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Influence of emotion on purchase intention of electric vehicles: a comparative study of consumers with different income levels

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Abstract

Promoting electric vehicles (EVs) adoption has become one of the important paths for countries around the world to address climate change and accelerate the transformation of energy system for achieving sustainable development. As one of the important psychological factors, the research on the explanatory power of emotions to EVs purchase intention is still insufficient. This paper collected 400 valid questionnaires all around China. By incorporating emotions and moral norms into the Theory of Planned Behavior (TPB) model, this study used structural equation model to estimate the impact of positive anticipated emotion (PAE), negative anticipated emotion (NAE), and moral norms together with TPB elements on EVs purchase intention. In order to explore the heterogeneity effect of the above factors on EVs purchase intention among consumers of different income groups, we divided the total sample into high-income subsample and low-income subsample according to the household monthly disposable income. We concluded as follows: for the total sample, PAE has the greatest impact on EVs purchase intention, followed by attitude, NAE, and perceived behavioral control (PBC). In particular, the purchase intention of high-income consumers mainly depends on NAE, while the purchase intention of low-income consumers mainly depends on PAE. Additionally, PBC has more significant impact on EVs purchase intention of high-income group. Finally, targeted policy implications are proposed to promote EVs purchase.

Keywords Extended theory of planned behavior · Electric vehicles purchase intention · Positive anticipated emotion · Negative anticipated emotion · Different income level

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Introduction

Lucid waters and lush mountains are invaluable assets. In view that the successful introduction of electric vehicles (EVs) can not only bring fundamental changes in sustainable traffic behavior but is also an important way to protect the environment and sustainable development (Smith, 2008), how to effectively stimulate the wide application of EVs has become a special concern in countries around the world. China's Development Plan of the New Energy Vehicle Industry (2021–2035) proposed that the sales volume of new energy vehicles will reach about 20% of the total sales volume in 2025 (the General Office of the State Council 2020, No. 39 Document). Despite this, Chinese auto companies are still facing the dual challenges of declining subsidies for EVs and the ongoing novel coronavirus (COVID-19) pandemic. As industry competition intensifies, methods for further stimulating EV purchase demand have become very important and urgent. Therefore, the relevant governments need to understand the motivations and obstacles that determine

consumers' adoption of EVs in order to provide an objective basis for relevant policy making. Specifically, what are the key factors that affect the intent to purchase EVs? It has been suggested that consumers' emotional factors may be more critical than their rational factors for the successful adoption of new products (Moons & De Pelsmacker, 2012). However, consumers' anticipated emotions constitute a relatively neglected aspect in the study of EV adoption intention (Adnan et al., 2016), and the background and significance of this important factor have not been fully examined. Therefore, it is necessary for relevant governments to understand the emotional factors affecting consumers' intent to purchase EVs, together with a series of psychological factors affecting their purchase decisions.

The theory of planned behavior (TPB) model has been deemed to be effective at predicting green purchasing and other pro-environmental behavior (Huang & Ge, 2019). The model suggests that behavioral intention is determined by three core elements: attitude, subjective norms, and perceived behavioral control (PBC) (Ajzen, 1991). However, the TPB model is still insufficient to predict individual behavior or behavior intention exclusively from the perspective of rational choice (Perugini & Bagozzi, 2001). Some scholars have expressed the belief that emotion and affective factors are very important and yet often ignored in the TPB model (Ajzen, 2011). It has been found that the effectiveness of the TPB model could be improved by incorporating other elements, such as anticipated emotion and moral norms (Ajzen, 1991, 2011; Rivis et al., 2009).

In the TPB model, emotional factors may exert effects in two ways. Firstly, emotional factors indirectly affect purchase intention and behavior by influencing the three core elements of TPB: attitude, norms, and control belief (Schaller & Cialdini, 1990; Perugini & Bagozzi, 2001). However, some scholars have expressed the belief that anticipated emotion can directly affect intention and behavior independent of other core elements in the TPB model and can effectively enhance the explanatory power of the extended TPB model (Perugini & Bagozzi, 2001; Wang & Wu, 2015). Therefore, emotional factors should be included in the TPB framework as parallel predictors of TPB elements. Further research has shown that due to different situations and the different meanings of behavioral goals, different types of anticipated emotions, such as positive anticipated emotion (PAE) and negative anticipated emotion (NAE), may have different effects on behavioral intention (Perugini & Bagozzi, 2001). Although many studies have been conducted on the application of the TPB model with the incorporation of emotional factors (Carrera et al., 2011, 2012), there are limited comparative studies on the role of PAE and NAE on consumer groups with different levels of income based on the extended TPB model. Some scholars have indicated that income has played an important role in predicting energy use behavior (Abrahamse & Steg, 2009, 2011). Moreover, it was found that family income positively moderates the renewable energy equipment purchase attitude–behavioral intention relationship (Yang & Zhao, 2015), which emphasizes the importance of income classification. Based on the TPB model, Chen et al. (2017) have shown that attitudes and perceived behavioral control has the greatest influence on energy-saving behavior intention among low-income residents in the United States. However, it remains to be explored whether income level has an impact on the relationship between emotional factors and green purchase intention. Therefore, in the field of EV purchase, research on the purchase intentions of consumers with different levels of income through the addition of anticipated emotional factors to the TPB has great theoretical and applied value.

Some studies have discovered that, compared with the core elements in the TPB model, the incorporation of moral norms into the model can help to increase the explanatory variance of behavioral intention in specific situations (Ajzen, 1991; Jansson et al., 2017; Manstead, 2000; Rivis et al., 2009). The purchase of EVs is an altruistic pro-environmental behavior, so consumers' moral norms are likely to affect their intent to purchase EVs. Some scholars have confirmed that moral norms can significantly promote the intent to purchase EVs (Jansson et al., 2017; Shalender & Sharma, 2021). In this regard, this study will incorporate moral norms into the model in an attempt to explore their impact path on the intent to purchase EVs.

This study was conducted in two steps. First, by incorporating moral norms and anticipated emotions (including PAE and NAE), we extended the TPB model and then administered a questionnaire survey and analyzed the total sample using structural equation modelling. Second, considering that there may be heterogeneity in the effects of driving factors on EV purchase intention among different income groups, we divided consumers into two income groups based on their monthly disposable income and explored the factors and paths that influenced EV purchase intention for different income groups.

This study aims to contribute to the following three aspects: (1) In view that consumers' expectation of the complexity of technological innovation adoption is an important factor in generating emotion, which, in turn, affects the adoption of innovation and innovative product purchase decision making (Wood & Moreau, 2006), as an important eco-innovation product, it is obviously important to understand the role of emotion in EV purchase intention. Therefore, exploring the effect of PAE and NAE on EV purchase intention can provide insights and perspective for understanding EV purchase behavior. (2) In addition, we further examine whether there are differences in the determinants of EV purchase intention for different income groups, as previous research has paid less attention to this point. (3)

We attempt to discover the rarely studied antecedents of PAE and NAE, such as cognitive environmental risk (CER) and cognitive environmental benefits (CEBs).

