities in terminal, so it is critical to have a research on pedestrian behavior and psychological characteristics, as well as the reasonable arrangement of management and operation. This paper analyzes the pedestrian traveling environment and the characteristics of their behavior in terminals. In terms of the passengers, the paper proposes the idea of hierarchy of needs and some suggestions on mitigating the congestion in terminals, and on the improvement of pedestrians' security. The study is conducted based on a dedicated survey of the pedestrian psychological characteristics.

Keywords: transportation terminal; pedestrian behavior; psychological characteristics

* Corresponding author. Tel.: 0471-4996782; fax: 0471-4996800.
E-mail address: xsjlibing@163.com.
1. Introduction

In recent years, the security problems in crowded place have been taken more and more attention. The terminal is a place of the very gathered crowd, the pedestrian traffic in terminal is a dynamic system which the density of cluster is uneven and the individuals and the environment are interacting with each other. The laws of motion and the traits of the pedestrian flow in terminal are closely related to the internal environment and operations there. The movement process of pedestrians in transportation terminal involves many factors, like the interaction between people, people and buildings, the traits of human psychology and behavior, the traits of the crowd and environment, etc.

2. The Analysis of Pedestrian Behavior in Transportation Terminal

2.1. The effect of terminal internal facilities structure on pedestrian behavior

Different regions of transportation terminal have their respective style of structure, so, in order to pursue the aesthetic effect, ignore the architectural space within terminal; however, the unreasonable planning of terminal will also result in the reduction of internal pedestrian activity space.

The limited architectural space in terminal is an important factor in restricting the pedestrian traffic activities. The unreasonable layout of internal building space, such as the insufficient number of entrances and exits, wickets and waiting rooms, will cause psychological anxiety, confusion and panic in terminal, thereby affecting pedestrian traffic behaviors; in terminal exists the passengers flow and the package flow streamlines of different directions, the cross points of those streamlines are often the intensive place of traffic flow. The imperfect of internal structure is the most difficult obstacle to overcome for the streamlines, and the source of causing the psychological panic of pedestrian; whereas, the psychology of pedestrians prompt most of them to gather in the weakness point of the terminal, and eagerly flock in the entrance or exit, so at the security, wickets, aisles, stairs and the exits, there will form a high density of congestion, and finally cause the security risks.

2.2. The characteristics of pedestrians within terminal

Due to the pedestrians in terminal are for the purpose of travel, in terms of the whole traffic, it will present the following traits:

(1) Because different people have different travel leading time, and the traveling activities have a high request on travel time, the pedestrian travel present the characteristic of time urgency, especially the entrance is most obvious.

(2) Most of the pedestrians in terminal always carry luggage and other items, which cause the walking speed significantly lower than normal walking speed; at the same time, the individual required space increases.

(3) Many travellers are not familiar with internal space layout and the environments, if there are no obvious signs in terminal or no workers to dredge; it easily causes some problems, like the pedestrian stagnation or confusion.

(4) Because of the relatively short parking time, the very crowded people and the fear of failing to get on the vehicle exist in their minds; it will cause the apparent phenomenon of congestion when travellers have their tickets checking, enter the station and wait for the coming vehicle.

(5) Because there lack the marks of on and off the vehicle when the vehicle enters the station, it makes the pedestrians crazily chasing the vehicle with their luggage, and neglect the marks of security, which causes the security risks and the interlaced interference of pedestrians flow from each direction.

(6) When passengers take the security, the packages and the travellers highly gather at the entrance, which lower the capacity of terminal, and cause the vicious cycle of congestion.
The travel needs of the pedestrians in terminal present the seasonable volatility on the quantity, especially the spring festival travel seasons and holidays, the more congestion the pedestrian flow are, the more obvious is the seasonable volatility.

