Analysis of the Influencing Factors on the Travel of People with Disabilities in Guangzhou City

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Abstract. China pays more attention to the rights and interests of people with disabilities and promotes the development of barrier-free cities. But it is still difficult to see people with disabilities integrated into daily commuting in the travel scene. To help build a complete and humanized barrier-free environment in Guangzhou City, we explored the influencing factors of people with disabilities' travel.

In this paper, we first verified the factor through column analysis and chi-square test .Based on the above results, the Random Forest Model was applied to analyze the influence of each factor in the above three dimensions at a deeper level, and the model was trained with the SMOTE After ranking the relative importance of the variables, it is found that psychological factors have a higher influence on the travel of people with disabilities than social factors and higher than economic factors, among which the psychological factor of "lack of security" is the most important factor affecting the travel.

Finally, based on this study utilizes data analysis to draw pertinent conclusions that we need multiple efforts from society to make them feel safe in shared mobility without discrimination. We also have designed a product that couples shared cars and smart wheelchairs for the disabled, hoping that it can really help the disabled to get around when it is put into use.

Keywords: People with disabilities; Travel influencing factors; Factor analysis; Random forests

1   Introduction

According to the 14th Five Year Plan for the Protection and Development of Persons with Disabilities issued by the State Council of China, education for persons with disabilities is included in key projects, aiming to further deepen the special education system, from disabled children to preschool rehabilitation education to vocational education improvement, as well as incubating teacher programs and promoting braille sign language. With the further deepening of educational equity and the diversification of higher education, disabled students can enter higher levels of education. China is vigorously promoting the development of integrated higher education for disabled students, creating experience for students to enter higher education institutions. After the

opening of the epidemic this spring, based on the demand for offline learning, the frequency and willingness of disabled students to travel have also increased significantly.

Due to the acceleration of population aging, disability is gradually showing a high incidence trend, with many people with disabilities and a high risk of returning to poverty. Moreover, disabled people have difficulty finding employment or poor quality of employment. In many low-income families with disabilities, there is currently a lack of public services for disabled people, it is still a long time before the equal rights of the disabled are realized. The rights and interests of the disabled are still unfairly treated or unsatisfied [1], especially in Underdevelopment, rural areas, and grass-roots units.

Transportation barrier-free should serve the elderly, the weak, the sick, and even every ordinary group, and everyone will face the scene of inconvenience such as large luggage. Moreover, as an important user of social transportation, disabled people should strengthen their medical insurance and serious illness insurance services, effectively reduce the burden of medical expenses on disabled people and families, and alleviate the pressure and burden on disabled people and their families [2].

There are many factors that affect the travel of the disabled, and the internal motivation to solve the problem lies in the systematic study of the travel factors of the disabled. This paper attempts to explore, reflect and evaluate the travel problems of the disabled from the perspective of system theory and Accessibility construction, and then explore the factors that affect the travel of the disabled in Guangzhou through field visits, follow-up interviews and other research methods, Through the analysis of the experience of Accessibility and the matching degree of the demand for barrier free facilities, to promote the travel problem of the disabled to be solved, build a systematic system to protect the due rights of the disabled, increase the investment of judicial resources, and safeguard the equal sovereignty of the people including the disabled [3].

However, the existing regulations, standards, and provisions are often of an advocacy nature, with very few being mandatory norms. This creates some pain points or loopholes in the supervision or acceptance of barrier free construction. Secondly, the barrier free facilities of public transport, especially buses, have been in slow progress [4]. In Guangzhou, the tactile paving on both sides of the barrier free channel has been interrupted at several consecutive sections, and there are still many problems in the barrier free construction. On the other hand, due to the discovery that people with disabilities refuse to be specialized, with the increasing construction of accessible facilities and new buildings, there are still very few people with disabilities traveling. Since such many disabled people, the proportion of using Guide dog is very small, and there are still difficulties after use, and the public's awareness of Guide dog is also very limited [5].

Traditional accessibility design is based on environmental and architectural considerations, only achieving physical accessibility while neglecting the actual needs of people with disabilities. Most accessibility facilities are designed based on object objects. The public also finds it difficult to see their figures in daily life scenes such as shopping malls and commuting, or to respond with curiosity to a few visible disabled people [6].

2   Literature review

Wang Yukai [15] proposed in the article that the comprehensive intervention of individuals, families, and communities with disabilities can meet the diverse needs of people with disabilities, thereby achieving good community care for them. Liu Yuchen [5] raised concerns about the social acceptance of visually impaired people using Guide dog to travel and the deepening and detailed development of social work for the disabled.