The paper is arranged as follows. Section 2 contains a literature review and hypothesis development; Section 3 presents research methods, including questionnaire design, data collection, and data descriptions; Sections 4 and 5 are results and discussion, respectively; and Section 6 concludes and proposes policy implications.

Literature Review and Hypothesis Development

Davis' (1989) technology acceptance model (TAM) is used to examine users' acceptance of information systems. TAM has become a powerful and concise theoretical model to analyze consumers' acceptance or purchase intention of new technology products. Previous literatures have examined the influence mechanism of consumers' EV purchase intentions based on the theory of rational behavior (TRA) and TAM. Some scholars have used the TRA to explore the impact mechanism of personal values, attitudes, and subjective norms on EV purchase intention (Afroz et al., 2015; Alzahrani et al., 2019). In recent years, some studies have discussed factors affecting EV purchase intention based on TAM. For example, Chen (2020) discussed the impact of perceived ease of use, perceived usefulness, perceived risk, consumer innovation, and attitude on EV purchase intention. The results show that: (1) consumers' perceived usefulness, perceived ease of use, and consumer innovation have a significant positive impact on purchase intention through attitude; (2) consumers' perceived risk has a significant indirect negative impact on purchase intention through attitude and also has a significant direct negative impact on purchase intention. Some scholars combined TAM with other theoretical models and put forward new perspectives in this field. For example, Tu and Yang (2019) combined the TPB and TAM and showed that: (1) consumers' environmental awareness and acceptance of technological products significantly affect their behavior intentions; (2) when consumers think that EVs are more beneficial at the individual, environmental, or national level, or when they think that the use of EVs is simpler and more convenient, they will show a more positive attitude toward buying EVs. However, Song (2020) constructed a comprehensive theoretical framework based on TAM and perceived risk theory. The research showed that perceived usefulness, perceived ease of use, perceived risk, and attitude are the key factors determining intentions to adopt pure EVs. Based on TAM and TPB, Wang and Wang (2013) concluded that perceived usefulness and perceived ease of use have a positive impact on Beijing residents' purchase attitude.

In general, the main reason this study chose the extended TPB model and includes anticipated emotion and moral norms is that compared with TAM alone, the TPB model also considers subjective norms and perceived behavior control on the basis of TAM, which is more comprehensive.

The Basic Elements in the Theory of Planned Behavior

The TPB assumes that individual decision making is based on the rational evaluation of the possible consequences of motivation and behavior (Ajzen, 1991). In the TPB framework, intention is a direct predictor of individual behavior, while attitude, PBC, and social norms were found to be predictors of intention (Ajzen, 2011). The TPB model takes the maximization of benefit and utility as the basis of human behavior. Therefore, some scholars have used the TPB model to study EV purchase behavior as a pro-environmental behavior and have argued that EV purchase behavior is a rational behavior (Egbue & Long, 2012).

Theoretically, attitude is an individual's stable psychological tendency toward a specific object (including a person, idea, emotion, event, etc.). In the TPB framework, attitude is defined as the evaluation of the positive and negative consequences of behavior (Moons & De Pelsmacker, 2012). Based on the TPB, attitude has been identified as one of major psychological factors influencing EV purchase intention (Mohamed et al., 2018). Many studies have used different dimensions to measure attitudes toward EVs, yielding the belief that mileage, purchase cost, charging station installation cost, operating costs, experiences, and other related policies play an important role in attitude toward EV purchase (Haustein & Jensen, 2018; Li et al., 2020; Liu et al., 2020b). Attitude can change EV consumption intention (Yang & Zhang, 2011). Moons and De Pelsmacker (2012) expressed the belief that attitude is one of the strongest determinants of EV purchase intention. In the TPB framework, PBC is defined as the degree of control that individuals perceive regarding participating in a particular behavior (Ajzen, 1991). By establishing a hierarchical model, Ajzen (1991) suggested that PBC has good explanatory power of consumers' behavior intentions. In addition to attitude, Moons and De Pelsmacker (2012) measured the impact of PBC on EV purchase intention and argued that the PBC dimension includes the affordability to buy and adopt EVs. Schuitema et al. (2013) expressed the belief that PBC is an important factor influencing EV purchase intention. In a further study, Wang et al. (2018) used big data methods to determine that consumers' PBC has a direct and significant positive impact on EV purchase intention. Tu and Yang (2019) found that consumers' PBC has the greatest effect on EV purchase intention. Subjective norms refer to the social pressure that an individual perceives as emanating from a

person who is important to them and who wants them to act in a specific way (Ajzen, 1991). Moons and De Pelsmacker (2012) showed that besides attitudes and emotions, subjective norms are the most important determinants affecting the intention to adopt EVs. Some recent studies have indicated that subjective norms significantly promote EV purchase intentions (Sang & Bekhet, 2015; Simsekoglu & Nayum, 2019; Tu & Yang, 2019).

Hence, this study proposed the following hypotheses:

H1: Attitude positively influences EV purchase intention.
H2: PBC positively influences EV purchase intention.
H3: Subjective norms positively influence EV purchase intention.

Extensions of the Theory of Planned Behavior

Anticipated Emotions

Anticipated emotion refers to the prospect of feeling positive or negative emotions after performing or refraining from performing a behavior (Rivis et al., 2009). Therefore, anticipated emotion is regarded as a basic psychological mechanism formed during the process of an individual's pro-environmental behavior selection in order to adapt to the changing environment, which has a significant impact on pro-environmental behavior. As an extension of the TPB, the model of goal-directed behavior (MGB) also contains the constructs of anticipated emotions; in comparison to the TPB, the MGB explains greater amounts of variance in pro-environmental behavioral intentions (Perugini & Bagozzi, 2001).

Regarding the specific path of the influence of anticipated emotion on pro-environmental behavior, Vining and Ebreo (2002) expressed the belief that PAE and NAE have direct and significant effects on pro-environmental behavior or that they mediate between other factors and pro-environmental behavior. Han et al. (2016) showed that emotional process plays a crucial role in the generation of behavioral intention. They confirmed the mediating effect of anticipated emotion in promoting behavioral intention.

