Influence Factors of Purchase Intention of Pure Electric Vehicle

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ABSTRACT
In order to reduce automobile exhaust pollution, government departments should formulate transportation policies to promote the popularization of pure electric vehicles, and effective transportation policies require a thorough understanding of the factors that influencing the purchase intention of pure electric vehicles. Based on travelers' environment behavior and environment attitude, travelers' environmental awareness is obtained through the Raschmodel. Then bring environmental awareness into the logit discrete selection model, and analyze the impact of three factors of travelers' environmental awareness, vehicle purchase restriction policies, and individual characteristics of travelers on their willingness to purchase pure electric vehicles. The result shows that the environmental awareness of travelers has a significant and positive impact on the purchase intention of pure electric vehicles; the vehicle purchasing restriction policy of oil-fueled automotive and the construction of charging pile and other infrastructure can increase travelers' purchase intention of pure electric vehicles.

Keywords: *Purchase intention of pure electric vehicles, Discrete choice model, Car purchase restriction, Individual characteristics of travelers, Environment awareness.*

1. INTRODUCTION

The transportation industry has huge energy consumption and is an important source of atmospheric fine particulate matter (PM2.5) in cities. Motor vehicle emissions in some cities have become the primary source of PM2.5. In 2018, more than a dozen major cities, including Beijing, Shanghai, Guangzhou, Shenzhen, Wuhan and Hangzhou, accounted for more than 20% of the total PM2.5 emissions from mobile sources in this city, with Shenzhen and Beijing exceeding40% [1].

In view of the huge proportion of motor vehicle exhaust pollution in air pollution, it is necessary to reduce motor vehicle exhaust pollution and achieve low-carbon transportation. Pure electric cars are driven by electricity, do not produce exhaust pollution, and the electricity cost per kilometer is less than the fuel cost per kilometer of fuel vehicles. It is an important way to achieve low-carbon transportation. However, compared with gasoline vehicles, there are several shortcomings of pure electric vehicles: (1) the battery mileage of pure electric vehicles is not as good as fuel cars; (2) due to the lack of infrastructure such as charging piles, the convenience of charging pure electric vehicles is far lower than that of fuel cars [2].

In order to promote the popularization of pure electric vehicles, various domestic cities are building pure electric vehicle charging piles. On the other hand, there are some cities, such as Beijing, Shanghai, Shenzhen, Hangzhou and Guangzhou, have restrict the purchase of fuel vehicles. Residents only obtain license plates for fuel vehicles through lotteries or auctions. But the auction costs are generally highand the probability of obtaining a license by lottery is very low. However, pure electric vehicle licenses of those cities are easier to obtain than gasoline vehicle licenses.

Analysis of the existing research results on the purchase intention of pure electric vehicles, it is found that scholars mainly research from several aspects: (1) The influence of psychological factors on the purchase intention of pure electric vehicles, such as Wu Yang [3], Yunhui Xue [4], J KIM et al. [5], A F JENSEN et al. [6], CBARBAROSSA et al. [7]; (2) The impact of demographic characteristics on the willingness to buy pure electric vehicles, such as P PLÖTZ et al. [8]; (3) The impact of price on purchase intention of pure electric vehicles, such as M K HIDRUE, etc. [9]; (4)

The impact of government policies on the willingness to purchase pure electric vehicles, such as Xiaohua Sun and others [10] studied the impact of government subsidies.

Since pure electric vehicles have appeared in large numbers in recent years, there is not much research on the willingness to buy pure electric vehicles. Analysis of existing articles found that most of them focused on the influence of psychological factors, prices, and personal statistical characteristics on the purchase intention of pure electric vehicles [11]. The research on the influence of government purchase restriction policy and infrastructure construction on purchase intention of pure electric vehicles is relatively lacking. Based on the above background, this article uses the actual survey data to study the impact of vehicle purchase restriction policies, individual characteristics of travelers, and the environmental protection intentions of travelers on residents' willingness to purchase pure electric vehicles.

