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Analysis of shared parking demander' choice behavior based on elaboration likelihood model

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ABSTRACT

The shared parking mode is an effective measure to solve the problem of urban parking difficulties. However, due to insufficient research on the parking choice behavior and its influence factors, the shared parking mode has not been effectively promoted and applied. In order to study the parking choice behavior of the demander in the shared parking mode, this paper establishes a choice intention model of shared parking demander based on Elaboration Likelihood Model (ELM), and divides effect route in the process of promoting shared parking mode into central route and peripheral route. Firstly, we study the external influence factors that correspond to central route and peripheral route. And then we establish the connection between external influence factors and attribute factors of the demander by assuming 20 correlations. Finally the hypotheses in the model are verified by questionnaire investigation and statistical test. The research results indicate that the walking distance and parking time are significantly correlated with the travel purpose of the demander; the parking fee is significantly correlated with the income of the demander; the security risk factor is significantly correlated with the age of the demander. The research results of this paper have certain significance and reference value for platform operators and government departments to issue relevant incentive policies to promote the shared parking mode.

1. Introduction

With the rapid growth of China's economy and the accelerating urbanization process, China's car ownership has increased year by year, resulting in increasing demand for parking spaces, insufficient parking space planning, and low standards of parking facilities, which has become the main obstacle to the development of urban transportation at this stage. How to improve the efficiency of parking space utilization and urban parking has become an important content of urban traffic management. In the face of such challenges, in addition to improving the traditional parking management, the government departments also need to adjust the urban parking development and management strategy.

With the development of information technology and shared economy, private parking space sharing has become possible, and the shared parking mode has been proposed and applied. The concept of shared parking was first proposed by the Urban Land Institute of America in 1983. It defines shared parking as the sharing parking spaces by using the different peak parking periods of the day in a certain area. However, the initial research was mainly used in the design of parking lot. With the aggravation of urban parking problems, parking congestion has become a shackle that seriously affects and restricts the development of urban traffic, only then has shared parking theory achieved substantial development. Later, the city of Portland promoted the practice of shared parking theory. Since 2013, countries such as England, Germany, France, and Italy have also begun to use the shared parking mode to solve urban parking problems. On the one hand, the shared parking mode can improve the utilization rate of idle parking spaces, bring certain benefits to the parking space sharers, on the other hand, it can reduce the time for the parking demand to find parking spaces, thereby further alleviating traffic congestion. With the development and application of the shared parking theory, many researchers have studied the shared parking mode and its application in urban parking.

In terms of the shared parking policy, Czerwienskit (2013) defined the responsibilities of the government and developers in the implementation of shared parking policy, and believed that the government should provide convenience for parking space sharing as much as possible, such as compile shared parking technical manual, research and provide shared parking protocol template, establish shared parking database and open to the public. Chen (2008) analyzed the feasibility

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of applying shared parking concept to transit-oriented development design, and discussed the design method, management strategy and operation mode of applying shared parking in TOD planning. Shaheen et al. (2010) conducted 34 expert interviews with government agency staff involved in the development and management of U.S. car-sharing and parking policies, and concluded that shared parking policy should focus on seven key elements, including parking space allocation; parking restrictions; fees and permits; signs, installation and maintenance; enforcement; impact research; public participation. Gao and Zhu (2010) recommended shared parking strategies such as suspending the charging of public parking lots, strengthening the management of parking lots, and the new public buildings should provide some public parking spaces while meeting their own parking needs. Ran (2013) analyzed the adaptability and feasibility of the implementation of the sharing parking strategy in the central area of large cities, and summarized four main measures to implement shared parking policy in the built-up areas. Wang (2017) established a shared resource matching model of combined land use and studied the shared matching of parking spaces.

In terms of the parking choice behavior, the researchers mainly study the parking choice behavior of drivers from the aspects of parking cost, parking time and walking distance based on the basic parking data survey. Lambe (1996) built a linear function model based on travel distance, walking distance and parking rate. Hu (2009) proposed a linear utility function of the parking choice behavior. Bonsall and Palmer (2004) believed that the parking experience and path selection of the parking lot is an important factor affecting the parking choice behavior. John et al. (2002) used SP survey method to study the choice preference of on-road and off-road berths, through the establishment and calibration of logit model, it is found that parking cost is the most important factor affecting the parking choice preference. Sattayhatewa and Smith (2003) established a logit combination model based on parking lot selection and route selection. Sun (2010) established a logit model of commuter parking choice by using the random utility theory. Ibeas et al. (2014) investigated and analyzed the parking choice behavior of different types of parking lots in Spain, and found that the parking choice behavior is not only affected by factors such as driving distance and walking distance, but also related to the driver's driving age, income level and whether it is a local resident. Li and Zhu (2007) established the travel choice behavior model and parking behavior model under the constraint of capacity. Ji et al. (2008) established a two-stage parking choice behavior model. Leurent and Boujnah (2014) built a network model of parking route selection under the premise that each traveler needs to make a two-stage selection. Chang et al. (2012) established a parking choice behavior model based on the prospect theory, and proposed that adjusting the parking rate can optimize the resource utilization level of the urban parking system.