Zhang Mangmang et al. [3], from the perspective of the experience of the disabled, studied the travel needs of the disabled and the obstacles in the travel process, and proposed the planning and imagination of future barrier free travel in combination with Assistive technology and barrier free design. After collecting data through questionnaires and interviews, Jin Chenyu [4] explored the construction of Accessibility in Shenzhen and found that the construction of Accessibility needs to be promoted to provide a good guarantee for the travel of the disabled. Liu Yuchen [5] proposed relevant measures to promote social acceptance of Guide dog through analysis. Wang Boyu [13] proposed through online and offline salons that suitable aging transportation is an important guarantee for the travel of people with disabilities and the elderly. Jia Qinglin [14] proposed that attention should be paid to the psychological activities of low mobility passengers by studying the mode of public transportation. Through relevant literature, it can be found that the current travel and life improvement measures for the domestic disabled mainly focus on the construction of Accessibility, improving public transport travel security, and paying attention to the mental health of the disabled [2].

3   Data analysis

Taking Guangzhou city as the survey location, investigate the influencing factors of travel for people with disabilities and accessibility, including personal basic information such as age, gender, educational background, independent travel status, disability level, and travel purpose and frequency; Social environment (including accessible facilities, social awareness, policy subsidies); Economic situation (including income sources and annual income overview); Conduct research on the current travel situation of people with disabilities from four aspects: psychological state (including travel experience, travel considerations, autonomous control of actions, willingness to go out, and sense of security). Understand the current situation of travel for people with disabilities, analyze the factors that affect their travel choices through interviews, and explore solutions.

Based on the requirements of this evaluation, a 95% confidence level was adopted to calculate the sampling error. Combined with repeated argumentation of indicators and questionnaire design, the reliability and validity met the statistical requirements. Taking 11 districts of Guangzhou as the survey subjects, covering multiple places such as transportation, service venues, health institutions, educational venues, shopping and entertainment venues, basic living areas, etc., on-site measurements and research were conducted to collect accessibility and relevant real-time data, explore the pain points of

citizens' travel, investigate the shortcomings of accessibility facilities, and construct a list of factors affecting the travel of disabled people. The survey unit was every disabled person in Guangzhou.

We selected the proportion of data provided by the Guangzhou Disabled Persons' Federation as the overall parameter to estimate and calculate the optimal sample size [5]. To determine the optimal sample size based on the proportion of people with disabilities participating in travel activities, p, it is necessary to obtain the allowable absolute error during the sampling process, which can be combined by the following formula:

$$f = \frac{n_0}{N} \tag{1}$$

$$v(p) = \frac{1-f}{n_0} \frac{N}{N-1} p(1-p) \tag{2}$$

Where $v(p)$ and d need to be obtained through pre survey, N represents the total number of survey units selected in the pre survey, i.e., the total number of pre survey questionnaires distributed, n_0 represents the total number of questionnaires retrieved in the pre survey, which is the number of valid questionnaires. t is the critical value when the confidence level is 95%, and $t = 1.96$. P is the sample proportion, and d is the absolute allowable error.

$$d = t\sqrt{v(p)} = t\sqrt{\frac{N-n_0}{N-1} \frac{p(1-p)}{n_0}} \tag{3}$$

$$n_0 = \frac{t^2 p(1-p)}{d^2} \tag{4}$$

The sampling method of this survey is unequal probability pps sampling, stratified sampling and multi-stage sampling, by the relationship between the sample size and the design effect coefficient, the sample size of the questionnaires to be recovered is calculated as 383, and taking into account the actual questionnaire survey, may be due to the fact that some of the disabled people give up to fill out the questionnaire in the middle of the questionnaire to the question of the lack of understanding of the problem or fill out the questionnaire in a disorderly manner, and so on, and for other reasons, according to the experience we assume that the effective rate of the questionnaire is 90% and we can get the total number of questionnaires distributed in the survey is 426.

Quality control and assessment as an indispensable part of survey implementation, can help us obtain objective and accurate data that are true and effective, reduce the impact of human error on the survey. So we have carried out quality control in the following aspects. Online distribution, offline field research to retrieve the questionnaire way. A total of 480 questionnaires were eventually recovered, and the recovered questionnaires will be screened according to the criteria. After screening and eliminating invalid questionnaires, the valid questionnaires obtained will be processed with missing values. A total of 480 questionnaires were distributed in this survey, a total of 480 questionnaires were recovered, and after many samples with missing values were excluded and very few samples with missing values were filled with the mean to deal

with the missing values, the actual valid samples totaled 444, with an effective rate of 92.5%.

