Factors Affecting Consumer Purchasing Intention to Buy Electric Vehicles in Taiyuan, China

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Abstract

Based on the technology acceptance model, this paper studies the influencing factors of consumers' purchasing intention of electric vehicles and the relationship between different variables. It reveals the influence path and effect of the independent variables of perceived usefulness, perceived ease of use, consumer innovation and perceived risk, as well as the mediating variable of purchasing attitude on the dependent variable of purchasing intention. A total of 611 questionnaires are distributed and collected from the automobile sales market, which can improve the pertinence of respondents and the reliability of the questionnaire data source. The results show that: (1) perceived usefulness has a significant positive impact on purchasing attitude; (2) perceived ease of use has a significant positive impact on purchasing attitude; (3) perceived risk has a significant negative impact on purchasing attitude; (4) perceived risk has a significant negative impact on purchasing intention; (5) consumer innovation has a significant positive impact on purchasing attitude; (6) consumer innovation has a significant positive impact on purchasing intention; (7) consumer purchasing attitude has a positive impact on purchasing intention; (8) purchasing attitude plays a positive mediating role between perceived ease of use and purchasing intention; (9) purchasing attitude plays a positive mediating role between perceived usefulness and purchasing intention; (10) purchasing attitude plays a negative mediating role between perceived risk and purchasing intention; (11) Purchase attitude plays a positive mediating role between consumer innovation and purchase intention.

Keywords: Electric vehicle, Technology acceptance model, Innovation diffusion theory, Purchase intention

Introduction

As one of the basic industries of the national economy, the transportation industry is developing rapidly with the acceleration of urbanization, but its development is highly dependent on fossil fuels, driven by the national policy of saving energy consumption and reducing carbon emissions, forcing the transportation industry to shift the development of the automotive field to more environmentally friendly electric vehicles (Chenlei., X., 2019). According to the National Bureau of Statistics of China, as of September 2021, China has 476

million motor vehicle drivers and 390 million motor vehicles, including 297 million fuel vehicles (Yixin., W. (2021). which shows that China is the world's largest automobile market in the future and will become the largest electric vehicle market.

Although China's electric vehicle industry faces great development opportunities, it is also inevitable to encounter many challenges (Jinfeng, S.et al.. (2014). Although the technology of electric vehicles continues to develop and gradually mature, and the price also presents a great advantage, it is difficult to further increase the sales of electric vehicles (Wenzhao., L. (2018). This makes it particularly important and urgent to study the purchase intention of electric vehicle consumers. Based on the technology acceptance model, this paper will make a more comprehensive analysis by adding the factors affecting perceived risk and consumer innovation, which is of great significance and value to the production and marketing of enterprises and to better guide consumers to achieve the purchase intention.

Research Objective

To identify the effect of consumer innovation, perceived risk on attitude and purchase intention.

To explore the effect of perceived usefulness and perceived ease of use on attitude.

To explore the effect of attitude on purchase intention.

To determine the mediating effect of attitude in the relationship between customer innovation, perceived risk, perceived usefulness, perceived ease of use and purchase intention.

Literature Review

This part includes theoretical basis and six variables related research results.

Theoretical basis

The theoretical hypothesis of this paper is based on The technology acceptance model (TAM) model, combined with the theory of innovation diffusion and the theory of perceived risk, to study the factors affecting the purchase intention of pure electric vehicles. There are two key factors in the technology acceptance model: perceived usefulness and perceived ease of use (William, L.et.al.. (2003). Based on the theory of innovation diffusion and perceived risk, this study adds two variables of consumer innovation and perceived risk. Finally, we introduce the intermediate variable of consumer attitude and the dependent variable of purchase intention to form the research framework of this paper.

Perceived usefulness refers to an individual's perception of how the use of a specific information system can improve his or her life performance, that is, whether the adoption and use of information system products can improve the efficiency of actual work (Heyun., Z. (2021). Perceived ease of use is used to interpret whether an individual can learn easily and quickly, emphasizing the difficulty of learning and operation (Ming, Z.& Wu., Y. (2018).

