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Towards Sustainable Mobility: Determinants of Intention to Purchase Used Electric Vehicles in China

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Abstract: A thriving electric vehicles (EVs) market serves as a pivotal embodiment of the global push towards sustainable mobility. As one of the leading global EV sellers, China owns a huge used EV market, which should be spotlighted. While most studies focus on the mechanism of new EV purchases, few put their insight into the trade of used EVs. To fill this gap, this paper aims to clarify the mechanism of consumption behaviour towards used EVs. First, we identified 11 variables that have a direct or indirect impact on consumers' purchase intention and constructed a conceptual framework. Then, we checked the structural relationships of the model through an empirical study (n = 431). The results showed that purchase intention was determined by two variables: perceived risk and attitude. We also observed an association between income and purchase intention. Functional risk had a direct and significant impact on perceived risk. Economic value, brand trust, and after-sales service were crucial predictors of attitude. Education could moderate the relationship between attitudes and purchase intention. Based on theoretical findings, we present the design strategies to enhance consumers' purchase willingness from car companies' and policymakers' viewpoints. In practical situations, this article offers valuable insights for stakeholders related to the used EV industry, providing a critical reference for advancing sustainable mobility.

Keywords: sustainable behaviour; green purchase; used electric vehicle; structural equation modelling; strategic design

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1. Introduction

Emissions from transport sectors constitute a significant source of greenhouse gases, leading to a series of environmental damage issues, such as climate change, global warming, and air pollution [1]. According to the International Energy Agency report, nearly a quarter of the global Carbon Dioxide comes from transport systems [2]. The carbon emission issue has received much attention from the heads of governments worldwide. In this context, electric vehicles (EVs), an alternative to conventional gasoline-powered vehicles, are developed and acknowledged as a pivotal solution to control carbon emission amounts across the globe, including China [3,4].

China's authorities have recently imposed incentives and preferential policies to boost the production and adoption of EVs for the following reasons. On the one hand, the transition to EVs is a major part of the Chinese government's plan to achieve 2030's "carbon peak" and 2060's "carbon neutral" goals [5]. On the other hand, EVs are acknowledged as one of the pillar industries in China, and the development of EVs can contribute to industrial upgrading and economic growth. Besides, China is a large oil-importing country, and developing the EV industry can mitigate the dependence on oil. Until now, China has

gained a dominant position in the global electric vehicle market, and China's EV market is projected to reach a staggering revenue of US$319.0 bn [6].

In addition to the new EV market, China's used EV market is also rapidly growing. From 2019 to 2020, the sales of used EVs in China experienced a growth exceeding 84%, compared to an increase of 104.5% for their new counterparts [7]. At present, China has the world's fastest-growing EV market. Similar to the first-owned EV market, China's used EV market has also seen a rapid increment in recent years. According to a report launched by the China Automobile Dealers Association (CADA), the proportion of used EVs rose from 3.8% to 5.9% in the used vehicle market in 2023 [8]. This statement was also verified by a statistical report from Guazi, a well-known used vehicle trading platform in China, indicating used EV transactions are gradually becoming mainstream in China's market [9]. Although the used EV market in China is still in its infancy, it is necessary to pay attention to it and make it more attractive to customers. From the view of consumers, used EVs can offer more affordable opportunities for people to buy. Generally speaking, used EVs depreciate faster than their combustion-engine cousins due to the rapid update of technology. The report showed that more than 48% of all pre-owned electric vehicles in the United States have a selling price below $25,000, while nearly 30% were priced under $20,000 in 2021 [10]. From the EV industry's perspective, the consumption of used EVs is closely associated with the vitality of the whole market. Taking the European EV market as an example, most new EVs are sold through leases there. Every year, a vast number of EVs will end their leasing contracts and enter the used EV market [11]. In this case, if consumers are unwilling to buy used EVs, it will undermine enterprises' plans for new EVs [11].

China has a large volume and growing popularity of the EV market, as well as a promising future for the industry. However, there are still some problems. On the one hand, recent reports revealed that pre-owned EVs were not welcomed as new EVs in the global market, including in China [11]. This unfavourable purchase intention can be attributed to several reasons, such as lack of subsidies, expectations for technological improvements, and the lagging progress in charging facilities [11]. If a vast volume of EVs enter the used market and cannot be consumed, it will adversely affect the whole industry. On the other hand, some literature gaps need to be filled in academic fields. In the consumer behaviour field, previous studies have explored the purchase intention of EVs from various aspects [2,12–14]. However, few of them concentrate on second-hand EVs. There may be a significant distinction between individuals' consumption willingness of new EVs and used EVs. On the other hand, studies on the consumption behaviour of used products are mostly related to clothes or luxury goods [15–18]. Few researchers have shifted their focus to second-hand EVs.