Although researchers have made a lot of achievements in the research of shared parking policy and parking choice behavior, these research results are all to explore the external factors which influence the parking choice intention of the parking demander, such as parking time and walking distance, while always ignoring the attribute factors of the demander which also could have a great influence on parking behavior. Although Ibeas et al. (2014) believed the driver's driving age and income level could influence parking behavior, they didn't study the connection between these attribute factors and external influence factors, and there is no systematic relationship model between them at present, especially in the shared parking mode. It is important to study the influence of users' attribute factors on shared parking behavior. Therefore, the primary goal of this research is to study the parking choice behavior in shared parking mode by combining external factors and attribute factors of the demander, and to explore the connection between them. Elaboration likelihood model is the most influential theoretical model in consumer information processing, which believes that the consumer mainly conducts comprehensive evaluation through the central route and the peripheral route, and it is often used to study consumer behavior patterns. The driver's parking choice process is essentially a consumption process, the driver is influenced by both central factors and peripheral factors when making parking choices, especially in the shared parking mode, but most of the previous parking choice models only considered central factors, such as parking time and walking distance. Therefore, the elaboration likelihood model can be well adapted to study the parking choice behavior in the shared parking mode, and it can provide a theoretical framework for this research. Based on the analysis of the influence factors of shared parking demander and elaboration likelihood model, we will establish a parking choice intention model and then make relevant hypotheses, after that we will carry out questionnaire investigation and statistical tests to verify these hypotheses, so as to study the correlations between external influence factors and attribute factors of the demander.

The key contribution of this work is the parking choice intention model it provides, which can help us better study the driving factors influencing the choice of the shared parking demander, so as to provide more detailed and accurate decision-making basis for the promotion and application of the shared parking mode. The obtained results have primary significance in the design and application of shared parking mode. These results will be widely used in urban parking management, parking facilities planning and residential area management, and have practical significance in improving urban parking organization, reducing parking accidents and saving parking resources. This paper is divided into four major sections as follows: Section 1 introduces the study background and literature review. Section 2 develops the hypotheses on the connection between external influence factors and attribute factors, and establishes the parking choice intention model. Section 3 develops hypotheses test and model validation. Section 4 is discussion and conclusion of this research.

2. Modeling

In this section, we have established a choice intention model of shared parking demander. Firstly, we have studied the driving factors influencing the choice of the shared parking demander. Those factors are categorized in two types: external influence factors and attribute factors. And then 20 hypotheses have been proposed to establish the relationships of those factors. Finally, we have established the parking choice intention model based on elaboration likelihood model, and divided effect route in the process of promoting the shared parking mode into central route and peripheral route, so as to study parking choice behavior in the shard parking mode.

2.1. Analysis of driving factors of shared parking demander

From the perspective of sharing parking demander, the influence factors are categorized in two types: external influence factors and attribute factors. External influence factors refer to the factors in the external environment (shared parking lot) which have an influence on the demanders' parking choice behavior, such as walking distance and parking time. Attribute factors refer to the demanders' socioeconomic characteristics, such as age and income. Then we have studied how those factors affect the decision making, so as to provide the basis for modeling.

2.1.1. External influence factors

(1) Walking distance: Walking distance is the actual distance from the exit of the parking lot to the destination, which reflects the accessibility of the parking lot to the destination, therefore it is one of the main factors affecting the parking choice. Zhang and Li (2009) proposed that the walking distance is the most

concerned factor when the driver chooses the parking lot. In general, the acceptable maximum walking distance is 300 ~ 500 m, and there is an increasing relationship between the acceptable walking distance and the city scale.

(2) Parking time: The parking time is an important factor affecting the parking choice. The length of parking time is closely related to the travel purpose and travel time, and it is also directly related to the utilization ratio of the parking facilities. Van der Goot (1982) studied the parking behavior in Haarlem area of the Netherlands, it is found that for the parking demand of working trips, the restrictions of walking time and parking time have a significant influence on the choice of parking spaces.

(3) Parking fee: The parking fee is also an important factor that parking demanders pay attention to. Sometimes the drivers prefer to use a lower parking fee in exchange for a longer walking distance. In other words, the drivers are willing to park in a parking lot which is far away from the destination but with a lower parking fee. Liu et al. (2016) proposed that the charging standard has a significant influence on parking choice behavior, especially in the situation of private payment.

(4) Service level of shared parking platform: The shared parking platform technology is a series of technical means provided by the operator in the shared parking mode, such as shared parking app, parking space sharing process and service, transaction mode and parking guidance system. The service level of the shared parking platform will affect whether the demander is willing to choose the shared parking mode.

(5) Security risk factor: The security risk factor is also an important external influence factor. Compared with regular parking lots, the shared parking lots don't have special management personnel and protection measures, foreign vehicles frequently enter the shared parking space in the community, which will face the risk of theft or scratch with other vehicles. Besides, the driver's personal information may also be at risk of being leaked. The parking lot with better security will be more attractive to the parking demanders.

