Journal of Systems Science and Information
Aug., 2023, Vol. 11, No. 4, pp. 503–517
DOI: 10.21078/JSSI-2022-0025

Does Gender Affect Travelers' Intention to Use New Energy Autonomous Vehicles? Evidence from Beijing City, China

Xiaolu FENG
School of Economics and Management, Beijing Jiaotong University, Beijing 100044*, China*
E-mail: 20241268@*bjtu.edu.cn*

Wenhuan XIE
School of Economics and Management, Beijing Jiaotong University, Beijing 100044*, China*
E-mail: 20241271@*bjtu.edu.cn*

Fanyu GUO
School of Economics and Management, Beijing Jiaotong University, Beijing 100044*, China*
E-mail: 20241269@*bjtu.edu.cn*

Lingling XIAO
School of Economics and Management, Beijing Jiaotong University, Beijing 100044*, China*
E-mail: lxiao@bjtu.edu.cn

Abstract To explore the factors and paths that influence the willingness to use sharing new energy autonomous vehicles (SNEAVs), this paper incorporates the unified theory of acceptance and use of technology (UTAUT2) as the basic frameworks, with gender serving as a moderating variable. Seven psychological latent variables, including performance expectancy, social influence, hedonic motivation, price sensitivity, perceived risk, trust in technology, and innovativeness, are considered to examine their effects on behavioral intention. Quantitative data ($n = 1082$) was collected via an online questionnaire in Beijing. The ordered logit model was used to preliminarily demonstrate the significant impact of gender, with further parameter fitting confirming the good fit of the psychological latent variable model. Path analysis results reveals that gender influences the willingness to use SNEAVs in multiple aspects. Specially, females are more significantly influenced by hedonic motivation, whereas males prioritize performance expectation. Furthermore, price sensitivity positively has a positive impact on male behavioral intention, but a negative effect on female behavioral intention. Additionally, trust in technology plays a more important role for women compared to men. These findings are crucial in promoting the development of SNEAVs.

Keywords new energy autonomous vehicles; sharing system; ordered logit models; UTAUT2 model

1 Introduction

In recent years, Pandemics have been heavily impacted several countries around the world. To be able to slow the transmission of the virus, governments have reacted with various restricting measures including wearing masks and applying quarantine. With more understanding of

Received December 1, 2022, accepted May 29, 2023
Supported by the National Natural Science Foundation of China (71971020)

the virus, the implementation of epidemic prevention measures more in place that epidemic prevention effect has gradually improved. many scholars believe that the world has entered the post-epidemic era and launched empirical research[1]. Due to the contradiction between huge demand of travel or commute and the possible infection on the road, the sharing new energy autonomous vehicles (SNEAVs) may help to stop the transmission of the virus in comparison to carsharing. As a new product of multidisciplinary interaction, autonomous vehicles are developing rapidly with the advent of artificial intelligence technology[2]. However, the advent of autonomous technology is a turning point, whose implementation will have ramifications for road safety, air pollution, travel behavior, parking issues, commute time, and other aspects of daily life[3]. In addition, domestic research shows that compared with European and American developed countries, Chinese consumers to the development prospects of autonomous vehicles hold more positive and open attitude[4].

With the increasing cost of car purchasing and maintaining, the fuel prices and the restricted available parking space in urban areas, people have been driven to look for alternative ways, such as public transportation which restricts the freedom and quality of travel, car and bike-sharing schemes seem to be the middle solution[5]. People's thinking changed from owning the ownership of cars to owning the right to use cars. This measure can effectively solve the problem of high cost, difficult parking, and has gradually become a development trend. Carsharing can support the spatial allocation of traffic resources and optimize the layout of urban functions, which has become an important way to solve urban problems such as urban traffic congestion, social inequality and environmental pollution[6]. With the COVID-19 epidemic ban in recent years, China's carsharing market has faced new opportunities and gradually matured due to the safety of public transportation.

Environmental protection is also a target of SNEAVs. Governments around the world encourage the investment on alternative, sustainable, urban transport schemes which including conventional or electrified carsharing. Under the background of the national policies of vigorously promoting the construction of new energy vehicles and basic charging infrastructure, the combination of new energy vehicles and time-sharing rental was born in line with the market demand with the rapid development of the Internet[7]. The advantages of new energy vehicles in terms of carbon emission cost gradually emerge, and rational consumers will be more inclined to buy new energy vehicles[8]. For the prevention and control of environmental pollution, car sharing, as a safe and green public travel tool and way, can effectively fill the gap between urban public transportation tools (such as buses, buses) and private cars[9]. As a heavy asset component under the sharing economy, it can be predicted that new energy autonomous driving vehicles will be a new direction for the future social transportation development[10].