PAE, such as an emotional affinity or love for nature, have a significant impact on pro-environmental behavior (Kals & Maes, 2002). Moons and De Pelsmacker (2012) defined emotion as having three levels (visceral, behavioral, and reflective) and indicated that consumers' PAE has an important impact on EV purchase intention. Schuitema et al. (2013) showed that positive emotions such as desire, happiness, and pride inspire the purchase of EVs, and PAE can help consumers overcome uncertainty when purchasing EVs. Wolf et al. (2015) expressed the belief that positive excitement will promote EV purchase intention. As an important factor in consumption decision making, PAE reflects the consumer's expectation and goal intention regarding the consumed goods (Carrus et al., 2008). The existing literature indicates that consumers who anticipate more positive emotions associated with EV purchases show stronger EV purchase intentions correspondingly (Rezvani et al., 2017). Further empirical research has indicated the importance of three motivations (gain, normative, and PAE) in consumers' EV purchase intentions. In addition, for those consumers with high social norm perception, the direct impact of PAE on EV purchase intention is stronger, while the direct impact of gain is not significant (Rezvani et al., 2018). Further, some studies have shown that the driving effect of PAE on pro-environmental behavior is significantly greater than that of NAE (Wang & Wu, 2015).

NAE, such as guilt and indignation about the lack of natural protection, has a significant impact on pro-environmental behavior (Carrus et al., 2008). Odou and Schill (2020) expressed the belief that NAE is conducive to consumers making the most effective consumption decision to a certain extent, which is of great significance to EV purchase. Jiang et al. (2019) incorporated anticipated guilt into the TPB model and concluded that it has a direct positive impact on promoting the purchase of EVs. NAE is considered to be an important predictor of pro-environmental behavioral intention (Carrus et al., 2008; Schneider et al., 2017). Therefore, this study proposed the following hypotheses:

H4: PAE positively influences EV purchase intention.
H5: NAE positively influences EV purchase intention.

Moral Norms

Moral norms refer to an individual's perception of the moral correctness or incorrectness of a particular behavior (Ajzen, 1991). Moral norms are known as perceived moral obligations or personal norms. The research on moral norms can be traced back to the norm activation model (NAM; Schwartz, 1977), according to which activating individual norms requires that individuals feel responsible for others in society based on their internal moral rules. Scholars have explored the effect of moral norms on the attitude–behavior relationship in the TPB model (Manstead, 2000) and found that incorporating moral norms into the TPB model can greatly improve the model's predictive power regarding behavior intention (Parker et al., 1995). Rivis et al. (2009) confirmed this, finding that the explanatory variance of behavioral intention increased by 3% when moral norms were included and TPB elements were controlled.

Leung et al. (2015) argued that individual cosmopolitan orientation has greater explanatory power regarding pro-environmental behavior, compared to the pro-environmental worldview, motivation, and belief. Moreover, Ito et al. (2020) showed cognitive and emotive pathways between

cosmopolitanism and pro-environmental behavior. Specifically, some scholars found that moral norms have significant positive impacts on EV adoption intention (Nayum & Klockner, 2014; Wang et al., 2014).

Attitude and moral norms are closely related because a person may change their attitude (such as disgust, shame, etc.) after breaking internalized moral rules (Rivis et al., 2009). Previous literature has shown that moral norms have a significant positive effect on attitude toward using EVs (Wang et al., 2018). In the context of green car promotion, we should adhere to the role of moral norms, which affect perceived social pressure and behavioral tendencies (Rezvani et al., 2017). Based on the existing literature, the following hypothesis is proposed:

H6: Moral norms positively influence attitude.

Cognitive Environmental Benefits and Cognitive Environmental Risks

With the further development of EV technology, the technical obstacles encountered in the largescale adoption of EVs may not be directly related to consumers' purchase intention. In fact, encouraging consumers to choose EVs largely depends on consumers' psychological cognition of purchasing and using EVs (Moons & De Pelsmacker, 2012).

Consumers' cognitive benefits are considered to have a significant positive impact on EV purchase intention (Chen, 2015). Schuitema et al. (2013) found that consumers' perceived hedonic attributes, perceived symbolic attributes, and instrumental attributes have significant positive impacts on EV purchase intention. According to the value–belief–norm theory (Stern, 2000), cognitive risk and the negative outcome of behavior can lead to NAE, thus influencing individuals' behavior intentions. Therefore, formulating targeted EV marketing strategies and effective information communication strategies for different consumer groups (such as by income, gender, and age) would be helpful to explore the effect of consumers' cognitive benefits and risks on EV purchase intention.

Environmental knowledge is considered to be a stronger predictor for commitment to and frequency of engaging in pro-environmental behaviors (Ito et al., 2020). On the one hand, awareness of environmental problems tends to spur individuals to engage in pro-environmental behaviors (Soares et al., 2021). On the other hand, Hamzah and Tanwir (2020) found that perceived green value (one of the CEBs) exerts a positive influence on green purchase intention. However, Liu et al. (2020a) argued that environmental knowledge itself does not directly affect environmental behavior unless the emotional system is activated. For example, feelings of guilt play an important mediating role in the relationship between risk perception and pro-environmental behavioral intention (Yoon et al., 2021). Thus, we concluded that knowledge, including of CEBs and CERs, influences green purchase behavior by activating emotion.

Based on questionnaire data, Ziefle et al. (2014) found that consumers of different ages and genders vary in the CEBs of using EVs, and elder female consumers have higher EV purchase intentions. Degirmenci and Breitner (2017) showed that consumers' CEBs are more effective at explaining EV purchase intention than cognitive financial benefits. Specifically, Ziefle et al. (2014) believed that consumers' perceived environmental benefits constitute one of the important perceived benefits of purchasing EVs. In terms of how CEBs affect purchase intention, Zhang et al. (2018) found that CEBs have a significant positive impact on positive emotions from the perspective of rationality–emotion–behavior, thus affecting purchase intention. Therefore, the following hypothesis is proposed:

H7: Cognitive environmental benefits positively influence PAE.

In addition, Loewenstein et al. (2001) proposed the risk emotion hypothesis, which combines the role of cognitive risk and emotion. According to this hypothesis, CER will lead to people's NAE, such as fear and anxiety. Specifically, individuals' cognitive assessment of environmental risk will lead to NAE, and their NAE will often drive behavior. Wang et al. (2018) found that NAE plays a partial mediating role in the impact of CER on pro-environmental behavior. That is, people's CER will manifest NAE, which will promote engagement in pro-environmental behaviors. The findings of these previous studies mean that the cognitive evaluation of environmental risk may have a certain predictive effect on NAE. Therefore, when consumers clearly recognize and evaluate the problem that relying on traditional fuel vehicles instead of EVs may bring greater risks to the environment, they are more likely to form NAE. Therefore, this study proposed the following hypothesis:

H8: CER positively influences NAE.

The proposed theoretic model in the study is illustrated in Fig. 1.