2.3. The cause of the pedestrians’ traffic behavior in terminal

2.3.1 Pedestrian physiological characteristics

Pedestrian physiological characteristics mainly perform in psychology and the behavior, and the behavior is the reflection of psychological characteristics to some extent. There are also many factors affecting psychological characteristics, such as gender, age, physical condition, the number of packages, the speed of travelers around, and the directions of travelers. All those factors effect on the characteristics of pedestrians’ behavior, which lead to the increasing of space the pedestrians have and the decreasing of the walking speed. According to YANG Li-li statistics at the year of 2010, in the region of Beijing, the average speed of pedestrians in terminal is 1.39m/s, whereas, pedestrians interact with each other at the access facilities, like the aisles, the railway platform, and the stairs that will lower the pedestrians’ average speed, the reduction of speed will affect their psychological state in return, and finally cause the unsafe behavior.

2.3.2 Trip purpose

Passengers’ travel is based on different trip purposes. The pedestrians’ trip purposes can be roughly divided into several aspects: commuter, visiting relatives and friends, tourism, business and work. The pedestrians for the purpose of commuter, business and work, their expect waiting time is short, and likely cause the anxiety in the level of psychology, which makes the walking speed faster than ever; However, The pedestrians for the purpose of visiting relatives and friends, tourism, their expect waiting time is relatively longer, so the walking speed is slower. Different trip purposes will lead to different trip behavior. So, it will cause the confusion in terminal and form the security risks.

2.3.3 Travel crowded

According to the division of gender, pedestrians in terminal can be divided into female and male, adult men stronger than adult women in the aspects like, strength, endurance and the stride due to physical factors. Many adult women like to wear high-heeled shoes, so adult men’s desired speed is greater than the desired speed of women, and also the space they take up. According to the division of age, it can be divided into four types: the old, adult, youth, and children. For the old, and the children, because the walking speed is relatively lower, and the identification is also low, it will cause the walking speed obvious lower than other groups of people; for the vulnerable groups of the disabled, they have higher request on the access facilities in terminal.

2.3.4 Travel time

In many factors that affect the traffic behavior of pedestrians inside the terminal, the most significant factor is the volatility of the travel time. The travel time of pedestrians in a day mostly concentrates in between 8:00-22:00, however, during the holidays and the spring festival travel seasons, most people based on the purpose of tourism and visiting relatives present more obvious time volatility and the characteristic of regional and direction, which makes the load of terminal exceed the saturated state, and reduces the social distance among individuals. Finally, causes the limb friction between pedestrians, leads to psychological panic and threat personal security.
3. The Analysis of Pedestrians’ Psychological Characteristics Inside the Terminal

3.1. psychological needs affecting the traffic behavior of pedestrians

According to the principles of psychology, the need is a kind of inner state that the organism feels a certain lack in life and strives to meet. It is the reflection of organisms’ inner environment and external living standard requirements in human minds. From the subjective perspective, it’s often felt and experienced by the feeling of dissatisfy, and it is the source of pedestrians’ activity. If to say the needs are the basic motivation and source of behavior, the concrete expression or the inner motive system is that the motions, which are the internal causes of directly promoting the individual’s behavior. So the traffic behavior is caused by traffic needs and controlled by the motion, and the behavior will direct to the objective of traffic needs, that is, the pedestrians’ behavior shows a certain quality of objective. People in different traffic needs will select different mode of transportation, and therefore show different traffic behavior and purposes.

3.2. The psychological analysis of pedestrians’ traffic behaviors

Generally speaking, all humans’ activities are caused by the stimulation of environment which is a process that the organism felt by organs, and it is also a cognitive process that the psychology achieved by individual. The cognitive process of psychology is expressed by conation, which direct the psychological cognitive to a certain behavior activity. Pedestrians in terminal are influenced by the subjective or objective environment, such as, the pedestrians’ flow, the layout of facilities. Through the organs stimulation of sensation, vision, and small to receive the signal, which can be inputted into the brain and effect on psychology of people, stimulate the conation, and thus cause the relative action. For example, when the traffic flow is too large and the fundamental facilities are not complete, these external sensed massages get into the organism and cause the fidgety, nervous and anxious psychology, eventually, lead them to walk faster, collide with rub and some other unfriendly increases, it will produce a comfortable, pleasant and safe psychology.