2.1.2. Attribute factors of shared parking demander

(1) Gender: The gender of parking demanders has a certain influence on the choice of shared parking mode. Relatively speaking, the shared parking mode is a new thing, while men and women pay different attention to new things, so men tend to try and use it more than women. And in terms of the number of drivers, the number of male drivers is higher than that of female drivers, so gender is an important attribute factor which must be considered.

(2) Age: The age of parking demanders has an important influence on the selection and use of shared parking mode, because young drivers are more willing to accept the shared parking mode which belongs to new things, while older drivers are relatively willing to use the traditional parking lot.

(3) Income: The income of parking demanders has a great influence on parking choice behavior. In general, low-income drivers are more willing to choose a low-cost parking lot.

(4) Travel purpose: The travel purpose is what the parking demander need to accomplish in this driving trip. The travel purpose has a significant relationship with the length of parking time, walking distance and parking cost, and it has a significant influence on the choice of parking lot.

2.2. Elaboration likelihood model

Elaboration Likelihood Model (ELM) is an important model of communication science, which was proposed by psychologists Petty and Cacioppo (1984). ELM is a dual-factor theoretical model to study how the information recipient processes the received information, and it is also an influential theoretical model in consumer information processing. ELM model believes that the process of the information adoption is also a persuasion process, when the audiences receive information, they will make a series of judgments of the confidence level, which will affect the decision of information adoption (Ho and Bodoff, 2014). Based on ELM model, the information will show two effect routes in the process of persuading the audience, the first is central route and the other is peripheral route, as shown in Fig. 1.

ELM model believes that the information recipient mainly evaluates the credibility through the central route and the peripheral route. The central route is that the information recipient actively thinks about the views or contents of the received information, and makes corresponding response after fully understanding these views and contents. In this case, the quality of the information received by the recipient will significantly affect its perception of information usefulness, if the information has a high quality, then the recipient will accept the view of the information. When the information fails to arouse the interest of the recipients, they will not think deeply about the views and contents of the information, then the information will affect the recipient through the peripheral route. The peripheral route refers to some peripheral factors that have nothing to do with the views or contents of the information, such as the characteristics of the information publisher, the quantity or length of the information, as well as some opinions and attitudes of others towards the information, these peripheral factors also have a persuasive influence on the information recipient.

In the shared parking mode, the parking demander will decide whether to choose shared parking based on the information obtained from outside, and the demander is faced with a process of receiving information, processing information, changing attitudes and behaviors, and making decisions. In this process, if the demander has a certain understanding and cognition of the shared parking mode, the information will be deeply considered and affect the demander through the central route. On the contrary, the demander will be easily affected by the peripheral factors, the peripheral route will take effect. The promotion route of the shared parking mode under elaboration likelihood model is shown in Fig. 2. The motivation and ability of the parking demander to process information is called involvement degree, the higher the involvement degree of demanders, the more likely they are to adopt the central route for information processing, that is, to make decisions after carefully considering the information. When the involvement degree is low, the parking demanders tend to process information according to the peripheral information of the parking lot. Therefore, based on the analysis of the driving factors, we will establish the central route and peripheral route in the promotion process of shared parking mode, and then study the connection between external influence factors and attribute factors.

2.3. Proposing hypotheses

2.3.1. Variable selection

Based on the previous analysis, we took the external influence factors as independent variables, including walking distance, parking fee, parking time, technical service level of the platform and security risk factor, and we took the attribute factors as dependent variables, including age, gender, income level, and travel purpose. Combined with two effect routes in ELM model, we further divided the independent variables into central driving factors and peripheral driving factors. According to the attention and thinking degree of the demander to the external influence factors, we took walking distance, parking fee and parking time as central factors, and took service level of the platform and security risk factor as peripheral factors. Then 20 hypotheses have been proposed to establish the relationships of those factors.

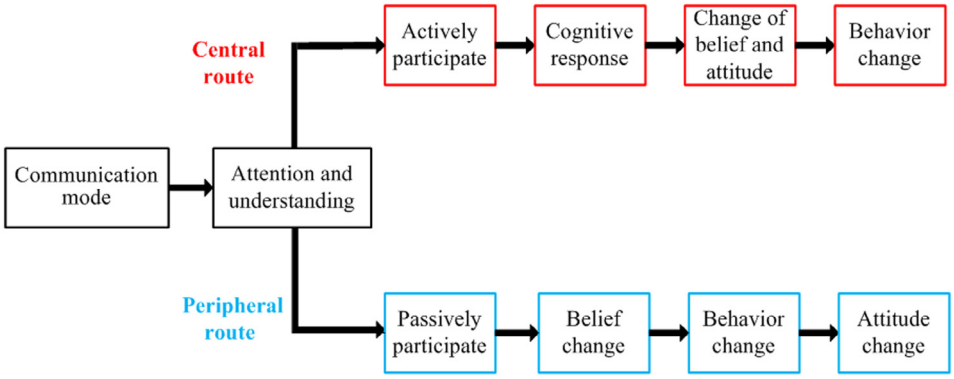

Fig. 1. Two effect routes in Elaboration Likelihood Model.