The main purpose of this paper is to provide some insight into the factors, which affect the adoption of this combination vehicle systems, SNEAVs. Firstly, while there has been a lot of research focusing on travelers' willingness to use autonomous vehicles, there is less literature on taking into account the complementary benefits of autonomous driving, new energy properties, and shared platforms, such as Baidu Apollo's Robotaxi. Secondly, SNEAVs service has just emerged in China, which is actually unknown. Therefore, we provided a detailed introduction of SNEAVs service (see Subsection 2.1) to help respondents better understand it, so that the

data collected can more accurately reflect the actual situation. And the SP intention survey method is adopted in this paper to provide certain assistance for the application and promotion of autonomous vehicle technology in China. Thirdly, besides potential variables such as trust in technology and price sensitivity are considered in the study of behavioral intentions, there are also dominant variable surveys of population characteristics, commuting characteristics[11] which can play an important role in the evaluation of new technologies shown by many studies. In addition, it should still be considered that different characteristic groups with significant differences will have completely different latent variable survey results, such as the gender. Including gender as a moderating variable allows for a group difference analysis of the study population, which can further explore the different mechanisms of the influencing factors on men and women. This is beneficial for companies to develop more targeted promotion designs and optimize marketing strategies.

This paper is structured as follows: First, the background is outlined theoretically by reviewing previous research on user acceptance of shared cars, new energy vehicles and autonomous vehicles, the proposed framework and the development of the hypotheses are presented. Next, the research methodology and the data analysis procedures will be presented. Finally, the summary and some conclusions are presented.

2 Conceptual Framework

2.1 Simulated SNEAVs Service

Before respondents fill out the questionnaire, they need to understand the concept and features of sharing new energy autonomous vehicles (SNEAVs) which refer to autonomous driving vehicles that use new energy as a carrier and provide services in a shared form. This may include individuals who purchase their own autonomous driving vehicles and participate in platform sharing, as well as using the platform's on-demand services for autonomous driving vehicles. But in this study, we only consider the latter. In addition, this study assumes that SNEAVs are in sufficient supply to meet consumer demand. Therefore, we simulate this travel service as a cycle of the following four steps (see Figure 1).

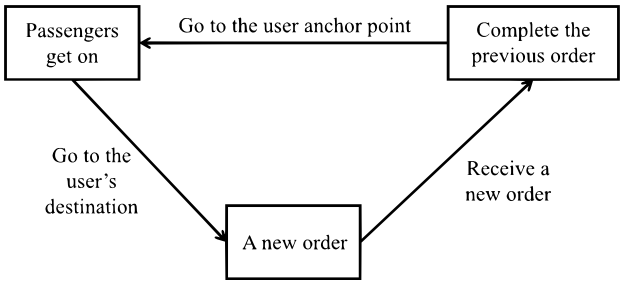

Figure 1 Simulated SNEAVs service

Step 1 Passengers call a car on the sharing platform.

Step 2 The platform system automatically processes orders through algorithms, assigning orders to the optimal cars.

Step 3 The car goes to the passenger's location after the last order is completed.

Step 4 Send passenger to a designated location for new orders near the end point.

2.2 Questionnaire Design and Survey Results

This study used the dissemination of questionnaires online and collected data online. The purpose is to study the views and attitudes of Chinese respondents on the new services of sharing new energy autonomous driving vehicles (SNEAVs), and analyze the influencing factors of their behavior willingness, and finally draw conclusions and provide reference opinions for the future SNEAVs market development. To improve and enhance the validity of the questionnaire, pre-tests were conducted with 10 participants with different population characteristics for the pretrial to correct any issues in advance to the data collection, and made minor changes to the wording of the questionnaire.

The questionnaire used in this study included four parts. The first part is personal characteristics, including gender, age, monthly income, education, and commuting characteristics. The second part is cognitive situation: The cognition and use of existing carsharing, new energy and autonomous vehicles. The third part is satisfaction with the current travel. The last part is the constructs items in Table 1: Performance expectancy (the degree of benefits that using SNEAVs will bring to you), Social influence (the degree of perception of the impact on the people and environment around), Hedonic motivation (the degree of enjoyment experienced when using SNEAVs), Price sensitivity (the degree of user response to price changes of SNEAVs), Perceived risk (the degree of perceived potential loss when using SNEAV), Trust in technology (the degree of trust in the technology used by SNEAVs), Innovation (Willing to try SNEAVs as a new mode of transportation), and Behavior intention (the willingness to use SNEAVs as a mode of transportation).

It should be noted that the survey object SNEAVs is only a development trend but not yet emerging, so we use SP intention survey to achieve the content of the survey is not yet happened. Using the UTAUT2 model[12–14], we set the latent variable to seven parts: Performance expectancy, social influence, hedonic motivation, price sensitivity, perceived risk, trust in technology, innovation.