The existing literature can be summarized as follows: (1) Some studies have focused on the influence of a single factor on EV purchase intention, such as TPB elements, emotions, moral norms, and so on. However, few studies have incorporated both emotions and moral norms into the TPB model simultaneously to explore the mechanism of comprehensive factors on EV purchase intention. (2) In terms of the specific mechanism, many studies have focused on the direct effects of the above factors on EV purchase intention and less on the

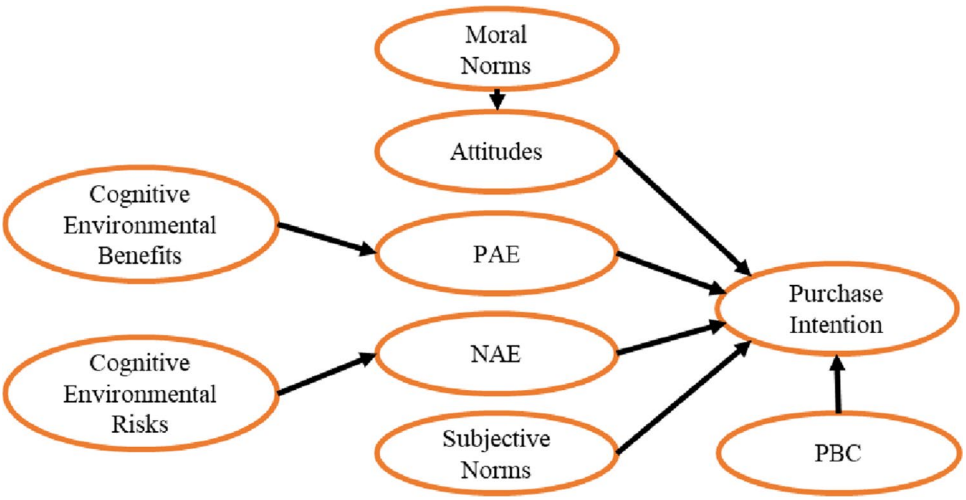

Fig. 1 Theoretical structure framework of the research

relationship among TPB elements, emotions, and moral norms. Accordingly, this study incorporated emotions (including PAE and NAE) into the TPB model as independent parallel predictors, alongside other TPB elements, and moral norms as antecedents of attitude to explore the mechanism of the influence of emotions and moral norms, together with TPB elements, on EV purchase intention. Furthermore, this study incorporated CEBs and CERs as the antecedents of PAE and NAE, respectively, into the TPB model and divided consumers into different groups according to actual income level in order to explore the influence of the above factors on the EV purchase intentions of different income groups to ultimately provide targeted policy implications to promote the adoption of EVs.

Methodology

Questionnaire Measures and Data Collection

The measures for attitude toward EV adoption, PAE, and NAE were based on the literature (Carrera et al., 2011; Carrus et al., 2008; Kals & Maes, 2002). We developed four items to assess PBC and six items to measure subjective norms based on the literature (Moons & De Pelsmacker, 2012; Schuitema et al., 2013). We also developed items based on the literature to measure CER, CEB, moral norms, and EV purchase intention (Nayum & Klockner, 2014; Wang et al., 2014; Yuan et al., 2017). Based on the literature, a total of 41 items have been designed for the nine constructs (including 38 items for eight constructs representing factors that influence EV purchase intention and three items representing EV purchase intention).

From October to December 2019, we conducted an online survey on EV purchase intention among Chinese families nationwide. A total of 649 questionnaires were obtained, some of which were deleted due to random filling. Finally, 400 valid questionnaires were selected, with an effective response rate of 61.63%. Respondents' sociodemographic characteristics are shown in Table 1.

Descriptive Statistics of Survey Samples

Among the 400 valid questionnaires, 40.5% of respondents were male and 59.5% were female. In terms of age structure, 43.75% were between 22 and 28 years old, and 21.5% were between 36 and 45 years old. In terms of educational background, 39.75% were undergraduates and 39% had a master's degree or higher. In terms of monthly disposable household income, 19.25% of the respondents had an income of 5000 yuan or less, 34.75% earned 5001–10,000 yuan, 20.25% earned 10,001–15,000 yuan, 18.25% earned 15,001–30,000 yuan, and 7.5% had an income of more than 30,000 yuan.

The survey questionnaire was measured on a 5-point Likert scale, where 1 = "*strongly disagree*," 2 = "*slightly disagree*," 3 = "*neutral*," 4 = "*slightly agree*," and 5 = "*strongly agree*."

Empirical Results

Using AMOS 19.0, we used confirmatory factor analysis (CFA) to determine the theoretical structure of each construct based on the survey data. We then used path analysis to explore the mechanism of each construct's influence on EV purchase intention.

Table 1 Demographics statistics

Variable	Number	Percentage	Variable	Number	Percentage
Gender			**Marital status**		
male	162	40.5	married	162	40.5
female	238	59.5	not married	238	59.5
Age			**Education level**		
below 22	55	13.75	junior high school	30	7.5
22–28	175	43.75	senior high school	21	5.25
29–35	57	14.25	junior college	34	8.5
36–45	86	21.5	undergraduate	159	39.75
46–52	19	4.75	postgraduate	156	39
53–60	8	2			
Number of private cars			**Household monthly disposable income**		
0	127	31.75	0–5000	77	19.25
1	216	54	5001-10,000	139	34.75
2	50	12.5	10,001-15,000	81	20.25
3 or above	7	1.75	15,001-30,000	73	18.25
			over 30,000	30	7.5

Measurement Model

CFA is used to test whether the relationship between a construct and the corresponding measurement items is consistent with the theoretical relationship the researchers designed. CFA allows researchers to determine the correctness of the assumed relationship between the measurement items and the constructs.

We conducted a preliminary first-order CFA analysis on the items comprising the influential factors for EV purchase intention scale and found that the standardized factor loading of 38 items ranged from 0.359 to 0.89. In particular, the factor loading of behavior control (PBC1) was 0.359, which was lower than 0.5, indicating that the item has weak explanatory power to the construct (PBC), resulting in the deletion of PBC1. In addition, combined with the correlation testing of each item and the overall fitting indexes, SN1, SN2, SN3, PAE1, NAE1, CEB3, and CER2 were deleted. Therefore, the modified measurement model contains 30 items. The modified model was analyzed again using first-order CFA, and the results are shown in Table 2. It was found that the standardized factor loading of the 30 items ranged from 0.531 to 0.871, indicating that each model fitting index is satisfactory. It indicated that the conceptual model matches the collected data.

In order to ensure the rationality of the survey results, we conducted reliability and validity tests on the eight constructs: attitude, subjective norms, PBC, NAE, PAE, CEB, CER, and moral norms.