4. Pedestrian psychological questionnaire survey

Humans’ behavior is the direct reflection of psychological state, at present, psychological study of traffic behavior is mainly based on the questionnaire; this paper is also based on the questionnaire to study the psychological characteristics of pedestrians in terminal.

4.1. The design of questionnaire

For the pedestrians inside the terminal, we design the questionnaire survey of travelling psychology. It involves a series of problems of pedestrians in terminal, for example, the process of queuing, ticket checking, waiting and getting on the vehicle. This survey chooses the railway station in Hohhot to investigate, issued 350 questionnaires to recover 350 copies, 100% recovery rate, including 312 valid questionnaires, the effective rate is 89.2%, and the basic situation of the survey is shown in Table 1:

<table>
<thead>
<tr>
<th>gender</th>
<th>Education background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>female</td>
</tr>
<tr>
<td></td>
<td>Primary</td>
</tr>
<tr>
<td>The number of people</td>
<td>218</td>
</tr>
<tr>
<td>Percentage %</td>
<td>69.9</td>
</tr>
</tbody>
</table>
The text of the questionnaire involves many aspects: what is the choice of passengers within the terminal when facing a series of circumstances; the herd mentality, the expectation psychology, and the loss aversion psychology, etc. In order to test whether the certain psychological characteristic exists or not, we establish the corresponding problems with each psychological characteristic, and analyze it from different perspectives.

4.2. The analysis of the questionnaire results

This paper concludes the psychological characteristics the pedestrians express with the survey results by analyzing the travelling behavior and psychological activities inside the terminal.

4.2.1 Conformity psychology

In terminal, passengers will be directed by the sign marks when facing the choices and most of them will perform according to the sign marks. But when there is no sign mark to instruct, as shown in the survey, there are 51.6% of the pedestrians choosing to go with the crowd, 37.5% choosing to act as their own judgment; when most passengers are waiting in a queue for their tickets checking, 62.2% of the total chooses to go with the crowd, 29.5% chooses to go with their own minds. The passengers choosing to go with crowd have their certain psychological factors: in the special place of terminal, when the behavior of individuals is not corresponded with the crowd, the individuals will feel nervous, and change their will and behavior to coincide with the crowd under the influence of conformity psychology. However, the conformity psychology can be divided into two parts, the reasonable and unreasonable. Many passengers believe that the passengers following can be as a proof, which causes the blind feeling of safety, and the conformity psychology drives them to believe that the choices of most people are correct. So, the unreasonable factors have great influence on them when make the decision facing them that is, showing the phenomenon of unreasonable conformity psychology.

In fact, this unreasonable psychology will greatly produce blindness and one-sidedness, which leads to the blind following and the bias of minds and behavior. In this survey, we visit many passengers in the uncertain situation, and many passengers show that they will jump into the queue if there are many participants in it. So conformity psychology characteristic of passengers inside the terminal.

4.2.2 Expectation psychology

Expectation psychology is the most intense inner reaction to achieve the goal in humans’ activities, and is also the main driving force for people to carry out each activity. Pedestrians in terminal under the domination of expectation psychology, will show a certain behavior, and expect that the goals achieved in this behavior are equal to or higher than their psychological expectations. For example, the travelers have a high request on time, and always expect to shorten traveling time under the premise of reaching destinations on time; always expect to get the best service while take the minimum cost. Travelers’ expectation psychology mainly shows in economy, convenience, comfort, and some other aspects. The economy is mainly manifested in traveling cost of pedestrians. For the pedestrians in terminal, their expectation psychology is to achieve minimal total cost of the trip, so we should consider the total cost of travel cost within the terminal and the cost from origin to the location of the travel. The convenience can be shown by the convenience of ride and time, the convenience of ride mainly refers to convenience of transformation and choices diversity of train number, travelers hope to satisfy their expectations by achieving more time-saving and economic mode of transformation and various mode of transportation; time convenience refers to that travelers could choose to complete the trip at the shortest time and the most suitable time. The comfort is that travelers want to get a higher level of service in the travel process and realize the "The minimum investment in the largest harvest" expectations psychology.
4.2.3 Loss aversion psychology