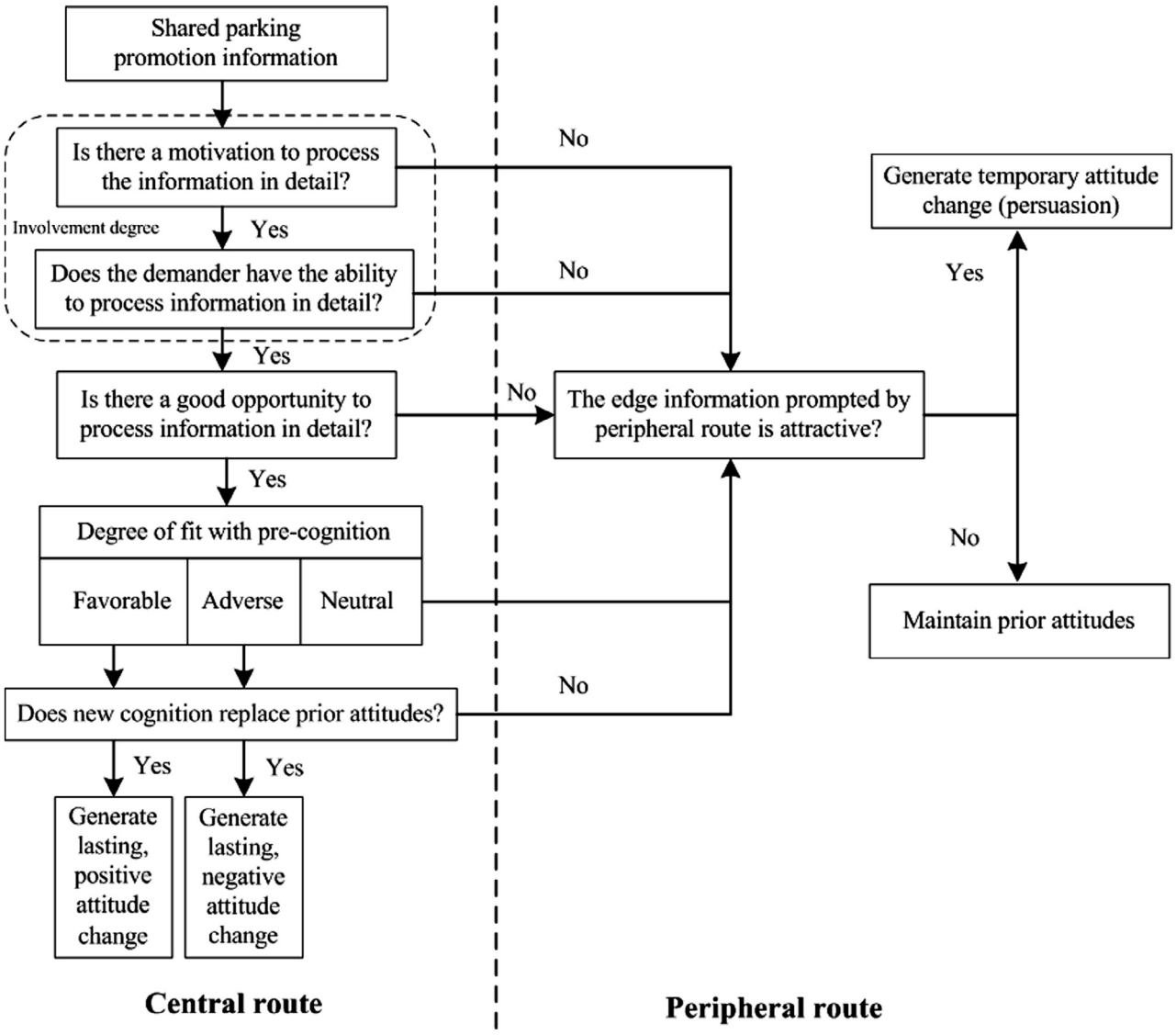

Fig. 2. Promotion route of shared parking mode under Elaboration Likelihood Model.

2.3.2. Analysis of central route effect

(1) In the shared parking mode, we assume the walking distance of the parking demander:

H1a: The walking distance has a slight correlation with the age of the demander.

H1b: The walking distance has a slight correlation with the gender of the demander.

H1c: The walking distance has a slight correlation with the income of the demander.
H1d: The walking distance has a significant correlation with the travel purpose of the demander.

(2) In the shared parking mode, we assume the parking time of the parking demander:

H2a: The parking time has no significant correlation with the age of the demander.
H2b: The parking time has no significant correlation with the gender of the demander.
H2c: The parking time has a slight correlation with the income of the demander.
H2d: The parking time has a significant correlation with the travel purpose of the demander.