2.3 Proposed Framework and Hypotheses

In this section, in order to provide some insight into the factors affecting this combination vehicle systems' adoption, the ordinal logit model was presented to analyze the influence of gender, age and other characteristic variables. The mechanism of the significant effects of gender was also explored (see Figure 2).

Venkatesh, et al.[12] integrated views from various models, including task technology fit (TTF), innovation diffusion theory (IDT), theory of reasoned action (TRA), theory of planned behavior (TPB), motivational model (MM), model of pc utilization (MPCU), and social cognition theory (SCT), to propose the unified theory of acceptance and use of technology (UTAUT). They believed that performance expectancy, effort expectancy, social influence, and facilitating conditions were significant factors influencing the intention to use technology, and empirical analysis demonstrated that the explanatory power of the UTAUT model could reach 70%. Venkatesh[13] added three variables, Hedonic Motivation, Price Value, and Habit, to construct the UTAUT2 model with higher explanatory power. Payre, et al.[15]

Table 1 Constructs items

Construct		Items
Performance Expectancy (PE)	PE1:	Using SNEAVs is very useful in my daily life.
	PE2:	Using SNEAVs helps me accomplish tasks faster.
	PE3:	Using SNEAVs can improve my work efficiency.
Social Influence (SI)	SI1:	Those who are important to me affect my SNEAVs.
	SI2:	People who affect my behavior can affect me in using SNEAVs.
	SI3:	People that I value prefer me to use SNEAVs.
Hedonic Motivation (HM)	HM1:	Using SNEAVs is interesting.
	HM2:	Using SNEAVs is relaxing.
	HM3:	You will enjoy it by using the SNEAVs.
Price Sensitivity (PS)	PS1:	I don't mind spending a lot of money on the SNEAVs.
	PS2:	Using SNEAVs or traditional travel is more expensive.
	PS3:	Whenever it's a good way to travel, it's worth spending a lot of money to use.
Perceived Risk (PR)	PR1:	Using SNEAVs as a travel option may be at risk of material loss.
	PR2:	Using SNEAVs as a travel option can be a personal hazard.
	PR3:	Using SNEAVs as a travel option poses a physical and physical risk.
Trust in Technology (TT)	TT1:	I believe that the new energy technology is reliable.
	TT2:	I believe that autonomous driving technology is reliable.
	TT3:	I believe the ride-sharing service is reliable.
	TT4:	I believe all these techniques are reliable.
Innovativeness (INO)	INO1:	If I hear about a new technology, I will look for ways to explore it in advance.
	INO2:	I am usually the first to explore new technologies.
	INO3:	I'd like to try the new technology.
Behavioral Intention (BI)	BI1:	I can accept to use SNEAVs as a travel option in the future.
	BI2:	I look forward to trying to use SNEAVs as a travel option in the future.
	BI3:	I plan to use SNEAVs frequently as a travel option in the future.

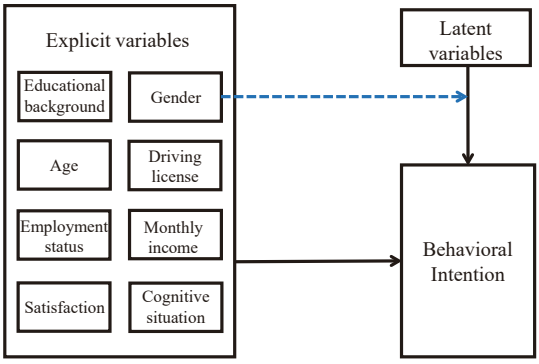

Figure 2 Framework

added trust and perceived security to the technology acceptance model (TAM), and found that trust had a positive impact on the intention to use, while perceived security acted as a potential loss and negatively affected the intention to use. Kapser[14] considered innovation and price sensitivity in the UTAUT2 model for autonomous delivery vehicles, expanding the application scope of the model.

Performance expectancy is considered as an important part of technology acceptance research[13], while the degree of benefits that customized SNEAV services can bring to users is more important. Social influence is the perceived level of impact on people and the environment[13], and it can play a role in the promotion and popularization of SNEAVs. In the UTAUT2 model, hedonic motivation variable has been shown to significantly affect behavioral intention[14]. Price sensitivity variable has been rarely considered in technology acceptance models in the past, research on AVs has found that consumers are more concerned about the price of autonomous vehicles compared to other attributes[16]. In recent years, trust and risk have been introduced into empirical studies of fully automated cars, unmanned delivery vehicles, and other autonomous driving services[15]. In this study, perceived risk will have a negative impact on the willingness to use SNEAVs, while trust in technology will have a positive impact. Innovation is considered as a variable that exists in group differences[14]. Behavioral intention represents the intention to use SNEAVs as a means of transportation, and this is the research object of the SP survey adopted in this study.