Loss aversion psychology refers that people have a tendency to avoid the loss, i.e., the same amount of loss and the same amount of gain is not equal in psychological utility and the former is bigger than the latter. Just as the father of modern economics, Adam Smith described a widespread phenomenon in his "Theory of Moral Sentiments": the pain suffered from good to bad is stronger than the happy people experience from bad to good. There is also the study discovering that people have feelings of loss aversion because people underestimate their own affordability in response to the loss, so the loss aversion is only an affective forecasting error, a negative emotional response when people overestimate their losses. Pedestrians in terminal are also exist the widespread loss aversion. In terms of the pedestrians, the sense of loss produced by the lower level of service is more impressive than the sense of satisfactory produced by the higher level of service; the feeling produced by a more convenience at a lower cost is not obvious than the feeling produced by a more convenience at a higher cost. For example, when the pedestrians buy tickets, they are always considering the consistency of price and service, hoping to receive the most comfortable trips at the minimal cost, but they will feel a sense of loss when find that the train of the same cost they take is no more comfort than other's. However, the pedestrians often will "carefully selected" to avoid the loss of all things, this is loss aversion.

4.3. Pedestrians’ traffic needs

American social psychologist Abraham Maslow put out the idea of Hierarchy of Needs, Which consider that humans are the animals in need, and the needs depend on what he has, or what he lack, and only the unsatisfied needs could influence on their behavior. Humans’ needs have the level of severity and slight, when one level of needs is met, another level of needs will appear. People show a certain level for the traveling needs. It is particular performed in the following aspects:

4.3.1 Security needs

Security needs are the first and the most important needs of pedestrians in terminal. Security needs refer to the need of not encountering danger for pedestrians in traffic activities, including the transport security, personal and property safety and so on.

Security needs are the basic internal request of pedestrians, when pedestrians are stimulated by harsh environment, it will cause unsafe behavior consciously or unconsciously and that unsafe behavior will naturally threat others’ safety. The entrance and exit, the wickets and the doors of the vehicle are the place of the highest density, and also the place that unsafe behavior takes place. However, there is a serious pedestrian conformity psychology among them, especially the external travelers; the phenomenon is more obvious. This to some extent aggregates the unsafe coefficient of traveling.

4.3.2 The need of saving time and effort

Most of the pedestrians in terminal tend to save time and travel conveniently, that is, it exists the need of saving time and effort.

Pedestrians always travel based on a certain purpose, so they are stricter for the request of time, including the transfer time punctuality and the vehicle departure punctuality. Travelers hope to achieve the trip of a certain purpose by the quick and effective way to transfer and less waiting time. However, pedestrians often show the offending psychology under the need of saving time and effort. For example, passengers neglect the warning signs to across the cordon in order to check the ticket first, and this causes the security risks. So, we should
reasonably arrange the transport organization to realize the need of saving time and effort in the premise of security.

4.3.3 Effectively comfortable needs

Comfort is the higher demands of travel based on the safe trip. The effectively comfortable needs mentioned in this text refer to harmonious development comprehensively considering the economy, convenience and swiftness and other aspects, which can realize the best comfort during the trip. According to the optimal theory of operations research, the comfort the travelers achieved is the objective function, the constrains are the economy, convenience and the swiftness, this optimization process is to make the travel be the optimization comfort in the premise that the travel reaches the least cost, the most convenience of transfer, and the most time-saving travel. With the development of society, pedestrians travel is now transferring from the safe trip to the integrated travel of safety, comfort, convenience and swiftness. From the travel angle to consider, the effective comfort is to reach the state of harmony at the hardware and software aspects, that is, it is to achieve the state of unity about the infrastructure level and the operational service quality, avoiding the uncoordinated state of high level of facilities with the low level of service.