(3) In the shared parking mode, we assume the parking fee paid by the parking demander:

H3a: The parking fee has no significant correlation with the age of the demander.
H3b: The parking fee has no significant correlation with the gender of the demander.
H3c: The parking fee has a significant correlation with the income of the demander.
H3d: The parking fee has a slight correlation with the travel purpose of the demander.

2.3.3. Analysis of peripheral route effect

(1) In the shared parking mode, we assume the service level of the platform:
H4a: The service level of the platform has a significant correlation with the age of the demander.
H4b: The service level of the platform has a slight correlation with the gender of the demander.
H4c: The service level of the platform has a slight correlation with the income of the demander.
H4d: The service level of the platform has a slight correlation with the travel purpose of the demander.

(2) In the shared parking mode, we assume the security risk factor:

H5a: The security risk factor has a significant correlation with the age of the demander.
H5b: The security risk factor has a significant correlation with the gender of the demander.
H5c: The security risk factor has a slight correlation with the income of the demander.
H5d: The security risk factor has a slight correlation with the travel purpose of the demander.

2.4. Parking choice intention model of shared parking demander

Based on the analysis of the central route effect and peripheral route effect, we have established the parking choice intention model of shared parking demander based on ELM model, as shown in Fig. 3. In this model, we could see that three central driving factors and two peripheral driving factors respectively act on four attribute factors of the demander, corresponding to the 20 related hypotheses assumed above, thereby we have established the relationships between external influence factors and attribute factors. After that we will verify the hypotheses in this model by questionnaire investigation and statistical test in the next section.

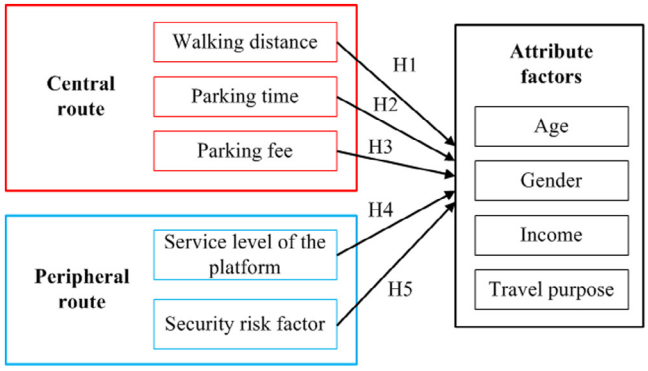

Fig. 3. Parking choice intention model of shared parking demander.

3. Model validation

In this section, the hypotheses in the parking choice intention model have been verified by questionnaire investigation and statistical test. Firstly, we have designed a questionnaire and carried out a field survey in the shared parking lots in Harbin. And then the survey results obtained have been statistically processed, the reliability and validity of the survey results have been tested. Finally, we have verified the hypotheses by single sample Student's *t*-test.

3.1. Questionnaire design and effectiveness analysis

3.1.1. Questionnaire design and investigation

The questionnaire was designed based on the parking choice intention model we have established, which consists of two parts. The first part was to investigate the attribute information of the demander, including age, gender, income and travel purpose. The second part was to investigate the influence degree of external influence factors, including walking distance, parking time, parking fee, technical service level of the platform and security risk factor, each factor needs to be measured qualitatively according to the feeling and cognition of the respondents, so the questionnaire was designed in the form of 5-point Likert scale.

When conducting a random sample survey, it is necessary to ensure sufficient sample size of the questionnaire to make the survey results credible. The formula for calculating the minimum sample size is as follows:

$$n = z^2 \cdot \sigma^2 / d^2$$

where n is the minimum sample size; z is the statistic of the confidence level Z, the z value corresponding to the 90% confidence level is 1.64; σ is the standard deviation of the population, generally taking 0.5; d is the allowable error. We pick 90% for confidence level and 10% for allowable error, the minimum sample size is 273 according to the formula. We have conducted a survey in ten shared parking lots in Harbin, and issued 40 questionnaires for each parking lot. 290 valid questionnaires were obtained after removing incomplete questionnaires, the statistics of the survey results of the parking demanders' attribute factors were shown in Table 1. Next, we need to test the reliability and validity of the questionnaire data.

3.1.2. Reliability analysis

Reliability is an index reflecting the stability and consistency of the survey results. The higher the reliability is, the higher the credibility of the questionnaire is. Cronbach's α coefficient is often used to test reliability, the formula for calculating Cronbach's α coefficient is as follows:

Table 1
Statistics of survey results of parking demanders' attribute factors.