2. MODEL SETTING AND QUESTIONNAIRE SURVEY

In the study of travel behavior, the loyalty of a traveler to a certain travel mode is mainly evaluated by two problem items[12-13]: (1) Are you willing to adopt this mode of travel; (2) Are you willing to recommend others to use this mode of travel. Based on the above research, and considering that infrastructure such as charging piles for pure electric vehicles is under construction, in order to analyze the willingness of travelers to purchase pure electric vehicles, three questions were set in the questionnaire: (1) Considering the city's transportation policy and various realities, are you willing give priority to the purchase of pure electric vehicles (electrocar1); (2) Considering the city's transportation policy and various realities, are you willing recommend others to buy pure Electric car now (electrocar2); (3) In the future, if the supporting measures such as charging piles are perfect, are you willing to give priority to pure electric car (electrocar3). The three problem items of electrocar1, electrocar2, and electrocar3 are all 0-1 variables. 0 represents no and 1 represents yes.

In addition, in the research on travel behavior of travelers, some studies have found that the psychological potential variables of travelers affect the travelers' choice behavior [14,15].

Based on the above background, it is assumed that the willingness of travelers to purchase pure electric vehicles is affected by three factors: (1) the city's purchase restriction policy for fuel cars; (2) individual characteristics of travelers; (3) environmental awareness of travelers.

The utility function of a traveler's purchase intention of pure electric vehicles can be expressed as:

$$U = \boldsymbol{\beta}'\mathbf{X} + \alpha \cdot limit + \gamma \cdot Environment + \varepsilon \quad (1)$$

Where: $\mathbf{X}$ represents the individual characteristics of the traveler; $Environment$ is the environmental awareness of the traveler; $\boldsymbol{\beta}$、α、γ is the coefficient to be sought; ε is the error term.

Travelers' environmental awareness is different from variables such as traveler's individual characteristics. It is a latent variable and cannot be measured directly. This article draws on the research results of J ROBERTS et al. [16], K-P TAM et al. [17], and sets two types of display variables for traveler's environmental behavior and traveler's environmental attitude to represent traveler environmental awareness. See Table 1 for details. Using the Likert five-scale questionnaire, the learner's five-item scale for environmental protection behavior is "never", "rarely", "occasionally", "often", and "always". The special five-level scale is "Strongly disagree", "disagree", "not sure", "somewhat agree", "completely agree".

Table 1. Questionnaire

Category	Variable	Symbol
Individual characteristics	Are they female (0 No, 1 Yes)	Female
	Age	Age
	Whether to get married (0 no, 1 yes)	Marriage
	Whether to buy a house (0 No, 1 Yes)	House
	Annual household income (ten thousand yuan)	Income
	Do you own a car (0 no, 1 yes)	Car
	Whether to drive to work (0 no, 1 yes)	Car2work
Purchase restriction	Whether the city limits the purchase of fuel cars (0 no, 1 yes)	Limit
Traveler Environmental behavior	Save as much electricity as possible in the office or classroom (Rickert Five-Level Scale)	b1
	Bring shopping bags when you go out shopping (Rickert Five-Level Scale)	b2
	Try to choose green products when consuming (Rickert Five-Level Scale)	b3
Traveler's environmental attitude	Government should develop stricter environmental policies to protect the environment (Rickert scale 5)	a1
	When buying a product, the focus is on whether the product is green and environmentally friendly (Rickert scale 5)	a2
	In order to protect the environment, which may lead to higher prices, I am happy to accept this (Rickert scale 5)	a3
	Resolutely support the government's "restriction order" policy (Rickert scale 5)	a4
Willingness to buy pure electric vehicles	Considering the transportation policy of the city in which it is located, and whether it will give priority to the purchase of pure electric vehicles (0 No, 1 Yes)	Electrocar1
	Considering the traffic policy and various realities in your city, will you recommend others to buy pure electric vehicles now (0 No, 1 Yes)	Electrocar2
	In the future, if supporting measures such as charging piles are perfect, are you willing to give priority to pure electric vehicles (0 No, 1 Yes)	Electrocar3

The data analysis process is shown in Figure 1.