Innovation diffusion refers to the process by which an innovative technology is widely disseminated and accepted in society through various channels (Shan,S. & Yi., W. (2021). Based on the research on consumer innovation, this paper defines innovation as a manifestation of personality and an individual's acceptance of innovative ideas and things. Perceived risk

refers to the degree to which consumers perceive the security and trust risks of a product when they adopt it (Jie., W. (2021).

Six Variables related research results

Al-rahmi AM, et.al.(2021). established a model based on technology acceptance model and information system, and took questionnaire survey as the main data collection method to study the positive and constructive impact of students' behavioral intention and actual use of online learning platforms on higher education satisfaction and academic performance. Research shows that perceived usefulness, perceived ease of use, perceived technology suitability, information quality and system quality have significant positive correlation to students' use of online learning platforms. When studying the purchase intention of new energy vehicles, Fengyao., H. (2021). improved the technology acceptance model and introduced the two indicator variables of use cost and use risk to empirally explore the influence degree of technology attitude, perceived usefulness, perceived ease of use, use risk and vehicle use cost on the purchase intention of new energy vehicles. Also based on TAM model. Pikkarainen, P.K & Karjaluoto H.（2014）studied the influencing factors of electric vehicle adoption based on innovation diffusion theory and planned behavior theory. The results show that the characteristics of perceived innovation (compatibility, design and comparative advantage) have an important impact on the formation of behavioral attitudes, and attitudes, subjective norms and personal norms influence consumers' adoption intentions. Ning,.W,et. al. (2015). on the basis of constructing a model of factors affecting the market acceptance of electric vehicles, used statistical methods such as Chi-square test and multiple Logistic regression to conduct an empirical study on the main factors influencing consumers' acceptance of electric vehicles. The regression results showed that social influence, convenience of charging and perceived risk were the main factors affecting the market acceptance of electric vehicles. Turrentine T.S, & Kurani K.S. (2007). confirmed that consumers could not properly calculate the economy between fuel and pure electric vehicles when buying cars, which would lead to a decrease in the purchase intention of pure electric vehicles . Tung., F. (2008). integrated innovation diffusion theory (IDT) and technology adoption model (TAM) and added two parameters of trust and perceived expenditure to form a hybrid technology adoption model (TAM). The study proved the applicability of the hybrid model and found that compatibility, perceived usefulness, perceived ease of use and trust can promote adoption behavior. The opposite is true of perceived spending.

According to the literature, the following conclusions can be drawn: In the research targeting purchase intention, consumer innovation and perceived risk have obvious direct effects on purchase intention. Perceived usefulness and perceived ease of use influence purchase intention through attitude. According to the results of literature research and the actual situation, the perceived risk has a negative impact on the purchase intention. On this basis, the research framework and hypothesis of this paper are proposed.

Conceptual Framework and Research Hypothesis

According to literature review, the conceptual framework is constructed, as Figure 1

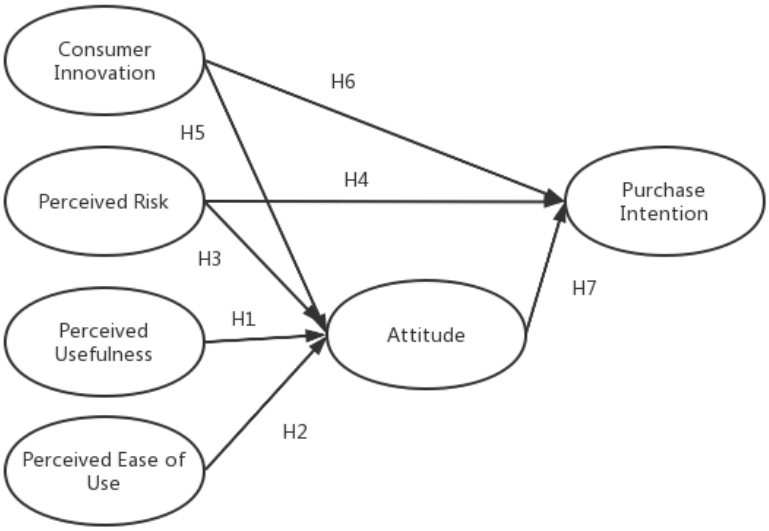

Figure 1 Conceptual Framework

Research hypothesis as follows:

H1: Perceived usefulness has a positive impact on consumers' purchasing attitudes.