Attribute factor	Classification	Quantity	Proportion
Gender	Male	180	62%
	Female	110	38%
Age	Under 25	14	5%
	26 ~ 36	190	66%
	37 ~ 55	68	23%
	Over 55	18	6%
Monthly income (yuan)	Under 3000	12	4%
	3000 ~ 5000	56	19%
	5000 ~ 8000	147	52%
	8000 ~ 13000	38	13%
	13000 ~ 20000	30	10%
	Over 20,000	7	2%
Travel purpose	Working	156	54%
	Shopping	52	18%
	See a doctor	21	7%
	Entertainment	38	13%
	Other	23	8%

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K}\sigma_{Y_i}^2}{\sigma_X^2}\right)$$

where K is the number of items in the questionnaire; $\sigma_{Y_i}^2$ is the variance of the observed sample i; σ_X^2 is the variance of the total sample. In general, when the α coefficient is above 0.6, the test is passed. We have used SPSS software to calculate the α coefficient, and the results were shown in Table 2. We can see the values of each reliability coefficient are above 0.6, which indicates that the reliability quality of the sample data meets the research requirements.

3.1.3. Validity analysis

Validity analysis refers to the analysis of the effectiveness of the survey. We have used the KMO test to test the validity, KMO (Kaiser-Meyer-Olkin) is an index used to compare simple correlation coefficient and partial correlation coefficient between variables, the formula for calculating KMO is as follows:

$$KMO = \frac{\sum\sum_{i\neq j} r_{ij}^2}{\sum\sum_{i\neq j} r_{ij}^2 + \sum\sum_{i\neq j} a_{ij}^2}$$

where r_{ij} is the correlation coefficient; a_{ij} is the partial correlation coefficient. The closer the KMO value is to 1, the stronger the correlation between the variables and the more suitable for factor analysis. It means the data has validity when the KMO value is greater than 0.6. We have used SPSS software to calculate the KMO value, the test results were shown in Table 3. We can see the KMO value is 0.842 above 0.8, and the corresponding relationships between each item and factor are consistent with the expectation, indicating that the structural validity of the questionnaire is well, and the sample data of the questionnaires have passed the validity test.

3.2. Questionnaire data analysis

In order to verify the hypotheses in the parking choice intention model, we have used single sample Student's t-test method to test the sample data in the second part of the questionnaires. The single sample t-test is used to compare the difference between the sample data and a specific value.

Table 2
Cronbach's α coefficient test.

Index	α coefficient
Walking distance	0.702
Parking time	0.724
Parking fee	0.698
Service level of the platform	0.659
Security risk factor	0.719

Firstly, we proposed the null hypothesis H0: $u = u_0$, where u is the population mean and u_0 is the test value, and then we constructed the test statistics $t = \frac{\bar{X}-u}{S/\sqrt{n}}$. After that, we used SPSS to calculate the observed values of T-statistic and corresponding probabilities (p-values). Finally, we judged whether the null hypothesis is true by comparing the p-value and significance level α.

The second part of the questionnaire is in the form of a five-level scale, which is very agreeable, agreeable, general, disapproved, and very disapproved, the corresponding scores in the single sample t-test are 1 ~ 5. We made the test value $\mu_0 = 1$, $\mu_0 = 2$, $\mu_0 = 3$, $\mu_0 = 4$, $\mu_0 = 5$ respectively, and used SPSS to carry out the single sample t-test. It is found that the p-values of the 20 items are less than 0.05 when $\mu_0 = 1, 4, 5$, which indicates that the assumption is not true, $\mu \neq \mu_0$. That is, no one of the results is in line with very agreeable, disapproval, and very disapproval. The t-test results were shown in Tables 4 and 5.

We divided the influence degrees of the external factors on the parking choice based on the p-values. According to Table 4, when $\mu_0 = 2$ (the degree is approval), the p-values corresponding to Q2a, Q2b, Q2c, Q3a, Q3b, Q3d, Q4a, Q4b, Q4c, Q4d, Q5b, and Q5d are greater than 0.05, which indicates that the corresponding hypotheses are true. The p-values corresponding to Q1d, Q2d, Q3c and Q5a are less than 0.05, and the average values are less than 2, so the influence degrees are higher, while the average values of Q1a, Q1b, Q1c and Q5c are greater than 2, so the influence degrees are lower. According to Table 5, when $\mu_0 = 3$ (the degree is general), only Q5c is true. Based on the average value, it can be concluded that the influence degrees of other items are higher than Q5c.

3.3. Model hypotheses test results

There were 20 hypotheses in the parking choice intention model we have established, and we have obtained the test parameters (p-values) of each hypothesis by single sample t-test, as shown in Fig. 4. Based on the t-test results, we could see the hypotheses of H1a, H1b, H1c, H1d, H2c, H2d, H3c, H3d, H4b, H4c, H4d, H5a and H5d were valid, as shown in Table 6. The correlation degrees between the external influence factors and attribute factors were shown in Table 7.

4. Conclusions

From the perspective of the shard parking demander, firstly we have studied the driving factors influencing the choice of the shared parking demander, those factors are categorized into two types: external influence factors and attribute factors. And then we have proposed 20 hypotheses and established the parking choice intention model based on ELM model. Finally, the hypotheses in this model have been verified by questionnaire investigation and statistical test. Fig. 4 and Table 7 have shown the results obtained from this research. The research we have done suggests that the walking distance and parking time are significantly correlated with the travel purpose of the demander; the parking fee is significantly correlated with the income of the demander; the security risk factor is significantly correlated with the age of the demander. These results support the original hypothesis that the external influence factors and attribute factors are related, which can be used in the promotion and application of the shared parking mode.