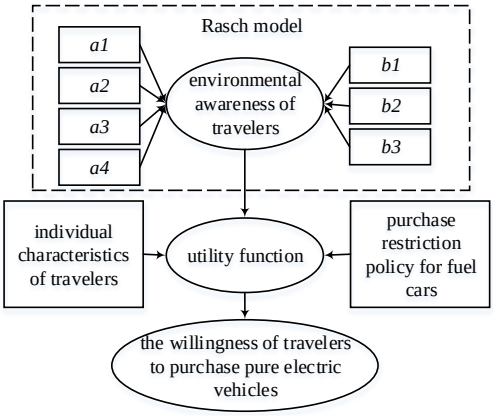

Figure 1 Data analysis process

The data survey was conducted in the form of a network questionnaire. In view of the fact that the group buying cars is a working group, the survey target is set to those who have already worked, and retirees and students are not included in the survey target. The survey was conducted in August 2018. A total of 993 valid questionnaires were collected, of which 52.4% were male; 24.4% were unmarried; 68.1% had a car; 67.0% had a house; 30.4% drove to and from work; the average annual family income was 174, 000 yuan; the average Age: 34.3 years old; 40.6% of the cities where the purchase of fuel vehicles is not implemented.

3. ANALYSIS OF TRAVELERS' ENVIRONMENTAL AWARENESS

According to the analysis in the second section, travelers' environmental awareness is evaluated by environmental behaviors and environmental attitudes; and the environmental behaviors and attitudes of travelers are each characterized by a series of problem items. Since the data answered by travelers in each question of environmental protection behavior and environmental attitude are sequence data, if the above data is treated as fixed distance data, actually imposes the assumption that the distance between the sequenced data is the same. The Rasch model is able to transform sequence data into distance data [18]. Therefore, this article uses Rasch model to process the sequence data of traveler's environmental protection behavior and traveler's environmental protection attitude, and get the data of traveler's environmental protection awareness.

It is assumed that the traveler i answers m with respect to the traveler's environmental behavior and environmental attitude j. According to the Rasch model principle, this response of traveler i to question item j is related to the one-dimensional latent variable related to the traveler and the latent variable of one-dimensional variable related to this problem item. Both variables are one-dimensional fixed-distance variables and are of the same dimension (logit).

Since the answer to the questions about environmental behaviors and attitudes of travelers

involves the environmental awareness of travelers, the variables related to travelers obtained through Rasch model can be used as a measure of the potential environmental awareness of travelers, which is represented by the symbol environment. At the same time, according to the traditional symbolic representation of the Rasch model, the latent variable related to the problem term is represented by the symbol difficult.

According to the Rach model, the probability that traveler i scores m on a problem item j can be expressed as:

$$\log\left(\frac{P_{ijm}}{P_{ij(m-1)}}\right) = environment_i - \left(difficulty_j + \tau_{ij}\right) \quad (2)$$

Where: P is the probability; τ_{jm} is step difficulty.

The larger the value of environment, the stronger the environmental awareness of the traveler, and the more the traveler agrees with environmental protection. By performing maximum likelihood estimation on the data, the potential environmental consciousness environment of the question responder and the difficult value of the question item can be obtained.

According to the data analysis of the Raschmodel, the information of IN MNSQ, OUT MNSQ, PTMEAS, IN ZSTQ, and OUT ZSTD of the 7 question items of traveler's environmental protection behavior and environmental protection attitude is shown in Table 2. According to TG BOND et al. [19], IN MNSQ and Out MNSQ are between 0.5-1.5, indicating a good fit, and PTMES is significantly greater than 0 indicating that the significance is better, and when IN MNSQ and Out MNSQ are between 0.5-1.5, there is no need to consider the value of IN ZSTQ and OUT ZSTD. Therefore, the fit of the data in this article is better.

Table 2. Estimation of the item's difficulty and fit statistics

NAM	IN.MS	IN.ZST	OUT.MS	OUT.ZST	PTM
b1	1.28	5.24	1.22	3.74	0.59
b2	1.31	6.43	1.43	8.21	0.67
b3	0.74	-6.26	0.78	-4.87	0.73
a1	1.06	0.90	0.82	-2.19	0.56
a2	0.73	-5.66	0.72	-5.22	0.69
a3	1.06	1.19	1.06	1.22	0.66
a4	1.11	1.87	0.96	-0.57	0.60

Using traveler's environmental awareness (environment) as the explanatory variable, and analyzing the influence of traveler's individual characteristics on traveler's environmental awareness, the coefficients are shown in Table 3. It can be seen from the data that at the 10% confidence level, the gender, vehicle ownership, and age of the traveler will affect the environmental awareness of the traveler; the environmental awareness of car owners is lower than that of non-car owners; the environmental awareness of women is higher than that of men.