H2: Perceived ease of use has a positive impact on consumers' purchasing attitudes.

H3: Perceived risk has a significant negative impact on attitude.

H4: Perceived risk has a significant negative impact on purchase intention.

H5: Consumer innovation has a significant positive impact on attitude.

H6: Consumer innovation has a significant positive impact on intention.

H7: Consumer attitudes towards electric vehicles have a positive impact on purchasing intention.

H8: Attitude plays a positive mediating role between perceived ease of use and purchase intention.

H9: Attitude plays a positive mediating role between perceived usefulness and purchase intention.

H10: Attitude plays a negative mediating role between perceived risk and purchase intention.

H11: Attitude plays a positive mediating role between consumer innovation and purchase intention.

Research Methodology

Population and sample

In order to find people with the possibility of buying intention as interviewees, questionnaires were distributed and collected in DaChang automobile sales market in Taiyuan

City. After 10 days of collection, a total of 652 questionnaires were recovered, and 611 questionnaires with obvious errors were removed. The recovery efficiency reached 93.7%.

Questionnaire design and measurement

This study used a structured questionnaire survey method. The questionnaire consists of two parts: the first part is the basic statistical information of the population, including gender, age, education and other variables. The second part is the formal measurement. Multiple observation items were used for all variables, with a total of 26 questions . Score according to 7-level Likert scale.

Reliability and validity analysis

When the Crombach 'a coefficient is greater than 0.7, it indicates that the data of the scale has good reliability. The reliability test results of each dimension are shown in Table 1.

Table 1 Reliability Analysis of Scales

Scale	Cronbach's Alpha
CI: Consumer Innovation	.879
PR: Perception risk	.886
PE: Perception ease of use	.861
PU: Perception of usefulness	.855
A: Consumer attitude	.817
PI: Purchase intention	.851

The KMO value of the questionnaire as a whole was0.882<0.7 ,and the Bartlett sphere test Sig was 0.000, indicating that the data were not an identity matrix and were suitable for factor analysis. KMO sample measure and Bartlett sphere test were conducted separately for each variable, and the test results were shown in Table**2 a**s shown.

Table 2 KMO and Bartlett Tests

Scale	Approximates chi-square	KMO	Bartlett Sig.
CI: Consumer Innovation	1664.991	.902	.000
PR: Perception risk	1538.814	.885	.000
PE: Perception ease of use	860.907	.730	.000
PU: Perception of usefulness	1205.950	.867	.000
A: Consumer attitude	666.228	.703	.000
PI: Purchase intention	1005.510	.821	.000

In this paper, based on the technology acceptance model, a model of influencing factors for electric vehicle purchase was constructed. AMOS26 was used to draw the model structure

chart, and relevant programs were run to verify the research hypotheses of the model through data model analysis, calculation and analysis of each path coefficient and significance coefficient. As shown in Figure2 ,the specific model includes 26observed variables ,6 latent variables, and28 residual terms. The summary of the measured data results of this model is shown in Table **3**