Despite the great advantages mentioned above, there are also some deficiencies. The limitation of this study is clear, this study has examined only five external factors and four attribute factors, we have not addressed all driving factors influencing the parking choice behavior,

Table 3
Factor analysis of questionnaire data.

Item	Factor loading					Communality
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	
Q1a	0.324	0.102	0.104	0.418	0.319	0.756
Q1b	−0.102	0.053	0.487	0.765	0.023	0.698
Q1c	0.422	0.023	−0.065	0.329	0.102	0.744
Q1d	0.342	0.560	0.411	−0.012	0.074	0.768
Q2a	0.342	0.105	0.065	−0.301	0.039	0.699
Q2b	0.457	0.136	0.576	0.579	0.091	0.702
Q2c	0.106	0.479	0.021	0.375	0.419	0.682
Q2d	0.498	0.021	0.349	0.574	0.128	0.649
Q3a	−0.031	0.309	0.497	0.403	0.216	0.695
Q3b	0.349	0.568	0.401	0.033	0.009	0.716
Q3c	0.208	−0.018	0.459	0.394	0.276	0.688
Q3d	0.347	0.205	0.349	0.479	0.008	0.729
Q4a	−0.074	0.279	0.381	0.247	0.198	0.686
Q4b	0.268	0.106	0.368	0.382	0.026	0.795
Q4c	0.294	0.379	0.098	0.288	0.008	0.703
Q4d	0.406	0.547	0.376	0.294	0.349	0.697
Q5a	0.209	−0.387	0.109	0.289	0.495	0.721
Q5b	0.031	0.209	−0.238	0.130	0.294	0.689
Q5c	0.430	0.103	0.294	0.108	0.274	0.702
Q5d	0.319	0.206	−0.243	0.394	0.439	0.696
Eigen value (Unrotated)	2.407	4.386	0.991	5.209	5.544	–
% of Variance (Unrotated)	12.109%	25.884%	12.494%	13.609%	9.198%	–
Cumulative % of Variance (Unrotated)	12.109%	19.658%	31.297%	29.874%	17.641%	–
Eigen value (Rotated)	1.986	1.874	1.909	2.017	2.101	–
KMO	0.842					

Table 4
Student's *t*-test results when $\mu_0 = 2$.

Item	N	Min.	Max.	Mean	S.D.	t	p
Q1a	290	1	5	2.37	0.69	1.46	0.00**
Q1b	290	1	5	2.68	0.79	2.01	0.00**
Q1c	290	1	4	2.43	0.91	1.57	0.00**
Q1d	290	1	5	1.77	0.81	−2.13	0.04
Q2a	290	1	5	2.62	0.90	3.05	0.94
Q2b	290	1	4	2.71	0.78	1.09	0.56
Q2c	290	1	5	2.71	0.76	2.49	0.68
Q2d	290	1	4	1.94	0.83	−0.32	0.02
Q3a	290	1	4	2.37	0.84	1.69	0.97
Q3b	290	1	5	2.49	0.78	3.27	0.99
Q3c	290	1	5	1.87	0.91	2.14	0.02
Q3d	290	1	4	2.69	0.71	1.56	0.68
Q4a	290	1	5	2.39	0.87	1.09	0.47
Q4b	290	1	5	1.85	0.78	2.04	0.21
Q4c	290	1	4	2.29	0.90	0.98	0.74
Q4d	290	1	4	2.61	0.86	−1.24	0.55
Q5a	290	1	5	2.38	0.81	2.16	0.03
Q5b	290	1	5	2.49	0.76	1.48	0.70
Q5c	290	1	4	3.23	0.80	3.16	0.00**
Q5d	290	1	4	2.38	0.67	1.69	0.59

* $p < 0.05$ ** $p < 0.01$

and the methods of this study were restricted to statistical test. In the follow-up research, we will consider more external influence factors and attribute factors, such as traffic environment of parking facilities and occupation of parking demanders, and we will conduct research combined with structural equation model. In the shared parking mode, the supplier and the demander will interact with each other, this paper only studied the parking choice intention of the demander, and we will further study the berth sharing intention of the supplier in the future research.

Compared with previous researches, this paper established a parking choice intention model of the shared parking demander based on ELM model, and studied the connection between external influence factors and attribute factors of the demander in detail. Based on the research results, we can provide detailed and accurate suggestions for the promotion and application of the shared parking mode:

(1) In terms of the location selection of shared parking lots, the walking distance between the main destination and the parking lot should be shortened as far as possible, so as to reduce the walking distance and improve the convenience of the shared parking lot, and the shared parking platform should simplify the parking process to reduce unnecessary parking time of the demander.
(2) The parking demanders are rather sensitive to the parking costs, especially for low-income group. In the promotion process of the shared parking mode, the government and the shared park-

Table 5
Student's *t*-test results when $\mu_0 = 3$.