Table 3. Impact of traveler's individual characteristics on traveler's environmental awareness

1.	2.Coef.	3.Std. Err.	4.t	5.P>t
Female	0.625	0.09	6.71	0.000
Marriage	0.141	0.15	0.95	0.340
House	-0.005	0.12	-0.04	0.969
Car	-0.217	0.11	-1.90	0.058
Car2work	-0.035	0.11	-0.31	0.758
Age	0.032	0.01	5.28	0.000
Income	-0.001	0.00	-0.23	0.819
_cons	0.434	0.19	2.29	0.022

4. ANALYSIS OF TRAVELERS' PURCHASE INTENTION OF PURE ELECTRIC VEHICLES

The traveler's environmental awareness (environment) obtained through the Rasch model is used as an explanatory variable to bring into the model to analyze the impact of individual characteristics of travelers, their awareness of environmental protection, and the city's purchase restriction policy on fuel cars on travelers' willingness to purchase pure electric vehicles. In other words, electrocar1, electrocar2, and electrocar3 were used to perform logit regression on individual characteristics of travelers, their environmental awareness, and fuel-car purchase restriction policies. The data are shown in Table 4.

Table 4. Regression coefficients

	Electroca1	Electroca2	Electroca3
Female	0.201	0.155	0.165
	(1.43)	(1.10)	(1.01)
Age	0.028***	0.021**	0.016
	(2.95)	(2.26)	(1.41)
Marriage	-0.165	0.062	0.008
	(-0.75)	(0.28)	(0.03)
House	-0.158	-0.328*	-0.022
	(0.86)	(1.77)	(0.11)
Income	-0.010**	-0.008	-0.000
	(-2.01)	(-1.53)	(-0.06)
Car	-0.121	0.106	0.054
	(-0.71)	(0.62)	(0.28)
Car2work	-0.178	-0.149	-0.068
	(-1.08)	(-0.90)	(-0.36)
Limit	0.323**	0.265*	0.374**
	(2.14)	(1.75)	(2.20)
Environment	0.419***	0.465***	0.396***
	(7.91)	(8.57)	(6.43)
_cons	-1.698***	-2.088***	-0.313
	(-3.32)	(-4.07)	(-0.54)

* p<0.10, ** p<0.05, *** p<0.01

According to Table 3, the coefficients of limit and environment in electrocar1, electrocar2, and electrocar3 are all significant, indicating that the fuel car purchase restriction policy (limit) and the environmental protection awareness (environment) of the traveler will affect the traveler's willingness to purchase pure electric vehicles (electrocar1), At this stage, it is recommended that others will buy pure electric vehicles (electrocar2) and the willingness to buy pure electric vehicles

(electrocar3) when the infrastructure is perfect in the future.

4.1. The Influence of Travelers' Environmental Awareness on the Purchase Intention of Pure Electric Vehicles

The coefficients of environment in electrocar1, electrocar2, and electrocar3 are all positive, that is, the traveler's environmental awareness (environment) has a positive effect on the traveler's willingness to purchase a pure electric vehicle. According to the data in Table 4, fit the traveler's willingness to purchase pure electric vehicles, electrocar1, electrocar2, and electrocar3, to obtain the traveler's environmental awareness The relationship between (environment) and the willingness of travelers to purchase pure electric vehicles is shown in Figure 2. It can be seen from the figure that with the improvement of travelers' environmental awareness, the probability of electrocar1, electrocar2, and electrocar3 gradually increases, that is, the willingness of travelers to purchase pure electric vehicles gradually increases. The two lines of electrocar1 and electrocar2 basically overlap, indicating that at this stage, the willingness of travelers to buy pure electric and recommending others to buy pure electric are basically the same; on the other hand, the line of electrocar3 is significantly higher than that of electrocar1, indicating that in the future, if infrastructure such as charging piles are completed, it will greatly increase the willingness of travelers to buy pure electric vehicles.