Reliability measurement is mainly to determine the degree of consistency and stability of the data, to test the relationship between the questions and to examine whether the questions have the same content or nature is mainly used to test the stability of the questionnaire itself [7], the size of the Cronbach's alpha coefficient is often used to measure the reliability of the questionnaire. In this paper, the overall reliability of the questionnaire is tested by SPSS software, and the Cronbach Alpha coefficient is 0.964, which is greater than 0.7, indicating that the design of the questionnaire structure and question options is reasonable and scientific, and the consistency of the questionnaire is high. The coefficient of Alpha coefficient after deleting any one of the influencing factors is lower than 0.964, which indicates that none of the factors of the current questionnaire can be deleted.

Once the reliability analysis is completed, it becomes essential to assess the questionnaire's validity. This is achieved through a validity test of the pre-survey questionnaire data. The analysis involves conducting KMO (Kaiser-Meyer-Olkin) and Bartlett's sphericity tests. The observed value of the statistic is 7658.894, with a p-value approaching 0. With a significance level (α) set at 0.05, the p-value (p) is found to be less than α (p < α). As a result, the original hypothesis is rejected, indicating a significant difference between the correlation coefficient matrix and the unit matrix. Moreover, the KMO value is determined to be 0.965, which is greater than the recommended threshold of 0.8. This indicates that the variables are suitable for factor analysis.

4   Exploring the influencing factors of travel for people with disabilities

The Chi-squared test is used to analyze the degree of fit between the actual observation values and the theoretical inferred values of two or more samples [8], which belongs to the nonparametric analysis hypothesis that the theoretical value and the actual value are mutually independent, and then the reliability of the theory is inferred by calculating the chi square value between the actual value and the theoretical value of the samples. The larger the chi square value, the more accurate the inference is.

The principle of factor analysis is to extract common factors through dimensionality reduction without missing or reducing missing original data as much as possible. Firstly, by determining whether there is a strong correlation between variables, factor extraction is performed to reduce the dimensionality of the original variable, reduce the number of variables, extract common factors, and obtain the cumulative variance contribution rate and initial value characteristics of each factor through principal component analysis. After naming the common factors, the factor score is calculated [9].

Firstly, construct a correlation matrix using SPSS to determine whether variables are suitable for factor analysis. Based on the results, it can be observed that most variables have high correlation, so factor analysis can be performed on them. Meanwhile, the analysis of KMO test results indicates that the original variables are suitable for factor analysis. By generating a factor load matrix, the importance of variables in the common

factor can be intuitively judged. If all variables have a load value greater than 0.4, they can be retained. At the same time, it can be observed that Component 1 most affects the 7th variable in Question 20, Component 2 most affects the 4th option in Question 19, and Component 3 most affects Question 22. After identifying common factors, name the factors. The rotated factor load matrix shows that Component 1 has the greatest impact on the first 8 variables, Component 2 has the greatest impact on variables Q19 | R4 to Q19 | R1, while Component 3 has the greatest impact on variables in questions 19, R1, and 22. Use the factor score coefficient matrix to observe the relationship between the main tables and the extracted common factors. If a common factor has a high score, it indicates that the closer the relationship between the indicator and the common factor is. The indicator results show that the three biggest factors affecting the travel of people with disabilities are psychological factors, social factors, and economic factors. Through contingency analysis and Chi-squared test, it is verified that gender and disability type have no significant impact on the travel of disabled people, so no further research will be conducted on gender and disability type.

At the same time, three common factors affecting the travel of disabled people are obtained through factor analysis, and three factors are determined through principal component analysis: psychological factors, social factors, and economic factors. Random forest regression is mainly a method of data mining. It builds a forest with many decisions based on decision trees in a random way, and each tree is independent of each other. It randomly selects characteristic variable parameters at nodes for bifurcation, and finally the decision tree votes to produce prediction results. The regression calculation is small, and the sample size is large. The Random Forest analysis of nonlinear data will have better fitting effect, lower Root-mean-square deviation, and higher prediction accuracy of the model [10]. In this paper, SMOTE Oversampling algorithm is used to synthesize minority Oversampling based on random sampling. The problem of overfitting caused by random sampling is solved by reserving minority samples for incremental operation [11]. New samples are added to the original dataset through artificial synthesis. Based on the analysis and prediction of the travel influencing factors of the disabled in Random Forest, the dependent variable is set to: "18. What do you think the degree of the impact of disability on your travel?", the independent variable is set to "19. What do you think the psychological factors affecting your travel are 1-9", "20. What are the social factors affecting your travel?" and "22 May I ask your annual income After randomly dividing the data into a training set (70%) and a testing set (30%) in proportion to the category, the training set data is subjected to SMOTE resampling processing before training the model. The results indicate that the Q19 series indicators have the greatest impact on travel, followed by the Q20 series indicators, and finally Q22., The psychological factors have the greatest impact on travel, followed by social and economic factors.