To further explore the mechanism of the significant effects of gender, we have learned that many studies have introduced gender as a moderator and achieved good results[17]. Also, gender impact on autonomous vehicles has been confirmed to exist, the paths of social influence, hedonic motivation and perceived risk to behavioral intention are only significant for women using data collected from 501 participants in Germany[14]. Based on previous literature, it is proposed that all relationships in this study are moderated by gender. For performance expectancy, men tend to be more task-orientated than women[18]. For social influence, women tend to be more led by opinions of others[13]. For hedonic motivation and innovativeness, men tend to be more willing to try new technologies in the early stages of introduction[13]. For price sensitivity, women tend to be more cost conscious than men[13]. For perceived risk and trust in technology, men tend to be more inclined to take risks than women[19]. Gender was introduced as a moderator into

the modified UTAUT2 model[14], establishing the following hypothesis (see Figure 3):

Hypothesis 1 Performance expectancy positively influences behavioral intention to use SNEAVs.

Hypothesis 2 Social influence positively influences behavioral intention to use SNEAVs.

Hypothesis 3 Hedonic motivation positively influences behavioral intention to use SNEAVs.

Hypothesis 4 Price sensitivity positively influences behavioral intention to use SNEAVs.

Hypothesis 5 Perceived risk negatively influences behavioral intention to use SNEAVs.

Hypothesis 6 Trust in technology positively influences behavioral intention to use SNEAVs.

Hypothesis 7 Innovativeness positively influences behavioral intention to use SNEAVs.

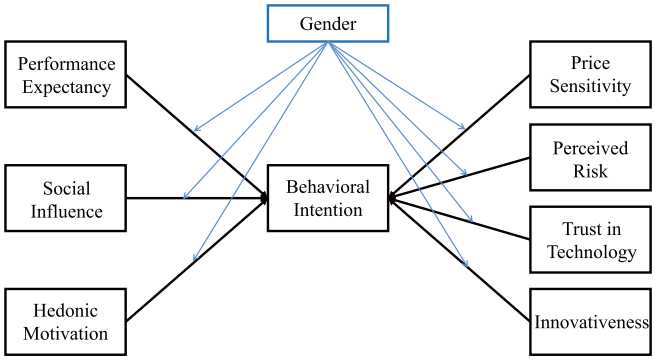

Figure 3 Modified and extended UTAUT2

3 Ordered Logit Models

A sampling scheme design combining multiple sampling methods was used in the questionnaire survey to avoid bias caused by non-random sampling as much as possible. The overall sampling scheme design referred to the method of multi-stage sampling and used snowball sampling and convenience sampling in Beijing, China, with both online and offline channels for questionnaire distribution and collection. A pre-survey was conducted to test the reliability and validity of the questionnaire and to improve the question design. The reliability and validity of the data are shown to be good in Table 2 and Table 3.

Table 2 Reliability test results

Construct	number of items	Cronbach α
Performance Expectancy (PE)	3	0.953
Social Influence (SI)	3	0.944
Hedonic Motivation (HM)	3	0.958
Price Sensitivity (PS)	3	0.953
Perceived Risk (PR)	3	0.952
Trust in Technology (TT)	4	0.964
Innovativeness (INO)	3	0.937
Behavioral Intention (BI)	3	0.955

Table 3 Validity test results

Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy		0.960
Bartlett's test of sphericity	chi-square approximation	37154.877
	degrees of freedom	300
	significance	.000

Table 4 The demographic profiles and familiarity with SNEAVs of Chinese

Variable	Category	Percentage	Chinese characteristics in Beijing (percentage)
Gender	Male	41	51.04
	Female	59	48.96
Age	18∼24 years	16.7	7.23
	25∼34 years	58.7	23.61
	35∼49 years	22.3	28.73
	50∼70 years	2	31.22
	70+ years	0.3	9.2
Monthly Household Net Income	3000 ¥ and below	10.7	11.1
	3000 ¥ ∼ below 4499 ¥	11.7	12.2
	4500 ¥ ∼ below 5999 ¥	14.3	18.7
	6000 ¥ ∼ below 7999 ¥	14	18.5
	8000 ¥ ∼ below 9999 ¥	18.3	10.5
	10000 ¥ ∼ below 14999 ¥	18	12.7
	15000 ¥ ∼ below 19999 ¥	7.3	6
	20000 ¥ ∼ below 29999 ¥	3.3	7.3
	30000 ¥ and above	2.3	
Education	Secondary School Certificate or below	1.7	56.82
	High school degree	10.3	8.17
	Bachelor's degree	75.3	21.22
	Master's degree	11.7	13.78
	Doctorate and postdoctoral	1	
Employment status	Full-time employment	62.7	52.90
	Part-time employment	20.7	
	Unemployment (Looking for a job)	4	1.69
	Unemployment (Not looking for a job)	1.7	
	Student	10.3	23.03
	Others	0.7	22.38

All data collected were screened for questionnaires with excessively short completion times and high answer consistency. In this study, a total of 1082 effective questionnaires were sent out and recovered. On average, participants took about 1.5 minutes to fill out the questionnaire. In Table 4, we compare the data from this survey with data from the National Bureau of Statistics of China. According to the data, most of the respondents are young people with high education and high income, who are more likely to join SNEAVs program. In addition, the male-to-female ratio of the samples obtained in this study is 41:59, and there is no issue of a significant difference in ratio affecting the research results, the conclusion is credible within the control range.