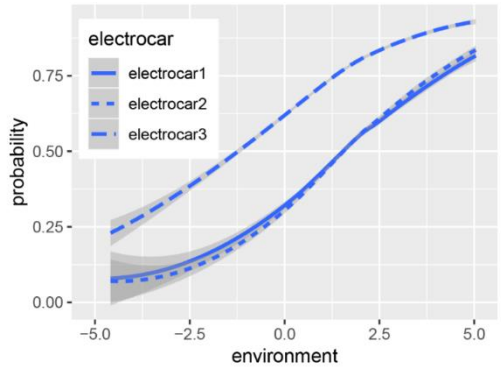

Figure 2 Relationship between travelers' environmental awareness and purchase intention of pure electric vehicles

4.2. The Influence of Fuel Car Purchase Restriction Policy on Purchasing Intention of Pure Electric Vehicles

The data in Table 4 are logit regression data, and the values of various parameters are not marginal effects.

Remember $p \equiv \mathrm{P}\left(y=1|\mathbf{x}\right)$, then $1-p=\mathrm{P}\left(y=0|\mathbf{x}\right)$.

Since $p=\frac{\exp\left(\mathbf{x}'\boldsymbol{\beta}\right)}{1+\exp\left(\mathbf{x}'\boldsymbol{\beta}\right)}$, $1-p=\frac{1}{1+\exp\left(\mathbf{x}'\boldsymbol{\beta}\right)}$, So

$$\frac{p}{1-p}=\exp\left(\mathbf{x}'\boldsymbol{\beta}\right) \quad (3)$$

$p/(1-p)$ is called odds ratio. If the odds ratio is 2, the probability that a traveler chooses 1 is twice the probability of choosing 0.

The probability ratio of each variable to electrocar1, electrocar2, and electrocar3 is analyzed, and the coefficients are shown in Table 5. Table 5 shows that if the traveler's city restricts the purchase of fuel cars, then:

At this stage, the odds of a traveler buying a pure electric car is 1.382 times higher than in the case of unlimited purchase;

At this stage, the odds of a traveler recommending someone to purchase a pure electric car is 1.303 times higher than in the case of unlimited purchase;

If the infrastructure such as charging piles is intact, the probability of a traveler buying a pure electric car is 1.454 times that of an unlimited purchase.

Table 5. Odds ratios

	Electrocar1	Electrocar2	Electrocar3
Female	1.222	1.167	1.179
Age	1.029	1.022	1.016
Marriage	0.848	1.064	1.008
House	0.854	0.720	0.978
Income	0.990	0.992	1.000
Car	0.886	1.112	1.055
Car2work	0.837	0.861	0.934
Limit	1.382	1.303	1.454
Environme	1.521	1.592	1.486
_cons	0.183	0.124	0.731

4.3.Influence of Purchase Restriction or Not on the First and Third Purchase Intention Results

Electrocar1 and electrocar3 respectively represent the impact of the introduction of automobile purchase restrictions on travelers' willingness to purchase pure electric vehicles under the current situation and under the condition that infrastructure such as charging piles are perfected in the future. According to the data in Table 4, fit the traveler's willingness to purchase pure electric vehicle electrocar1 (current willingness to purchase pure electric vehicle), The value of electrocar3 (willingness to purchase a pure electric vehicle when infrastructure facilities such as charging piles are perfect in the future). Comparing the differences in the values of electrocar1 and electrocar3, we can get the impact of the introduction of car purchase restrictions policy on travelers' willingness to purchase pure electric vehicles under the condition of perfect infrastructure construction such as charging piles in the future. The

results are shown in Figure 3.

From the data in Figure 3, it can be seen that under the condition of unlimited purchase, when the infrastructure such as charging piles is completed, the willingness of travelers to purchase pure electric vehicles has increased from 46% to 73%, an increase of 27%. In the case of purchase restrictions, when the infrastructure such as charging piles is completed, the willingness of travelers to purchase pure electric vehicles has increased from 55% to 79%, an increase of 24%. Regardless of whether the purchase is restricted, the improvement of infrastructure such as charging piles can greatly increase the willingness of travelers to purchase pure electric vehicles.