Internal consistency reliability tests reflect the reliability between the measurement model's internal constructs and examine whether each construct measures the same content or characteristics. As an index for internal consistency reliability, the higher the Cronbach's α coefficient, the higher the internal consistency. As shown in Table 2, each construct's Cronbach's α is between 0.756 and 0.875, which is greater than the threshold value of 0.7, indicating that the scale's internal consistency reliability is robust.

Composite reliability (CR) is used to explain the consistency of items under the same construct. Similar to Cronbach's α, the higher the CR value, the higher the internal consistency. The acceptable threshold is 0.7. As shown in Table 2, each construct's CR is between 0.762 and 0.877, which is greater than the threshold value of 0.7, indicating that the model's intrinsic quality is ideal.

In the measurement model, convergent validity is used to test whether the items effectively reflect the potential construct they measure. Convergence validity is significant because all average variance extracted (AVE) values range from 0.489 to 0.698 (see Table 2), basically exceeding the recommended threshold of 0.50. Hence, the results showed that the convergence validity is acceptable. If the significance of the correlation coefficient between any two constructs is not equal to 1, it means that there is a difference between the two constructs, which is called discriminant validity. The relevant discriminant validity test showed that the square root of each construct's AVE is greater than most of the correlation coefficients between this construct and all other constructs in the same column, which indicates that the discriminant validity is acceptable.

Table 2 Test results of measurement model

Constructs	Indicators	Factor loadings	α	CR	AVE
Subjective Norm (SN)	**My decision to purchase EVs will be influenced by** the social ethos. (SN4)	0.845	0.783	0.806	0.585
	the purchase atmosphere and consumption trend. (SN5)	0.821			
	the social standards. (SN6)	0.606			
Attitude (AT)	**Owning/Driving an electric vehicle can** meet the needs of my daily life. (AT1)	0.655	0.855	0.851	0.489
	meet my travel needs. (AT2)	0.608			
	effectively help combat climate change by reducing greenhouse gas emissions. (AT3)	0.657			
	be as pleasant as driving a traditional fuel car. (AT4)	0.785			
	help me to communicate with other like-minded people. (AT5)	0.771			
	have the same visual attraction as traditional vehicles. (AT6)	0.702			
Perceived Behavioral Control (PBC)	I have the right to decide whether the family will buy EVs. (PBC2)	0.531	0.756	0.762	0.524
	It is economically feasible for me to buy an electric vehicle. (PBC3)	0.820			
	As long as I am willing, I can choose EVs easily when buying cars. (PBC4)	0.786			
Negative Anticipated Emotions (NAE)	I would definitely regret missing the opportunity to buy an electric vehicle. (NAE2)	0.769	0.875	0.877	0.642
	The increasing number of gas-powered cars is bound to cause a serious deterioration in air quality, and I am horrified to think of the huge threat to people's health. (NAE3)	0.822			
	I am concerned that the shortage of local EVs is not conducive to addressing climate change. (NAE4)	0.867			
	I would be indignant if the surrounding residents did not fully fulfill their environmental responsibilities due to insufficient purchase of EVs. (NAE5)	0.742			
Positive Anticipated Emotions (PAE)	If I buy EVs, I will have the feelings of oneness with nature. (PAE2)	0.776	0.800	0.804	0.579
	The purchase of EVs bring us financial as well as environmental benefits, so I feel more satisfied. (PAE3)	0.708			
	Buying EVs can show my low-carbon and environmentally friendly lifestyle, so I am proud of it. (PAE4)	0.795			
Cognitive Environmental Benefits (CEB)	The purchase and use of EVs can reduce our dependence on fossil energy. (CEB1)	0.659	0.861	0.859	0.605
	EVs have obvious energy-saving benefits compared with ordinary fuel vehicles. (CEB2)	0.769			
	Compared with traditional fuel vehicles, driving EVs can achieve zero emissions, which helps to reduce environmental problems. (CEB4)	0.798			
	The purchase of EVs is one of the effective ways to reduce urban pollution. (CEB5)	0.871			
Cognitive Environmental Risks (CER)	**To what extent do you think** the environmental risks caused by automobile exhaust will pose a threat to human beings? (CER1)	0.782	0.814	0.818	0.530
	individuals contribute to mitigating environmental risks by buying EVs? (CER3)	0.724			
	the potential consequences of environmental risks caused by automobile exhaust are short-term or long-term? (CER4)	0.638			
	the environmental risks are caused by people driving fuel vehicles? (CER5)	0.760			

Table 2 (continued)

Constructs	Indicators	Factor loadings	α	CR	AVE
Moral Norms (MN)	I feel obligated to improve air quality by adopting EVs. (MN1)	0.840	0.872	0.874	0.698
	No matter how others choose, I will feel morally obligated to choose to buy an electric vehicle. (MN2)	0.860			
	I feel that I have the obligation to consider the impact of vehicle use on the environment. (MN3)	0.806			

α = Cronbach's α; CR = Composite Reliability; AVE = Average Variance Extracted

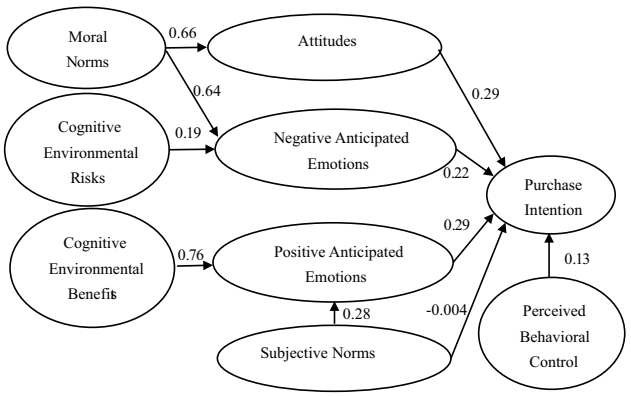

Fig. 2 The final path for the mechanism of key factors on EV adoption intention

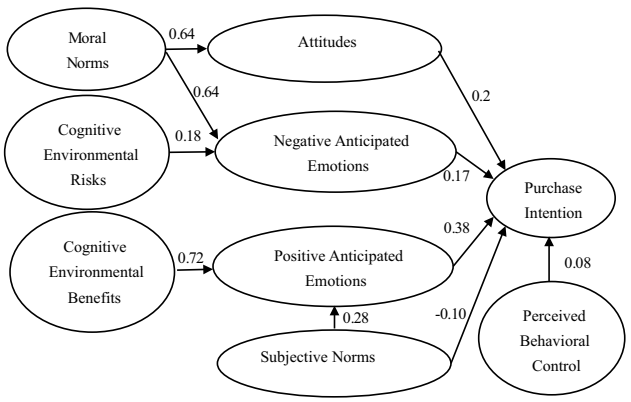

Fig. 3 The final path for the mechanism of key factors on EV adoption intention (low-income subsample)