This study set up three modules of personal characteristics (gender, age, monthly income, education, employment, have a license), satisfaction (satisfaction with current travel mode) and cognitive situation (carsharing, new energy vehicles and autonomous vehicles) as independent variables, and behavioral intention as the dependent variable for ordered logistic analysis. Table 5 shows the validity of the available independent variables, and then this model construction is meaningful.

Table 5 Likelihood ratio test

Model	−2log likelihood	χ^2	*df*	*p*	AIC price	BIC price
Only intercept	1500.069	-	-	-	-	-
The final model	1346.278	153.791	13	0.000	1380.278	1455.026

Based on the statistical analysis using ordered logit model (see Table 6), gender, cognition of SNEAVs and autonomous vehicles have a significantly positive impact on willingness to use SNEAVs; employment and carsharing cognition have a significantly negative impact on willingness to use SNEAVs. For the conclusion of significant positive effects of gender, we will further study it by factor analysis below.

4 Analysis and Results

According to the ordered logit model, gender has a significant influence on SNEAVs willingness, but the moderating mechanism of gender remains to be explored. Therefore, we introduced seven possible latent variables to further explore using the improved UTAUT2 model[14]. Next, this study applies structural equation modelling (SEM) and AMOS version 26 (Maximum Likelihood Estimations) to analyze the construct of consumer's willingness to adopt this new technology and the moderating effect of gender.

In Table 7, the model fit was assessed with three commonly applied model fit indices: Tucker-Lewis index (TLI$\geq$ 0.95), comparative fit index (CFI$\geq$ 0.95), as well as the root mean square error of approximation (RMSEA$\leq$ 0.07).

Additionally, the assessment of the model fit was complemented with further analyses in Table 6, including the factor loadings, discriminant validity, convergent validity and internal consistency. The factor loadings (betas) were all higher than the recommended threshold of 0.7, ranging from 0.820 to 0.979. Furthermore, the average variance extracted (AVE) was also higher than the required value of 0.5. As a matter of fact, convergent validity within this study

Table 6 Results of the first analysis of ordered Logistic regression model

Indicators		regression coefficient	standard error	z price	Wald χ^2	p price	OR price	OR value of 95%CI
Thresholds for dependent variables	1.0	−0.774	1.000	−0.774	0.599	0.439	2.168	0.305∼15.386
	2.0	1.483	0.965	1.536	2.360	0.125	0.227	0.034∼1.505
	3.0	3.087	0.967	3.192	10.186	0.001	0.046	0.007∼0.304
	4.0	6.486	1.011	6.417	41.182	0.000	0.002	0.000∼0.011
independent variables	Gender	0.343	0.169	2.030	4.121	**0.042**	1.410	1.012∼1.964
	Age	−0.089	0.124	−0.715	0.512	0.474	0.915	0.717∼1.168
	Monthly Household Net Income	−0.061	0.050	−1.206	1.454	0.228	0.941	0.853∼1.039
	Education	0.174	0.152	1.147	1.315	0.252	1.190	0.884∼1.602
	Employment status	−0.182	0.072	−2.529	6.396	**0.011**	0.833	0.724∼0.960
	Driving license	0.226	0.266	0.848	0.720	0.396	1.254	0.744∼2.113
	Satisfaction	−0.006	0.112	−0.050	0.003	0.960	0.994	0.798∼1.239
	Carsharing	0.117	0.130	0.896	0.803	0.370	1.124	0.871∼1.451
		−0.681	0.222	−3.066	9.400	**0.002**	0.506	0.328∼0.782
	New energy	0.616	0.138	4.466	19.949	**0.000**	1.852	1.413∼2.427
		−0.017	0.248	−0.069	0.005	0.945	0.983	0.605∼1.598
	Autonomous	0.817	0.162	5.041	25.409	**0.000**	2.263	1.648∼3.110
		0.182	0.203	0.897	0.804	0.370	1.200	0.806∼1.786
McFadden R square: 0.103								
Cox and the Snell R^2: 0.226								
Nagelkerke R^2: 0.226								

Table 7 Model fit assessment (measurement model)

Indices	χ^2	df	RMSEA	CFI	TLI
Standards	-	-	≤0.07	≥0.95	≥0.95
Results	1259.055	247	0.062	0.973	0.967

is supported. Moreover, the square roots of the AVE for each individual construct were larger than the construct correlations (see Table 9), which supports discriminant validity. Finally, following the recommendation of the threshold of the composite reliabilities (CR) (>0.70) by Payre, et al.[15], internal consistency is supported (see Table 8).