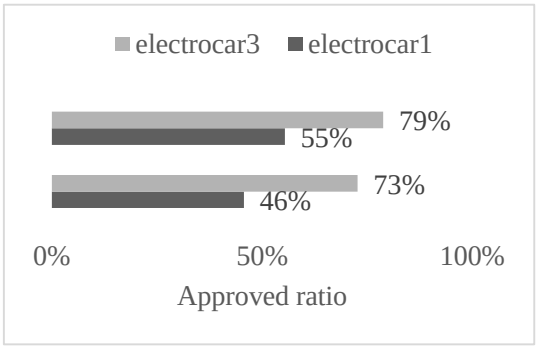

Figure 3 Influence of purchase restriction or not on purchase intention of 2 different pure electric vehicles

5. CONCLUSION

This paper uses the actual survey data and based on the logit model to study the impact of car purchase restrictions and environmental awareness of travelers on the willingness of travelers to purchase pure electric vehicles. The following conclusions are obtained through research:

(1) With the increase of travelers' environmental awareness, the willingness of travelers to purchase pure electric vehicles has gradually increased;

(2) If the city where the traveler is located restricts the purchase of petrol cars, the current odds ratio of travelers buying pure electric cars is 1.382 times that in the case of unlimited purchases; at this stage the odds ratio of travelers recommending others to buy pure electric cars 1.303 times in the case of limited purchase; if the infrastructure such as the charging pile is intact, the probability of a traveler buying a pure electric car is 1.454 times that in the case of unlimited purchase;

(3) In the case of purchase restrictions, travelers' willingness to purchase pure electric vehicles is 55%, if infrastructure such as charging piles is perfect in the future, travelers' willingness to purchase electric vehicles will increase by 24% on this basis; in the case of unlimited purchases, travelers will The willingness to buy pure electric vehicles is 46%, if infrastructure such as charging piles is perfect in the future, travelers' willingness to buy electric vehicles will increase by 27% on this basis.

Considering the impact of purchase restriction policies, travelers' environmental awareness, individual characteristics of travelers, and charging infrastructure on the willingness of travelers to purchase pure electric vehicles, in order to promote the popularization of pure electric vehicles, relevant departments can take the above measures to encourage people to switch from buying fuel-fueled vehicles to Electric car.

AUTHORS' CONTRIBUTIONS

Bing Zhang and Xiaoliang Zhang wrote the main manuscript and participated in the development of the model and the planning of the questionnaire survey. Xiaoliang Zhang also participated in the implementation of the questionnaire. Lei Chen built a model, carried out parameter estimation and analyzed the results. Zhishan Zhong collated and analyzed the data from the questionnaire survey.Jianrong Liu and Bing Zhang coordinated the study and reviewed the manuscript. All the authors read and approved the final manuscript.

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REFERENCES

[1] Ministry of Ecology and Environment of the People's Republic of China. China Motor Vehicle Environmental Management Annual Report (2018). Beijing, 2018.“in Chinese”.

[2] Abdorreza Joe Afshany, Ali Tourani, Asadollah Shahbahrami, Saeed Khazaee, Alireza Akoushideh. Parallel Implementation of a Video-based Vehicle Speed Measurement System for Municipal Roadways[J]. International Journal of Intelligent Systems and Applications, 2019, 11(3): 25-37, DOI: 10.5815/ijisa.2019.11.03

[3] Yang Wu. Research on the Impact of Consumer Environmental Values on the Willingness to Buy New Energy Vehicles[D]. Anhui University of Technology, 2018. “in Chinese”. DOI: https: //doi.org/CNKI: CDMD: 2.1018.257995.

[4] Xie Yunhui. An Empirical Study on Consumers' Perceived Risks and the Willingness to Buy New

Energy Vehicles[D]. Hubei University of Technology, 2018.“in Chinese”.DOI: https: //doi.org/ CNKI: CDMD: 2.1018.957375.

[5] KIM J, RASOULI S, TIMMERMANS H. Expanding scope of hybrid choice models allowing for mixture of social influences and latent attitudes: Application to intended purchase of electric cars[J]. Transportation Research Part A: Policy and Practice, 2014, 69: 71-85. DOI: https: //doi.org/10.1016/j.tra.2014.08.016.