Structural Model

Based on the results of the above measurement model, we conducted path analysis on the original model using AMOS 19.0. In view of the unsatisfactory fitting effect, combined with the mutual information (MI) coefficient, we modified the structural model and obtained the final model (as shown in Figs. 2, 3, 4). Compared with the original model, we

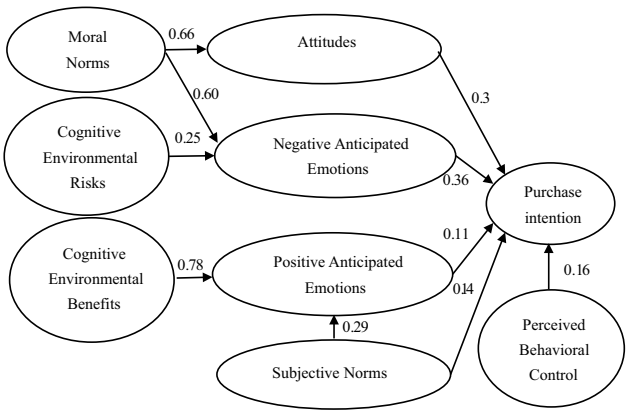

Fig. 4 The final path for the mechanism of key factors on EV adoption intention (high-income subsample)

added two paths to the final model: NAE < --- moral norms and PAE < --- subject norms. The above model modification is based on the following: The MI coefficient showed that there is a strong causal relationship between the two pairs of latent variables, and according to previous studies, moral norms indirectly affect intent to adopt green products by influencing NAE (Rezvani et al., 2017). It can be understood that subjective norms are likely to have a causal relationship with PAE; that is, individuals are affected by people around them, and then they generate PAE about buying EVs. The standard path coefficient and *p* value, as well as the fitting index of each model, are shown in Table 3.

According to the National Bureau of Statistics of China, in 2020, Chinese urban residents' per capita disposable income was 43,834 yuan. Calculated under the assumption of a three-person household, Chinese urban households' total monthly disposable income in 2020 was 10,958 yuan. This study rounded to 10,000 yuan. Therefore, as shown in Table 3, we divided all samples into two groups based on a monthly disposable household income of 10,000 yuan. We established three models: all samples (Model 1), subsample with monthly disposable income of less than 10,000 yuan (Model 2), and subsample with monthly disposable income of more than 10,000 yuan (Model 3).

Table 3 Model's path coefficients

Path			Model 1 ($N=400$)		Model 2 ($N=216$)		Model 3($N=184$)	
			Coef.	***p* value**	**Coef.**	***p* value**	**Coef.**	***p* value**
AT	<---	MN	0.667***	0.000	0.640***	0.000	0.66***	0.000
PAE	<---	CEB	0.761***	0.000	0.724***	0.000	0.783***	0.000
NAE	<---	MN	0.644***	0.000	0.636***	0.000	0.598***	0.000
NAE	<---	CER	0.189**	0.015	0.180*	0.059	0.251**	0.049
PAE	<---	SN	0.279***	0.000	0.278***	0.003	0.286***	0.000
PI	<---	AT	0.290***	0.000	0.258***	0.000	0.309***	0.000
PI	<---	PAE	0.292***	0.000	0.381***	0.000	0.110	0.414
PI	<---	NAE	0.221***	0.006	0.174*	0.082	0.357***	0.007
PI	<---	PBC	0.128***	0.005	0.082	0.171	0.157**	0.012
PI	<---	SN	−0.004	0.920	−0.103	0.098	0.142**	0.029
Indicators			Value	Test result	Value	Test result	Value	Test result
CMIN/DF			2.416	< 3	1.759	< 3	1.944	< 3
GFI			0.865	> 0.8	0.829	> 0.8	0.795	< 0.8
IFI			0.920	> 0.9	0.907	> 0.9	0.899	< 0.9
TLI			0.910	> 0.9	0.895	< 0.9	0.886	< 0.9
CFI			0.919	> 0.9	0.906	> 0.9	0.898	< 0.9
RMSEA			0.060	< 0.8	0.059	< 0.8	0.072	< 0.8

*$p<0.1$; **$p<0.05$; ***$p<0.01$; Model 1 represents all samples; Model 2 represents subsample with monthly disposable income of less than 10,000 yuan (low-income group); Model 3 represents subsample with monthly disposable income of more than 10,000 yuan (high-income group)

Test results are the comparison of indicator values and criteria

Table 4 Fitting index of multi-group invariance test

Model	CMIN/DF	GFI	CFI	RMSEA	AIC
Unconstrained	1.854	0.812	0.901	0.046	1745.558
Measurement weights	1.859	0.804	0.897	0.046	1745.751
Structural weights	1.85	0.804	0.898	0.046	1738.034
Structural covariances	1.852	0.8	0.897	0.046	1738.968

Model 1 meets the test criteria, while Models 2 and 3 generally pass the test criteria (Table 3), indicating the rationality of the models. Correspondingly, the final standard path coefficients for all samples, the low-income subsample, and the high-income subsample are shown in Figs. 2, 3, 4. Combined with the *p* value of each path coefficient shown in Table 3 and the fitting index of each model, it can be concluded that the final model improves model fitness and enriches the model's theoretical connotation.

Furthermore, we adopted multi-group invariance test to verify model stability and cross-group validity. Four different models were set up to test the influence of monthly income on the coefficient of structural equation model, including the unconstrained model, measurement weights model, structural weights model and structural covariances model. All of the fitting indexes in Table 4 have good fitting performance, which indicating that the assumed model has group equivalence.

Discussion

Based on the above empirical analysis, we conclude the following: For the total sample, PAE has the greatest impact on EV purchase intention, followed by attitude, NAE, and PBC. In particular, high-income consumers' purchase intentions mainly depend on NAE, while low-income consumers' purchase intentions mainly depend on PAE. In addition, PBC has a more significant impact on high-income groups' EV purchase intentions. Specifically, the results of the three models show that attitude has a significant direct role in promoting EV purchase intention, while moral norms have a significant indirect role in promoting EV purchase intention through attitude. Moral norms and CER have a significant positive impact on NAE, while subjective norms and CEB have a significant positive impact on PAE. This means that the stronger the consumer's moral obligation to protect the environment, the higher the CER and the stronger the consumer's NAE about failing to purchase EVs. Furthermore, the stronger the impact of subjective norms on consumers and the higher the CEB, the stronger the PAE that consumers may generate about purchasing EVs. For the total sample (Model 1), attitude, PBC, and anticipated emotion have a

significant direct impact on EV purchase intention, while subjective norms have no significant direct impact but do exert a significant indirect impact on EV purchase intention through PAE. For the low-income sample (Model 2), PAE has the greatest impact on EV purchase intention, followed by attitude, while NAE, PBC, and subjective norms have no significant impact on EV purchase intention. For the high-income sample (Model 3), NAE has the greatest impact on EV purchase intention, followed by attitude. PBC and subjective norms have significant positive impacts on EV purchase intention, and PAE has no significant impact on EV purchase intention.