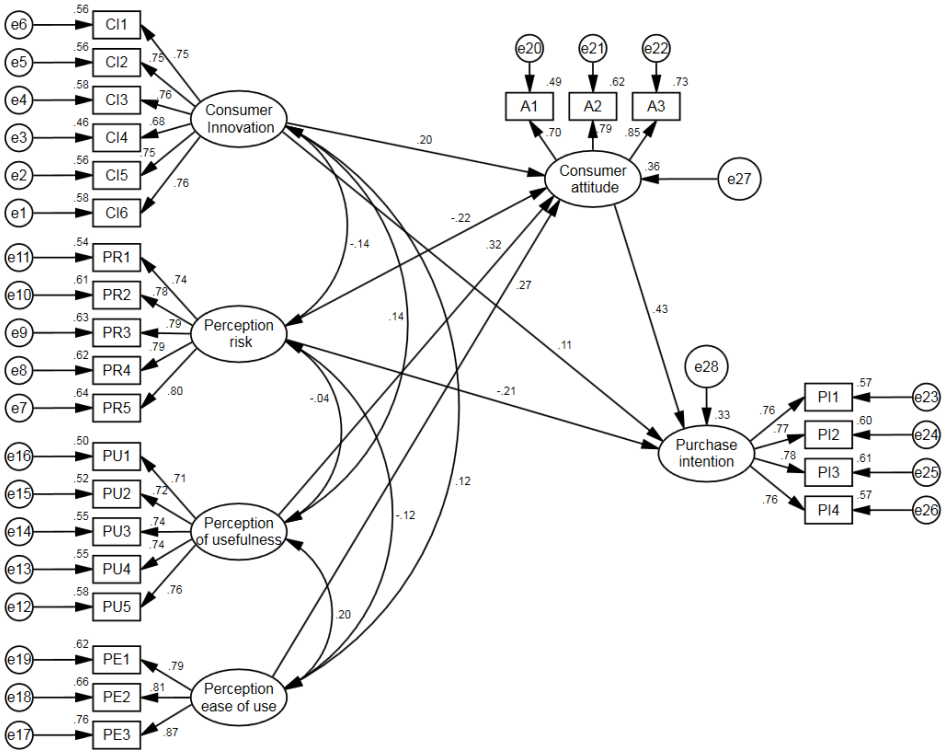

Figure 2 Output of CFA Model

Table 3 Results of the Confirmatory Factor Analysis

Fitting index	Ideal standard	Acceptable standard	Measurement result	Model adaptation
x^2/df	< 2.0	< 3.0	1.153	Ideal
RMSEA	< 0.05	< 0.1	0.016	Ideal
RMR	< 0.05	< 0.08	0.081	Ideal
GFI	> 0.90	> 0.08	0.960	Ideal
AGFI	> 0.90	> 0.08	0.951	Ideal
CFI	> 0.90	> 0.08	0.994	Ideal
TLI	> 0.90	> 0.08	0.993	Ideal
IFI	> 0.90	> 0.08	0.994	Ideal

Aggregation validity analysis refers to the degree to which the measurement scale correlates with other indicators of the same concept. Usually, the convergence validity of the

measured variable is judged by the factor load through confirmatory factor analysis. At present, there are two main principles for evaluating convergence validity, which are: combined reliability (CR) greater than 0.7, ideal threshold, and average variation extraction variance (AVE) of all measured structures greater than 0.5 ideal threshold. Aggregation Validity Results are shown in Table 4.The discriminant validity is shown in Table 5.

Table 4 Aggregation Validity Results

	AVE	CR	P
CI: Consumer Innovation	0.552	0.881	***
PR: Perception risk	0.687	0.886	***
PE: Perception ease of use	0.678	0.863	***
PU: Perception of usefulness	0.541	0.855	***
A: Consumer attitude	0.611	0.824	***
PI: Purchase intention	0.588	0.851	***

Note: * indicates p <0.05, * * p <0.01, and * * * p <0.001.
Source. According to AMOS Software.

Table 5 Discriminant Validity Results

	PE	PU	PR	CI	A	PI
PE	0.743					
PU	.200	.736				
PR	-.118	-.004	.687			
CI	.116	.136	-.139	.743		
A	.384	.412	-.296	.305	.782	
PI	.202	.200	-.355	.269	.524	.767

Source. According to AMOS Software.

Research Results

Descriptive statistical analysis was carried out on the questionnaire data to analyze the distribution and characteristics of the samples. The results of the structural equation model are used to quantitatively analyze the effect of each variable, and the utility of the intermediate variable is tested. Verify the hypotheses and analyze the corresponding results.