Interestingly, it seems that the participants in this study show a positive attitude towards the use of SNEAVs as a travel service. Statistically speaking, the scores of the mean of behavioral

intention, which is defined as user acceptance in this study, to use SNEAVs were higher than the mid-point 4 of the scales used (7-point scales) (see Table 8). With a view to public often holds a neutral opinion in the beginning when it comes to disruptive and emerging technologies, maybe we have reason to believe COVID-19 is helpful to increase the willingness for the adoption of a new travel option immensely.

Table 8 Factor loadings, construct reliability, AVE, item means, and standard deviations

Variable	Item	Factor loading	AVE	CR	Mean (total)	SD (total)	Mean (male)	SD (male)	Mean (female)	SD (female)
Performance Expectancy	PE1	0.949	0.873	0.954	4.57	1.52	4.65	1.40	4.52	1.61
	PE2	0.919			4.57	1.61	4.65	1.64	4.58	1.60
	PE3	0.935			4.62	1.47	4.65	1.45	4.60	1.48
Social Influence	SI1	0.937	0.851	0.945	4.49	1.74	4.46	1.72	4.51	1.76
	SI2	0.92			4.50	1.72	4.45	1.72	4.53	1.72
	SI3	0.91			4.48	1.79	4.49	1.72	4.48	1.84
Hedonic Motivation	HM1	0.944	0.886	0.959	4.65	1.54	4.63	1.66	4.66	1.46
	HM2	0.921			4.62	1.64	4.63	1.71	4.62	1.60
	HM3	0.958			4.62	1.59	4.62	1.65	4.63	1.55
Price Sensitivity	PS1	0.953	0.873	0.954	4.26	2.09	4.23	2.12	4.29	2.07
	PS2	0.931			4.25	2.16	4.29	2.03	4.23	2.25
	PS3	0.919			4.36	1.87	4.38	1.75	4.35	1.96
Perceived Risk	PR1	0.927	0.870	0.953	4.37	1.65	4.44	1.68	4.32	1.62
	PR2	0.929			4.35	1.77	4.40	1.88	4.31	1.69
	PR3	0.942			4.33	1.77	4.37	1.87	4.30	1.69
Trust in Technology	TT1	0.949	0.873	0.965	4.43	1.80	4.42	1.86	4.44	1.75
	TT2	0.93			4.47	1.61	4.45	1.70	4.49	1.55
	TT3	0.922			4.50	1.67	4.59	1.54	4.43	1.76
	TT4	0.937			4.50	1.54	4.52	1.61	4.49	1.49
Innovativeness	INO1	0.94	0.839	0.940	4.49	1.68	4.50	1.76	4.48	1.63
	INO2	0.908			4.41	1.96	4.48	1.88	4.36	2.01
	INO3	0.899			4.55	1.54	4.59	1.55	4.52	1.54
Behavioral Intention	BI1	0.94	0.876	0.955	4.67	1.63	4.70	1.61	4.64	1.64
	BI2	0.937			4.69	1.64	4.71	1.66	4.67	1.63
	BI3	0.93			4.69	1.68	4.77	1.54	4.63	1.77

Table 9 Discriminant validity of measures, inter-correlation matrix

	PE	SI	HM	PS	INO	TT	PR
PE	0.8731						
SI	0.798	0.8508					
HM	0.869	0.724	0.8857				
PS	0.721	0.731	0.669	0.8732			
INO	0.847	0.797	0.799	0.757	0.8388		
TT	0.771	0.74	0.724	0.782	0.79	0.8734	
PR	0.657	0.62	0.627	0.62	0.68	0.584	0.8699
Square root (AVE)	0.934	0.922	0.941	0.934	0.916	0.935	0.933

To identify the differences of user acceptance of SNEAVs when it comes to gender the data ($n = 1082$) is divided into two subgroups, i.e., men ($n = 448$) and women ($n = 634$) and the structural paths were calculated again (see Table 10). Moreover, a Chi-square difference test was also calculated to provide statistical evidence of the differences of men and women (see Table 11).

Based on the statistical analysis all proposed hypotheses could be supported by the underlying data except perceived risk (see Table 10). Perceived risk stems from people's fear psychology when using SNEAVs[20]. And whether the negative emotion will lighten or even quieten as technology matures remains to be further explored. In this study, we defined variables that contradict the hypothesis as unreliable, so we won't consider the item perceived risk whose reliability is poor in the subsequent comparative analysis and conclusions.