4.3.4 The respective needs

Because of the situation of infinite space and large pedestrians flow, it easily causes the lamb rubbing and some other congestion phenomenon then causes the impolite and unsafe behavior. However, the respective needs are the basis of human needs; travelers in terminal always expect to be respected, including the mutual respect of pedestrians and the respect of travel service. Pedestrians should be humbled, support, respect with each other, and create a harmonious atmosphere. The respect service is that pedestrian should enjoy equal rights to the use of facilities service as well as the respect for passengers when the staffs provide the services. The respective needs the pedestrians felt reflect the integrate service level of terminal.

5. Suggestions of Pedestrians’ Traffic Management Inside the Terminal

The traffic operational management inside the terminal has the factual significance on ensuring the effectively satisfaction of the traffic needs during the daily operation and the rush hour of traffic, easing the traffic congestion of the terminal in rush hours, reducing the risk and loss of abnormal events, and satisfying the request of safe and comfort travel. It is also the important issue needed to be resolved for the transportation management department.

The traffic management of pedestrians in terminal should make the “people-oriented” be the basic guide; the pedestrian flow is the absolute objective of internal traffic in terminal, and we should consider from the subjective and objective points to guide the pedestrians’ behavior in order to realize the management of pedestrian traffic; in terms of the building in terminal, its layout can’t be changed, so we should focus on how to optimize the operational organization and effectively use the layout of the terminal, and then promote the operational level of service inside the terminal.

5.1. The improvement of internal space environment inside the terminal

(1) Inspect and safeguard the facilities of terminal in a certain time, and apply the advanced detective and protective equipment into the aspect of safety inspection.

(2) Set the humane warning marks in terminal; for example, using the gentle tips instead of the laws and the regulations to warn the pedestrians of unsafe behaviour in the place existing security risks.
(3) Set special seats, facilities and aisles for the vulnerable groups within the terminal, and guarantee the security, comfort and swiftness of the facilities and the service to achieve the goal of “people-orient”.

(4) For the congestion caused by the security at the entrance of terminal, we can take the measures such as, appropriately increase the security conveyor or adopt the annular conveyor to add the connecting area between the conveyor and the pedestrians, which reduce the pedestrians per area, achieving the purpose of easing congestion.

(5) For the situation that the terminal seats can’t meet the demand, we could change most seats into the type of bench, so transfer the “one person one seat” to “more person one seat”, thus reduce pedestrian occupation of aisle space, and improve the security of waiting.

(6) Add to set the escalator of on and off in terminal; accelerate the speed of load pedestrians.

5.2. The improvement of operational organization in terminal

(1) In order to ease the congestion caused by the unsafe behaviors inside the terminal, this paper point out the issue of travel leading time. Combing with pedestrians’ psychology, calculate the total travel time under the relaxation psychological state by repeated experiments, including the time of entering, waiting time and the tickets checking delays, then we can know how long should the pedestrians reach the wicket before their tickets checking to reduce the delay of ticket checking and get across the wicket smoothly, namely, formulate the correct travel leading time when the pedestrians arrive at the wicket. Organize the pedestrians and realize the safe travel by reasonable control of leading time.

(2) Complete the instructional marks, signs and other infrastructures to achieve the smooth walking of pedestrians within the terminal.

(3) In order to improve travelers’ safety passing the wickets, implement the way of batch release at the wicket to ease the congestion when pedestrians get into the terminal. Take full advantage of the not in operation wickets in the same period, at the same time, carry out the practical operational organization in terminal.

(4) Add the real-time information display boards, timely, accurately pass the information to travelers when the traffic flow is too large.

(5) To avoid the confusion of passengers getting on the vehicle, set the corresponding numbers with the number of vehicle on the waiting platform, and organize the pedestrians queuing to enter the train with the chronological order, finally reduce the time delay of the passengers on the bus.

(6) From the viewpoint of publicity to consider, strength the publicity, education and popularization of pedestrian traffic regulations and traffic safety knowledge by the means of spot publicity and setting the code of conduct, and then prevent and correct unsafe behavior of pedestrians psychological.

6. Acknowledgements

The work is supported by the Scientific Research Projects of Institution of Higher Education of Inner Mongolia Autonomous Region (Grant No.NJZY13006).

References