Result of Questionnaire

The results of descriptive analysis of demographic data are as follows: Among the 611 valid questionnaires collected, 384 were male, accounting for 62.85% of the total number; The

number of 20-29 years old was 101, accounting for 16.53%; The number of 30-39 years old was 181, accounting for 29.62%; The number of 40-49 years old was 162, accounting for 26.51%; The number of people aged 50-59 was 86, accounting for 14.08%; The number of people over 60 years old was 81, accounting for 13.26%; According to the classification of monthly income, the statistical results are as follows: 110 people with less than 2000 yuan, accounting for 18.00%; From 2001 to 4000 yuan, 273 people, accounting for 44.68%; The number of people with 4001-8000 yuan was 164, accounting for 26.84%; 64 people with more than 8000 yuan, accounting for 10.41%; According to the classification of educational background, the statistical results are as follows: 274 people with bachelor degree or less, accounting for 44.84%; The number of people with bachelor degree or above was 257, accounting for 42.06%; The number of postgraduate students or above was 80, accounting for 13.09%; The number of respondents with driving licenses was 545, accounting for 89.20%.

In addition, the descriptive statistical results of each variable show that the mean interval is 3.35-4.49, and the standard deviation interval is 1.229-2.115.

Path analysis of structural equation model

SEM structural equation model can be used to explore the relationship between variables. It analyzes data by incorporating causal relationships between variables and measurement errors into a unified analytical framework, so that the relationship between multiple variables can be evaluated simultaneously. The results of path analysis are shown in Table 6

Table 6 Test results of path coefficient

Path			Estimate	S.E.	C.R.	P
Consumer attitude	<---	Consumer Innovation	.168	.036	4.681	***
Consumer attitude	<---	Perception risk	-.123	.024	-5.166	***
Consumer attitude	<---	Perception of usefulness	.302	.043	7.002	***
Consumer attitude	<---	Perception ease of use	.192	.031	6.117	***
Purchase intention	<---	Consumer attitude	.462	.056	8.208	***
Purchase intention	<---	Consumer Innovation	.099	.040	2.479	.013
Purchase intention	<---	Perception risk	-.127	.026	-4.811	***

Note: *** means significant at the 0.001 level

The test results of the fitting index shown in the above table show that the fitting index of the model basically meets the standard and can be used for path analysis and hypothesis testing.

H1: Perceived usefulness has a positive impact on consumers' purchasing attitudes.The standardized path coefficient of perceived usefulness on consumers' attitude is 0.302 (p <

0.001), indicating that the type of media use has a significant positive impact on environmental protection behavior, so this hypothesis is valid.

H2: Perceived ease of use has a positive impact on consumers' purchasing attitudes.The standardized path coefficient of perceived ease of use on consumers' attitude is 0.192 ($p < 0.001$), indicating that perceived ease of use has a significant positive impact on consumers' purchasing attitude, so this hypothesis is valid.

H3: Perceived risk has a significant negative impact on attitude. The standardized path coefficient of perceived risk to consumer attitude is-0.123 ($p < 0.001$), indicating that perceived risk has a significant negative impact on consumer attitude, so this hypothesis is valid.

H4: Perceived risk has a significant negative impact on purchase intention.The standardized path coefficient of perceived risk to purchase intention is-0.127 ($p < 0.001$), indicating that perceived risk has a significant negative effect on consumers' purchase intention, so this hypothesis is valid.

H5: Consumer innovation has a significant positive impact on attitude.The standardized path coefficient of consumer innovation towards consumer attitude is 0.168 ($p < 0.001$), indicating that consumer innovation has a significant positive impact on consumer attitude, so this hypothesis is valid.

H6: Consumer innovation has a significant positive impact on intention.The standardized path coefficient of consumer innovation to consumer purchase intention is 0.099 ($p < 0.05$), and consumer innovation has a significant positive impact on consumer purchase intention, so this hypothesis is valid. The significance is 0.013, which is not as significant as other paths, but it can prove the hypothesis.

H7: Consumer attitudes towards electric vehicles have a positive impact on purchasing intention. The standardized path coefficient of consumer attitude to purchase intention is 0.462 ($p < 0.001$), indicating that consumer attitude has a significant positive impact on purchase intention, so this hypothesis is valid.