Table 10 Results of structural relationships including moderating effects

Hypothesis	Path	Total			Male			Female		
		Effect	Estimate	*P*	Effect	Estimate	*P*	Effect	Estimate	*P*
H1	BI ←-- PE	+	0.183	***	+	0.376	***	+	0.03	**0.662**
H2	BI ←-- SI	+	0.136	***	+	0.116	0.047	+	0.154	***
H3	BI ←-- HM	+	0.211	***	+	0.098	**0.107**	+	0.315	***
H4	BI ←-- PS	+	0.003	**0.908**	+	0.051	**0.254**	−	−0.008	**0.79**
H5	BI ←-- PR	+	0.01	**0.697**	+	0.005	**0.925**	−	−0.009	**0.794**
H6	BI ←-- TT	+	0.26	***	+	0.165	0.004	+	0.331	***
H7	BI ←-- INO	+	0.15	***	+	0.133	0.044	+	0.144	0.014

Table 11 Chi-square difference test

Hypothesis	Path			χ^2	P	Result
H1	BI	←--	PE	16.627	0.011**	Significant
H2	BI	←--	SI	5.612	0.468	
H3	BI	←--	HM	20.108	0.003***	Significant
H4	BI	←--	PS	8.967	0.175	
H6	BI	←--	TT	15.79	0.015**	Significant
H7	BI	←--	INO	3.724	0.714	

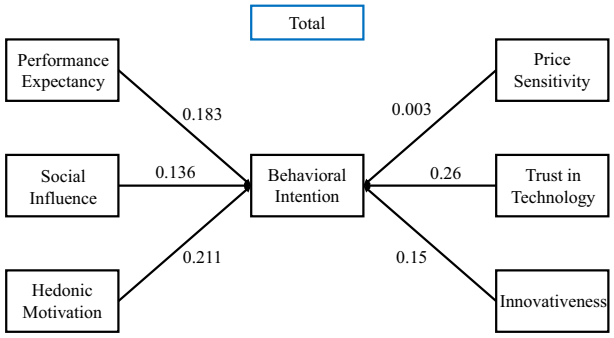

Figure 4 Path diagram (total sample)

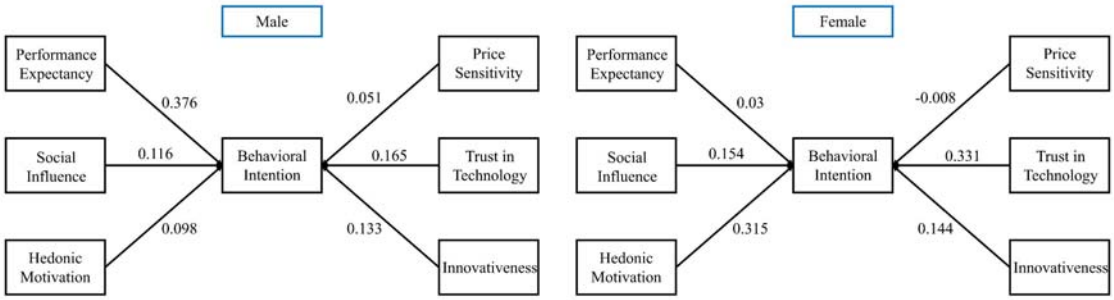

Figure 5 Path diagram (male and female sample)

Surprisingly, the structural results show that there is no significant effect of price sensitivity for the total sample, there is no significant effect of hedonic motivation for the male sample and there is no significant effect of performance expectancy for the female sample. It also shows that for the male sample, price sensitivity positively influences behavioral intention to use SNEAVs, but it's negative for female (see Table 10, Figures 4 and 5). The Chi-square difference test shows that there is no significant difference in the women and men sample except for performance expectancy and hedonic motivation (see Table 11).

It is known that men and women had significant differences in performance expectancy, hedonic motivation and trust in technology. Men tend to be more task-oriented than women (Morris and Venkatesh, 2000), so that performance expectations are more significant for men than women. women are more significant in hedonic motivation probably because women are more willing to enjoy. The greater impact of trust in technology on the intention to use among women indicates that they are more cautious when facing new technologies. Price sensitivity negatively influences behavioral intention to use SNEAVs for female probably due to women are more likely to trust additional information such as quality and safety that comes with a price.

5 Summary and Conclusions

In this paper, we investigated the factors influencing the behavioral intentions of Beijing residents to use SNEAVs and conducted a group difference analysis based on gender. The results of an on-line survey ($n = 1082$) in China quantitatively are analyzed. Structural equation modelling was used to analyze the data. Ordered logit models were used to capture the willingness of the respondents to join SNEAVs and shows that gender is a significant influence on SNEAVs willingness. Then, the Unified Theory of Acceptance and Use of Technology (UTAUT2) including gender as a moderator are extended theoretically but the reliability of perceived risk and trust in technology is poor practically. The model results show that price sensitivity has no significant effect for the total sample, hedonic motivation has no significant effect for the male sample, and performance expectancy has no significant effect for the female sample. Moreover, for the male sample, price sensitivity positively influences behavioral intention to use SNEAVs, but it's negatively for female.