Through the Random Forest model, the indicators in the above three common factors were disassembled, and the unbalanced data and retrograde processing and training [12] were performed with the SMOTE algorithm, and the prediction results were up to 93.28%. After ranking the importance, it was obvious that psychological factors were the most influential factors for the travel of disabled people, and the impact of psychological factors on the travel of disabled people was higher than social factors and higher

than economic factors, The psychological factor of 'lack of security' is the most important factor affecting travel.

5   Conclusions and recommendations

5.1   Incomplete and incomplete coverage of barrier-free facilities

For people with disabilities, pregnant women, people with disabilities and other groups, the barrier-free environment is a good helper in the life of the "barrier-free" travel, from the research data, the public believe that the complete coverage of barrier-free facilities still need to be improved [13], but also need to maintain the humanized design of toilet handrails, accessible toilets, accessible routes, accessible signs are not clear and other issues, bus accessibility measures are not comprehensive and the complexity of the facilities lead to inconvenience for people with disabilities in public transportation [14]. Signs are not clear and other issues; bus accessibility measures are not comprehensive, and the complexity of the facilities lead to the inconvenience of public transportation for people with disabilities [14].

5.2   Barrier-free facilities are not standardized, and safety hazards become the biggest obstacle to travel.

Poorly designed barrier-free facilities can easily bring invisible safety hazards to the travel of people with disabilities, people with handicaps, and child caregivers. For example, many people mentioned that there is a difference in the height of the sidewalk's curb ramps, which makes it difficult for strollers and manual wheelchairs to get on and off and pass through, and is virtually non-existent [15]; the pedestrian bridge lacks an accessible elevator, and the ramp of the staircase is too large and lacks a handrail, making it more dangerous for the public to get on and off the staircase.

5.3   Factors affecting the mobility of people with disabilities also include information barriers.

According to the interviews and research, most of the disabled people get the information of the districts through the sports activities organized by the community, and then reflect on the information they get to fight for the relevant welfare and wrong policies; however, for those who don't go out very often or don't have the means to contact with the information, the number of times they travel is relatively fewer, and when the contact with the outside world is getting less and less and the self is getting more and more closed, the difference in the mental outlook will be visible to the eyes. The gap in mental outlook can be visible to the naked eye.

6   Suggestions

6.1   Government: Plan the construction of barrier-free environment according to the actual needs of the group.

In the process of barrier-free environment construction, the relevant departments need to go deep into the grassroots, make construction plans based on the life trajectories of citizens and disabled groups' living and traveling habits, and take the voices and suggestions of disabled groups and elderly people with mobility problems as the main basis for decision-making, so as to realize the enhancement of the barrier-free environment construction and at the same time satisfy the application needs of the core groups.

6.2   Disabled Persons' Federation: Strengthening the Information Circulation of Barrier-Free Service System among Districts

It is necessary to strengthen the flow of information between districts, change the original single family or community-centered care for people with disabilities, strengthen the flow of information on welfare or activities for people with disabilities, and strengthen the interaction between districts so that people with different types of disabilities can understand each other, and make travel more diversified. The home can also promote the deepening and unification of barrier-free services and drive the communities that are lagging in terms of barrier-free facilities and services to realize a truly barrier-free city.

6.3   Related companies: scientific intelligent algorithms to accurately configure travel programs for people with disabilities

Combine the perspectives of both designers and users. Design in four cognitive ways: I know what I don't know, I know what I know, I know what others know as well as I do, and I don't know what others don't know as well as I do. Targeting objects and transforming by gathering information to gain knowledge from other perspectives. Transformation from an object identity to a subject-involved identity is what leads to the realization of many problems and experiential knowledge.

6.4   Community: Finding a new model to solve the shortage of human and material resources for community-based rehabilitation

Putting community rehabilitation for the severely disabled on the agenda, it is difficult for people with severe disabilities to walk from their homes to the community, and their daily travel can only be mild or moderate, and people with severe disabilities can only lie down at home or simply undergo rehabilitation, the community should look for a balance between business, public welfare and public services, and if they simply rely on subsidies from the government or higher authorities, there will be a lack of manpower or insufficient material resources which may lead to constant delays in the program.

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