According to the route coefficient and significance level of the model, it can be concluded that there is a perceived risk - attitude - purchase intention, consumer innovation - attitude - purchase intention and other paths, that is, attitude may have an intermediary effect in these paths, which needs to be further verified. On the basis that the sample can fully represent the whole population, the test method of repeated sampling from the collected samples is called Bootstrap method. The Bootstrap method includes the following steps: set the whole population as the whole sample in the research model, conduct repeated experiments with n samples extracted and put back to the whole population, finally obtain a total number of samples n, calculate the estimated value of the mediation effect of each sample (the formula is ai*bi), and add these values to get the estimated value of the mediation effect. These calculated estimates are arranged from small to large at a time, and the result of the arrangement is the nonparametric approximate sampling distribution of the mediation. The confidence interval between the 2.5 percentile and the 97.5 percentile constitutes a confidence interval of the mediation effect with 95% confidence. It is calculated that if 0 does not exist in the confidence interval, then the mediation effect exists; if 0 is in the confidence interval, then the mediation effect does not exist. The sample number of bootstrap is set to 5000. The intermediate effect test results are shown in Table 7.

Table 7 Test Results of Mediating effect

Path	Effect Value	Confidence interval 95% Lower	Upper
Perception ease of use — Consumer attitude—Purchase intention	0.117	0.082	0.157
Perception of usefulness — Consumer attitude—Purchase intention	0.169	0.118	0.224
Perception risk — Consumer attitude — Purchase intention	-0.66	-0.091	-0.043
Consumer Innovation — Consumer attitude—Purchase intention	0.098	0.060	0.140

According to the test results of the above mediating effect, we can verify the hypothesis involving mediating variables.

H8 :Attitude plays a positive mediating role between perceived ease of use and purchase intention.The standardized effect value of perceived ease of use-consumer attitude- purchase intention is0.117 ,and the confidence interval of indirect effect does not contain 0, which reflects that consumer attitude plays a positive intermediary role between perceived ease of use and purchase intention.

H9 :Attitude plays a positive mediating role between perceived usefulness and purchase intention.The standardized effect value of perceived usefulness-consumer attitude- purchase intention is0.169 ,and the confidence interval of indirect influence does not contain 0, which reflects that consumer attitude plays a positive intermediary role between perceived usefulness and purchase intention.

H10 :Attitude plays a negative mediating role between perceived risk and purchase intention.The standardized effect value of perceived risk-consumer attitude- purchase intention is-0.66, and the confidence interval of indirect effect does not contain0 ,which reflects that consumer attitude plays an obvious reverse intermediary role between perceived risk and purchase intention.

H11 :Attitud e plays a positive mediating role between consumer innovation and purchase intention.The standardization value of consumer innovation-consumer attitude- purchase intention is-0.098, and the confidence interval of indirect influence does not contain0 ,which reflects that consumer attitude plays an obvious positive intermediary role between consumer innovation and purchase intention. Although the effect value is small, but the hypothesis is true.

According to the test of the theoretical model, the verification results of this paper are shown in Table 8

Table 8 Research Hypothesis Test Results

Hypothesis	Results
H1: Perceived usefulness has a positive impact on consumers' purchasing attitudes.	Accepted
H2: Perceived ease of use has a positive impact on consumers' purchasing attitudes.	Accepted
H3: Perceived risk has a significant negative impact on attitude.	Accepted
H4: Perceived risk has a significant negative impact on purchase intention.	Accepted
H5: Consumer innovation has a significant positive impact on attitude.	Accepted
H6: Consumer innovation has a significant positive impact on intention.	Accepted
H7: Consumer attitudes towards electric vehicles have a positive impact on purchasing intention.	Accepted
H8: Attitude plays a positive mediating role between perceived ease of use and purchase intention.	Accepted
H9: Attitude plays a positive mediating role between perceived usefulness and purchase intention.	Accepted
H10: Attitude plays a negative mediating role between perceived risk and purchase intention.	Accepted
H11: Attitude plays a positive mediating role between consumer innovation and purchase intention.	Accepted

Conclusion

According to the analysis results, combined with the objectives of this study and the theory of technology acceptance model, perceived risk theory, innovation diffusion theory, etc., the research conclusions are as follows:

The technology acceptance model can be validated. The independent variables of this study are respectively the perceived ease of use and perceived usefulness of this model. Through analysis and proof in this paper, perceived usefulness and perceived ease of use have a positive impact on purchasing attitude. The regression coefficient of "perceived usefulness-attitude" is 0.302, and the regression path coefficient of "perceived ease-attitude" is 0.192. All achieved high significance (P<0.001). Therefore, it is believed that consumers' perception of the usefulness and ease of use of electric vehicles are positively correlated with their purchasing attitude. In other words, if consumers believe that electric vehicles can improve the quality of life and ease of driving can improve their propensity to buy electric vehicles, the stronger the consumer's experience of ease of use and usefulness of electric vehicles, the more positive his purchasing attitude toward electric vehicles.