The main contributions of this study are as follows: First, this study combines autonomous driving technology, new energy attributes and shared system, simulates the SNEAVs service. Secondly, in view of the population characteristics of gender with significant differences, the UTAUT2 model is adopted to make the investigation more targeted and the conclusion more reasonable. Meanwhile, the improved UTAUT2 model is adopted in this study to put forward the theoretical framework, which can provide reference opinions for the research of relevant behavioral intention. In theory, we validated the correctness of the extended UTAUT2 model and the eight antecedent behavior theories involved in gender moderation. Although some gender moderation theories were not confirmed, we offered some insights into performance expectancy, hedonic motivation, and trust in technology.

In this paper, we have not considered about the situation where SNEAVs can be purchased and added to the sharing platform, which is crucial for the sustainable development of SNEAVs services. In addition, perceived risk did not match the hypothesis in terms of impact in this paper, so it still needs to be addressed in the future study. Furthermore, SNEAVs services is not yet available in the real word yet, and participants may be impressed based on the information provided in the questionnaire and carsharing or new energy service they have used. In fact, the study also shows the significant effect of this factor, so the impact of carsharing use on SNEAVs can be further studied in the future.

References

[1] Guerrieri M, Parla G. Real-time social distance measurement and face mask detection in public transportation systems during the COVID-19 pandemic and post-pandemic Era: Theoretical approach and case study in Italy. Transportation Research Interdisciplinary Perspectives, 2022, 16: 100693.

[2] Yan C. Research on safety threat and strategy of autonomous vehicle technology development. Netinfo Security, 2021, S1: 38–41.

[3] Kumar G, James A T, Choudhary K, et al. Investigation and analysis of implementation challenges for autonomous vehicles in developing countries using hybrid structural modeling. Technological Forecasting and Social Change, 2022, 185: 122080.

[4] Yang J, Shen M. Survey on consumer market acceptance of autonomous vehicles in China. Journal of Chang'an University (Social Sciences Edition), 2017, 19(6): 34–42.

[5] Efthymiou D, Antoniou C, Waddell P. Factors affecting the adoption of vehicle sharing systems by young drivers. Transport Policy, 2013, 29: 64–73.

[6] Cao K, Deng Y. Spatial and temporal evolution of urban car-sharing distribution and its influencing factors: A case study of Beijing City. Scientia Geographica Sinica, 2021, 41(10): 1792–1801.

[7] Liu S. Research on new energy vehicle sharing based on market orientation. Sichuan: Xihua University, 2022.

[8] Li W, Li Y. Research on consumption choice behavior of new energy vehicles under carbon trading mechanism. Systems Engineering, 2023, 41(1): 15–26.

[9] Yuan H. Development problems and countermeasures of sharing economy: Taking car sharing as an example. Business News, 2021(28): 13–15.

[10] Miao H. Modeling and optimization of shared mobility system under technology fusion. Jilin: Jilin University, 2019.

[11] Kim J, Rasouli S, Timmermans H. Satisfaction and uncertainty in car-sharing decisions: An integration of hybrid choice and random regret-based models. Transportation Research Part A: Policy and Practice, 2017, 95: 13–33.

[12] Venkatesh V, Morris M G, Davis G B, et al. User acceptance of information technology: Toward a unified view. MIS Quarter, 2003, 27(3): 425–478.

[13] Venkatesh V, Thong J Y L, Xu X. Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarter, 2012, 36: 157–178.

[14] Kapser S, Abdelrahman M, Bernecker T. Autonomous delivery vehicles to fight the spread of Covid-19 — How do men and women differ in their acceptance?. Transportation Research Part A, 2021, 148: 183–198.

[15] Payre W, Cestac J, Delhomme P. Intention to use a fully automated car: Attitudes and a priori acceptability. Transportation Research Part F: Traffic Psychology and Behaviour, 2014, 27: 252–263.

[16] Shabanpour R, Golshani N, Shamshiripour A, et al. Eliciting preferences for adoption of fully automated vehicles using best-worst analysis. Transportation Research Part C: Emerging Technology, 2018, 93: 463–478.

[17] Hohenberger C, Spörrle M, Welpe I M. How and why do men and women differ in their willingness to use automated cars? The influence of emotions across different age groups. Transportation Research Part A: Policy and Practice, 2016, 94: 374–385.

[18] Morris M G, Venkatesh V. Age differences in technology adoption decisions: Implications for a changing workforce. Personnel Psychology, 2000, 53(2): 375–403.

[19] Sundheim D. Do women take as many risks as men?. Harvard Business Review, 2013.

[20] Cowart K O, Fox G L, Wilson A E. A structural look at consumer innovativeness and self-congruence in new product purchases. Psychology and Marketing, 2008, 25(12): 1111–1130.