(1) For Models 1 and 2, PAE has the strongest direct effect on EV purchase intention. For Model 1, PAE has the strongest direct effect, followed by attitude, NAE, and PBC. However, subjective norms have no significant effect on EV purchase intention. This is in line with previous literature (Mohiuddin et al., 2018; Ng et al., 2018; Tanwir & Hamzah, 2020) in which it is argued that consumers' intention to purchase green cars is not affected by social circles (subjective norms); instead, the purchase decision is more influenced by other factors, such as consumers' environmental concern, PBC, financial situation, or vehicular attributes. To some extent, this reflects that for the consumers sampled in this study, especially those in the low-income group, EV purchase intention has not yet been considered as a strong social norm. For the total sample (Model 1), this study confirmed the significant effect of anticipated emotions on EV purchase intention, supported by Han et al. (2016), who expressed the belief that emotional process plays an important role in the generation of behavioral intention. In addition, in terms of the heterogenous effects of different anticipated emotions, PAE (Coef. = 0.292, $p < 0.01$) has a more positive effect on EV purchase intention compared with NAE (Coef. = 0.221, $p < 0.01$). Schneider et al. (2017) supported this, arguing that, compared with NAE generated by inaction, action-generated PAE leads to higher pro-environmental behavioral intentions. That is, the more positive emotions consumers generate from EV purchases, the stronger their intention to purchase EVs.

(2) For Models 1 (total sample) and 3 (high-income group), PBC has a significant effect on purchase intention, but for Model 2 (low-income group), PBC has no significant impact. According to Table 5, we found that the average scores of the items representing the low-income group's PBC were significantly lower than those of the high-income group. The results showed that the lower scores for the economic and decision-making abilities represented by PBC had no significant impact on the low-income group's intention to purchase EVs. Obviously, high-income groups' advantages in terms of economic and decision-making abilities promote their intention to purchase EVs, which is consistent with the finding. In this regard, we think that although members of the low-income group have strong purchase intentions, purchasing an electric car is an important decision for them, which may mean that their other consumption is seriously restricted or that they have higher risk prevention awareness, so the relationship between their EV purchase intention and PBC is weak. In addition, our results indicated the rejection of H2 for the low-income group, in accordance with Huang and Ge (2019), who found that PBC has a significant positive impact on high-income consumers' behavioral intentions, while PBC has no significant impact on low-income consumers' behavioral intentions.

Table 5 The mean comparison for PBC

The average scores of the items for PBC	Low-income group (Model 2)	High-income group (Model 3)
PBC1	4.09	4.26
PBC2	3.30	3.64
PBC3	2.87	3.80
PBC4	2.92	3.48

(3) For Models 1 and 2, subjective norms have no direct significant impacts on the purchase intentions of the whole group (total sample) and the low-income group; for the high-income group (Model 3) only, subjective norms have direct significant impacts on purchase intention. Huang and Ge (2019) found that subjective norms have no significant effect on purchase intention for both the high- and low-income groups, and the relationship between subjective norms and behavioral intention is weak overall (Ajzen, 1991). Xu and Xu (2010) found that, compared with other factors (including after-sales service, purchase cost, vehicle quality, and energy consumption), subjective norms have the weakest impact on EV purchase decisions. However, we found that although subjective norms have no significant direct effect on the purchase intentions of the whole group and the low-income group, while subjective norms have direct and significant positive effects on PAE for all three groups (the whole group and the low- and high-income groups), for the whole group and the low-income group (Models 1 and 2), subjective norms have indirect and significant positive effects on EV purchase intention through PAE activation. Some studies' findings support this. For example, Rezvani et al. (2017) showed that subjective norms have a significant indirect impact on the adoption intention of

green products through NAE. Shin and Hancer (2016) showed that subjective norms have a significant indirect impact on local food purchase intention through attitude. In this regard, we believe that the social atmosphere makes people, especially low-income consumers, anticipate the generation of positive emotions such as pride and pleasure when purchasing EVs, thus stimulating their EV purchase intentions.

(4) According to our empirical results, PAE (Coef. = 0.292, $p < 0.01$) have a stronger influence on purchase intention than attitude (Coef. = 0.290, $p < 0.01$) for the total sample and for the low-income consumer group, PAE (Coef. =0.381, $p < 0.01$) also have a stronger influence on purchase intention than attitude (Coef. =0.258, $p < 0.01$). In contrast, our results showed that for the high-income consumer group, NAE (Coef. = 0.357, $p < 0.01$) have a stronger influence on purchase intention than attitude (Coef. = 0.309, $p < 0.01$). Thus, these results indicated that anticipated emotions effectively explain the gap between attitude and intention. By comparing the groups based on real income, we then found an interesting phenomenon. Consumers with a higher income are more likely to be affected by NAE, while consumers with a lower income are more likely to be affected by PAE.

Higgins (1997) indicated that there are two kinds of self-regulation tendencies involved in achieving goals that correspond to different regulation goals. Specifically, promotion-focused consumers pursue the maximization of positive results and strive to approach the ideal self, while prevention-focused consumers pursue the minimization of negative results and prevent themselves from becoming the ought self. In this regard, we argue that the purchase of EVs is the development demand for low-income consumers, which means the expression of the ideal self. However, the purchase of EVs means responsibility for high-income consumers. The implication is that failing to purchase EVs will cause environmental pollution, which means the expression of the ought self. Therefore, in terms of EV purchase intention, low-income consumers tend to be promotion-focused, which makes such customers more sensitive to CEBs and causes them to generate more obvious PAE, while high-income consumers tend to be prevention-focused, which makes those customers more sensitive to CERs and causes them to generate more obvious NAE. The findings of Zhang et al. (2018) support this.

(5) According to the results of this study, for all samples (Models 1, 2, and 3), moral norms have a significant positive impact on NAE, and subjective norms have a significant positive impact on PAE, showing that consumers with higher moral norms tend to anticipate negative emotions from EV purchases, so they have a higher intention to purchase EVs. This is because when individuals perceive what they should do to improve the environment, they naturally feel guilty about or regret not purchasing EVs. Zhang et al. (2014) confirmed this, arguing that NAE is related to moral norms, that is, related to the interests or welfare of other people or the whole society. This is consistent with our finding that NAE is significantly positively correlated with moral norms. In addition, our results showed that subjective norms have a significant positive impact on PAE for all three models (for the whole group, Coef. = 0.279, $p < 0.01$; for the low-income group, Coef. = 0.278, $p < 0.01$; for the high-income group, Coef. = 0.286, $p < 0.01$), indicating that those consumers who regard EV purchase as a social norm tend to generate PAE from purchasing EVs, thus forming a stronger intention to purchase EVs. It is easy to understand that when consumers realize that purchasing EVs is in line with the surrounding reference groups or social pressures, they will naturally be more likely to generate PAE and tend to purchase EVs.