The theory of innovation diffusion can be tested. In this paper, the data analysis results show that the path coefficient of "consumer innovation → attitude" is 0.168, and the significance level is less than 0.001. The path coefficient of "consumer innovation → intention" is 0.099, and the significance level is 0.013 and less than 0.05. That is to say, if consumers themselves have the pursuit of experience, keen to explore scientific and technological products and other personal characteristics, then the higher this sentiment, the higher their attitude towards the purchase of electric vehicles, so the intention is also stronger.

The theory of perceived risk can be tested. Any purchase behavior of consumers will produce certain results, and some results are not expected by consumers, and these results are the risks that consumers may take these behaviors. These influences will have a reverse impact on consumers' purchasing attitudes and behaviors. After data analysis, it is concluded that the path coefficient of "perceived risk-attitude" is -0.123 and the significance level is 0.001, and the coefficient of "perceived risk-intention" is -0.127 and the significance level is 0.001. Therefore, according to the research results, individuals' risk perception and attitude towards electric vehicles are negatively correlated. That is, if consumers believe that the purchase of electric vehicles will bring financial pressure for later maintenance and maintenance, personal safety concerns that may be caused by driving failures, and the time cost of charging, then their purchase attitude toward electric vehicles is negative, and their purchase intention will also decline.

Consumer attitude is the mediating variable in this study, which plays an intermediary role between all independent variables and purchase intention. According to the results, the standardized path coefficient of consumer attitude on purchase intention is 0.462 (p<0.001), indicating that consumer attitude has a significant positive impact on purchase intention. Therefore, this hypothesis is valid. Attitude plays a significant mediating role among perceived ease of use, perceived usefulness, perceived risk, and consumer innovation and intention.

Recommendation

Relevant enterprises in the electric vehicle industry should clarify market positioning, pay attention to differentiated marketing, and create new brands. At present, China's electric vehicle market is not saturated, and relevant enterprises should do a good job of market positioning according to their own capabilities, and continue to conduct market research and adjust their

own strategies. It can target different markets for different purposes. For example, it can target the family market to meet the commuting needs of office workers, launch specific electric vehicle products, and carry out topic marketing to save living costs and green life to advocate people to change their lifestyles. It can also take the high-end route, create a noble and avant-garde atmosphere, meet the emotional demands of high-end groups, and implement effective marketing strategies and product designs appropriately for consumers' preferences for innovative products.

Improve the performance of electric vehicles and improve the infrastructure. Therefore, the author believes that: in view of usefulness, relevant enterprises should pay attention to improving the performance of electric vehicles, especially the performance of batteries, and develop electric vehicles with stable battery life to meet people's different needs, while highlighting the advantages of electric vehicles in interior, space and price. For ease of use, in addition to the simplification and intelligent control of the car itself, the government and enterprises should improve the relevant supporting facilities, enhance the fast charging guarantee, rational layout of charging piles, make the charging energy storage faster and more convenient, and strengthen the development of auxiliary automatic driving, automatic parking and intelligent navigation and other technologies.

Expand publicity and raise public awareness. Whether people buy an electric car depends largely on their perception. Through publicity, especially the publicity of external factors such as products, appearance and quality, it can effectively affect consumer cognition, and then affect consumers' attitude and evaluation of electric vehicles. The verification results of the model show that to promote the purchasing behavior of electric vehicles, reducing the uncertainty of consumption is an inevitable choice, that is, reducing the perception of risk to promote the consumption behavior. Therefore, enterprises should develop super charging technology, improve the safety level of batteries, reduce charging time, and reduce time costs. Pay attention to experience marketing and carry out test drive activities. Personal experience of consumers is a direct and effective way to reduce the perception of risk.

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