[6] JENSEN A F, CHERCHI E, MABIT S L. On the stability of preferences and attitudes before and after experiencing an electric vehicle[J]. Transportation Research Part D: Transport and Environment, 2013, 25: 24-32. DOI: https: //doi.org/10.1016/j.trd.2013.07.006.

[7] BARBAROSSA C, BECKMANN S C, DE PELSMACKER P, et al. A self-identity based model of electric car adoption intention: A cross-cultural comparative study[J]. Journal of Environmental Psychology, 2015, 42: 149-160. DOI: https: //doi.org/10.1016/j.jenvp.2015.04.001.

[8] PLöTZ P, SCHNEIDER U, GLOBISCH J, et al. Who will buy electric vehicles? Identifying early adopters in germany[J]. Transportation Research Part A: Policy and Practice, 2014, 67: 96-109. DOI: https: //doi.org/10.1016/j.tra.2014.06.006.

[9] HIDRUE M K, PARSONS G R, KEMPTON W, et al. Willingness to pay for electric vehicles and their attributes[J]. Resource and Energy Economics, 2011, 33(3): 686 705. DOI: https: //doi.org/ 10.1016/j.reseneeco.2011.02.002.

[10] Sun Xiaohua, Xu Shuai. Research on the Influence of Government Subsidies on the Willingness to Buy New Energy Vehicles[J]. Journal of Dalian University of Technology (Social Science Edition), 2018, 39 (03): 8-16.“in Chinese”. DOI: https: //doi.org/10.19525/j.issn1008-407x.2018.03.002.

[11] Zhang Guoliang, Li Fengxiang. Game Analysis on Technology Innovation Purchase under Complete Information[J]. International Journal of Education and Management Engineering(IJEME) , 2011, 8(29): 62-66, DOI: 10.5815/ijeme.2011.02.10

[12] Chen Jian, Tang Wei, Cai Xiaoyu, et al. Multi-group structural equation model of passenger satisfaction in urban rail transit[J]. Journal of Transportation Systems Engineering and, 2018, (01): 173-178. 244. “in Chinese”. DOI: https: //doi.org/10.16097/ j.cnki.1009-6744. 2018.01.026.

[13] SHEN W, XIAO W, WANG X. Passenger satisfaction evaluation model for urban rail transit: A structural equation modeling based on partial least squares[J]. Transport Policy, 2016, 46: 20-31. DOI: https: //doi.org/10.1016/j.tranpol.2015.10. 006.

[14] Ju Peng, Zhou Jing, Xu Hongli, et al. Research on car sharing selection behavior based on hybrid selection model[J]. Journal of Transportation Systems Engineering and, 2017, (02): 7-13.“in Chinese”. DOI: https: //doi.org/10.16097/ j.cnki.1009-6744.2017.02.002.

[15] Jing Peng, Tong Zhicai, Cha Qifen. Travel mode selection behavior model considering psychological latent variables[J]. China Journal of Highway and Transport, 2014, 27 (11): 84-92 + 108.“inChinese”. DOI: https: //doi.org/CNKI: SUN: ZGGL.0.2014-11-015.

[16] ROBERTS J, GURLEEN P, ROSEMARY H. Do environmental concerns affect commuting choices?: Hybrid choice modelling with household survey data[J]. Journal of the Royal Statistical Society: Series A (Statistics in Society), 2018, 181(1): 299-320.

[17] TAM K-P, CHAN H-W. Environmental concern has a weaker association with pro-environmental behavior in some societies than others: A cross-cultural psychology perspective[J]. Journal of Environmental Psychology, 2017, 53: 213-223. DOI: https: //doi.org/10.1016/j.jenvp.2017.09.001.

[18] Maria Ellen L. Estrellado, Ariel M. Sison, Bartolome T. Tanguilig III. Test Bank Management System Applying Rasch Model and Data Encryption Standard (DES) Algorithm[J]. International Journal of Modern Education and Computer Science (IJMECS), 2016, 10(8): 1-8, DOI: 10.5815/ijmecs.2016.10.01

[19] BOND T G, FOX C M. Applying the Rasch model: Fundamental measurement in the human sciences[M]. Psychology Press, 2013.