Conclusion and Implications

Based on the extended TPB model, we first examined the relative importance of the factors affecting EV purchase intention based on the total sample (Model 1), then divided the total sample into two subsamples, namely the low-income group (Model 2) and the high-income group (Model 3), based on monthly disposable household income, to test whether the factors have heterogeneous effects on EV purchase intention. For the total sample (Model 1), attitude, PAE, NAE, and PBC have significant effects on EV purchase intention, and the influence of subjective norms is not significant. However, the influence of various factors on EV purchase intention may vary across different demographic characteristics. For example, emotional factors have significantly heterogeneous impacts on green consumption decisions among different income groups (Yan & Wang, 2019). In this regard, we found that in the high-income group, purchase intention is primarily determined by NAE, while that of the low-income group depends more on PAE. In addition, we found that PBC has a significant positive effect on high-income consumers' purchase intentions, while PBC has no significant effect on that of low-income consumers. Another conclusion that is in line with our expectations is that social norms have a direct and significant impact on high-income

consumers' purchase intentions, while the direct impact on that of low-income consumers is not significant.

Based on the above conclusions, we propose the following policy implications:

(1) Enhance the positive emotional appeal of environmental publicity and bolster EV purchase intention among all consumers. In the total sample (Model 1), compared with NAE, PAE has a more positive effect on EV purchase intention, which means that marketing personnel should emphasize information messaging when formulating EV advertising strategy; that is, deliver more information about the PAE of purchasing EVs. After all, stimulating consumers' anticipated pride is one of the best strategies by which policymakers can promote consumers' green purchasing behavior through positive emotional appeal (Liang et al., 2018).

(2) Due to the heterogeneous influence of various factors on the EV purchase intentions of individuals at different income levels, enterprises should formulate targeted marketing strategies. For example, low-income consumers are more likely to be affected by PAE, which is activated by CEBs and subjective norms. Therefore, for low-income targets, enterprise marketing should focus on PAE and emphasize the environmental benefits of EVs as well as an environmentally-friendly social atmosphere. These strategies help to promote low-income consumers' EV purchase intentions. NAE rouses high-income consumers to purchase EVs, so advertising geared toward high-income targets should include the elements of negative emotional appeal. That is, enterprise marketing should emphasize consumers' guilt, such as self-guilt, guilt regarding others, and emotions linked to society, thus imperceptibly cultivating consumers' internal moral norms. On this basis, in view that CER and moral norms activate NAE, marketing personnel should emphasize the environmental pollution caused by driving fuel vehicles (that is, the CER caused by not purchasing EVs) and consumers' moral obligation to protect the environment. These strategies help trigger the anticipated guilt of not purchasing EVs, thus driving high-income consumers' stronger intention to purchase EVs.

(3) According to this study, for the total sample, PAE has the greatest impact on EV purchase intention, while subjective norms have no significant direct effect but do exert a significant positive impact on PAE, which means that subjective norms have a significant indirect impact on EV purchase intention through the mediating role of PAE. Therefore, the government can use a variety of media to guide green purchase behavior, increase the intensity of environmental education and publicity, and popularize relevant knowledge of EVs through the multi-platform and multi-directional use of media and Internet. The government can enhance all consumers' green consumption awareness through environmental education, thus creating a social atmosphere of green consumption. Moreover, the government can enhance consumers' environmental awareness and deepen their understanding of the economic applicability and environmental-friendly functions of EVs. In this green consumption atmosphere, consumers will feel that purchasing EVs is a green consumption mode, which promotes consumers' anticipated pride and happiness, thus promoting the adoption of EVs.

(4) According to this study, the impact of PBC on low-income consumers' purchase intentions is insignificant. We propose the following implications accordingly. Enterprises should implement targeted marketing strategies for low-income consumers and appropriately publicize the advantages EVs offer in terms of saving on operating costs, so as to improve low-income consumers' purchasing power. Enterprises can also improve low-income consumers' PBC by implementing knowledge marketing (Yang, 2019), publicizing the various functions and benefits of EVs through multiple resources and channels, and helping consumers master EVs' performance characteristics, so as to enhance consumers' confidence in driving EVs and improve their PBC. Enterprises should continue to develop and introduce new technologies to enhance the performance of EVs. Marketing personnel should pay attention to ensuring the safety of EV test driving, so that ordinary consumers have more experience with and cognition of adopting EVs. In addition, according to this study, considering the heterogenous influence of various factors on the purchase intentions of consumers at different income levels, enterprises should segment the market and develop comprehensive strategies for high, medium, and low-end products, which will help to improve the actual EV purchasing power of consumers of different income levels. Enterprises can implement the above marketing strategies to enhance the promotion of PBC with respect to low-income consumers' purchase intentions. The government can enhance consumers' PBC by introducing a series of incentive policies, such as parking concessions, bus lane right of way, lifting purchase and travel restrictions, improving the EV charging infrastructure, and so on.

This paper makes a theoretical contribution mainly by incorporating anticipated emotion and moral norms to broaden and deepen the TPB and provide new knowledge for the application of emotion in the field of

pro-environmental behavior and the literature on the adoption of EVs. Specifically, 1) this study incorporates anticipated emotions (PAE and NAE) into the TPB model as factors parallel to the basic TPB elements, thereby overcoming the limitation of the classical TPB model, which only considers the impact of personal rational cognition on behavior intention. This provides a new perspective for considering EV purchase intention from the comprehensive perspective of rational cognitive process and emotional process. 2) By incorporating moral norms into the TPB model as an antecedent of attitude, this study examines the transmission effect of moral norms on EV purchase intention through attitude, enriching the classical TPB model and expanding its applicability in the field of pro-environmental behavior.

Due to the availability of data, the research samples used in this study were mainly obtained from economically developed regions and cities such as Jiangsu, Zhejiang, Guangdong, Hunan, Shandong, Shanghai, and Beijing, which has some limitations. In addition, other demographic variables, such as gender, cultural backgrounds, and previous experience of owning an electric car are important factors, and we will examine the influence of these demographic variables on EV purchase intention in future research. Furthermore, multi-group structural equation modelling for other demographic variables is not included in our analysis and will be conducted in future research.

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Data Availability The data is deposited in Figshare (https://figshare.com/) (DOI: https://doi.org/10.6084/m9.figshare.14517057).

Declarations

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.
This is an observational study. The XYZ Research Ethics Committee has confirmed that no ethical approval is required.

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