Item	N	Min.	Max.	Mean	S.D.	t	p
Q1a	290	1	5	2.37	0.69	3.76	0.00**
Q1b	290	1	5	2.68	0.79	4.94	0.00**
Q1c	290	1	4	2.43	0.91	8.62	0.00**
Q1d	290	1	5	1.77	0.81	−2.81	0.00**
Q2a	290	1	5	2.62	0.90	−9.67	0.00**
Q2b	290	1	4	2.71	0.78	8.69	0.00**
Q2c	290	1	5	2.71	0.76	7.98	0.00**
Q2d	290	1	4	1.94	0.83	11.69	0.00**
Q3a	290	1	4	2.37	0.84	4.91	0.00**
Q3b	290	1	5	2.49	0.78	−6.72	0.00**
Q3c	290	1	5	1.87	0.91	6.59	0.00**
Q3d	290	1	4	2.69	0.71	4.86	0.00**
Q4a	290	1	5	2.39	0.87	11.27	0.00**
Q4b	290	1	5	1.85	0.78	−5.69	0.00**
Q4c	290	1	4	2.29	0.90	6.29	0.00**
Q4d	290	1	4	2.61	0.86	−10.28	0.00**
Q5a	290	1	5	2.38	0.81	−9.82	0.00**
Q5b	290	1	5	2.49	0.76	10.09	0.00**
Q5c	290	1	4	3.23	0.80	3.98	0.37
Q5d	290	1	4	2.38	0.67	−6.42	0.00**

* $p < 0.05$ ** $p < 0.01$
(Note: the p in Tables 4 and 5 is the significance value, which describes the probability of something happening. If the p-value is less than 0.01, it means that there is at least 99% assurance about the occurrence of something. If the p-value is less than 0.05 and above 0.01, it means that there is at least 95% assurance about the occurrence of something. Q1a is the survey result of the influence of walking distance on age, and so on.)

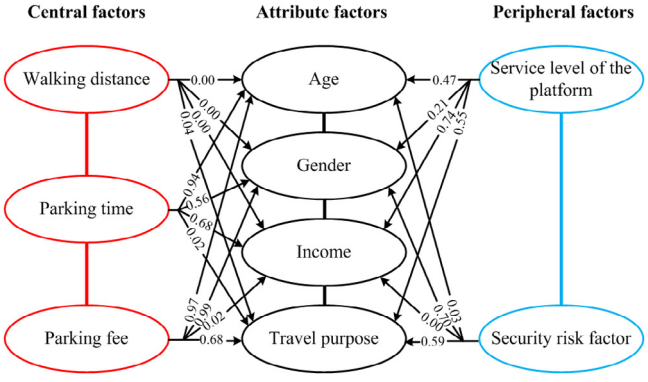

Fig. 4. Parameter calibration diagram of *t*-test in the parking choice intention model.

ing platform could give certain economic subsidies to the parking demanders, so as to make the shared parking mode be welcomed and used by the public.

(3) The shared parking demanders of different ages will pay different attention to the security risk factor. Most users of the shared parking lots are middle-aged people who pay more attention to the security, so we should improve the security in the design of the shared parking lots.

(4) The service level information of the platform has certain correlation with various attribute factors of the demander. Therefore, the operators should improve the service level of the platform, make the parking demanders easy to use the shared parking app, and strengthen the cooperation of online parking lot reservation and offline parking lot service, so as to simplify the business process of shared parking. The platform should also implement more attractive shared parking service according to the users' attribute factors.

Table 6
Test results of hypotheses in the parking choice intention model.

Item	Test result	Item	Test result	Item	Test result
H1a	true	H2d	true	H4c	true
H1b	true	H3a	false	H4d	true
H1c	true	H3b	false	H5a	true
H1d	true	H3c	true	H5b	false
H2a	false	H3d	true	H5c	false
H2b	false	H4a	false	H5d	true
H2c	true	H4b	true		

Table 7
The correlation degrees between external influence factors and attribute factors.

Item	Age	Gender	Income	Travel purpose
Walking distance	slight	slight	slight	significant
Parking time	slight	slight	slight	significant
Parking fee	slight	slight	significant	slight
Service level	slight	slight	slight	slight
Security risk factor	significant	slight	uncorrelated	slight

(5) In the promotion process of the shared parking mode, different promotion plans should be made for different target groups. Based on ELM model, the central information is easier to understand and accept than the peripheral information. Therefore, for those who are familiar with the shared parking mode, we should emphasize the information display of the parking fee, walking distance and parking time. However, those who do not have a deep understanding of the shared parking mode are more willing to accept the peripheral information, so we should pay more attention to the display of the peripheral information when promoting the shared parking mode to them.

The research on parking choice behavior can help in finding the main influence factors of the demander in the shared parking mode. Moreover, it can provide detailed and accurate decision-making basis for the promotion and application of the shared parking mode.

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