While China has become the world's leading EV seller, EV enterprises face fierce competition in domestic and overseas markets. In such a context, it is necessary to grasp consumers' preferences for used EVs and gain an advantageous position in the market. This paper attempts to clarify consumers' purchase intention of used EVs in China and construct a model to reveal the mechanism. Our study contains two key steps. First, key factors affecting people's purchase intention of used EVs were identified through an overview of the existing literature. After that, we proposed a theoretical model and a series of hypotheses. Second, we used a structural equation modelling approach to test the proposed hypotheses and validate the effectiveness of the framework. Finally, we developed strategies to facilitate customers' willingness to purchase EVs from policymakers' and car sellers' views.

2. Literature Review and Hypothesis Development

2.1. Related Studies

As this article strives to identify key determinants of people's purchase intention on used EVs in China, we present an overview of related research to this topic, which falls into two aspects: consumer purchase behaviour of EVs and consumer purchase behaviour of second-hand products. On the one hand, researchers attempt to reveal

the mechanism of consumption for EVs from various perspectives. Some applied well-known theories to construct the research model. For instance, Vafaei-Zadeh et al. (2022) combined the TPB and Technology Acceptance Model (TAM) to explain Generation Y's purchase willingness for EVs in Malaysia [2]. Le et al. (2023) introduced the Unified Theory of Acceptance and Use of Technology (UTAUT) model to show its moderating effects [12]. Upadhyay and Kamble (2023) applied the stimulus-organism-response (SOR) model to explore the effect of pro-environment attitudes and values on people's behaviour intention [15]. Shanmugavel and Balakrishnan (2023) added pro-environmental variables to refine the traditional TPB model to understand customers' behaviour intentions [16]. Some build the research model from a unique perspective. For instance, He et al. (2018) argued that customers' purchase intentions could be explained by positive unity and negative unity [17]. Zamil et al.'s (2023) study indicated that utilitarian and hedonic factors could influence people's consumption of EVs [13]. Some used a literature review approach to conclude core themes from prior studies. For example, Durmus and Senyapar et al. (2023) conducted a bibliometric analysis to explore users who adopted the behaviour of EVs in Turkey [18]. Ivanova & Moreira (2023) used a systematic approach and found that the antecedents of purchase behaviour could be categorised into three facets: user features, EV features, and related policies [19].

On the other hand, consumers' intention to buy second-hand products has also received attention in academic fields. Habib and Sarwar (2021) examined the effect of brand-related factors and after-sale services on behaviour intentions [20]. Lou et al. (2022) employed a multiple regression approach to comprehend people's consumption of pre-owned luxury goods in the US, and they found that perceived value-related factors could affect behaviour intentions [21]. Kawulur et al. (2022) found that low cost, appearance preferences, nostalgia, and trust were predictors of Generation Z's intentions to purchase used products [22]. Koay et al. (2023) study suggested that financial, aesthetic, and social risks could affect the public's willingness to buy second-hand clothes [23]. Tymoshchuk et al. (2024) found that hedonic, utilitarian, and environmental values were predictors of purchase intentions for second-hand apparel [24]. Overall, it can be derived that most prior literature has focused on customers' intentions to purchase new EVs or other second-hand products (e.g., clothes or luxury goods), but few target second-hand EVs.

2.2. Theoretical Basis

Since few studies focus on the intention to buy used EVs, we referred to prior consumer behavior research related to other used products and new EVs. Integrating the findings from these studies, we chose to describe consumers' behaviour intentions from two popular marketing theories: perceived risk theory and consumption value theory [14,24–26]. In effect, the trade-off between risk and value is a popular perspective for marketing researchers to build models [14]. Perceived risk theory emphasises one's assessment of potential negative consequences and uncertainty during consumption [27,28]. There are several dimensions of perceived risk in consumer behaviour implementation. Kim et al. (2021) introduced financial risk, functional risk, aesthetic risk and sanitary risk to examine circular fashion consumption [25]. Hu et al. (2023) argued that physical safety risk, performance risk and financial risk might affect EV purchase intentions [14]. Tymoshchuk et al. (2024) identified three dimensions of risks (functional, aesthetic, sanitary) that might occur when buying used apparel [24]. In this study, financial risk and functional risk were derived from the conceptual model. The former reflects people's concern about money loss when buying used EVs, as EVs may deprecate fast when entering the second-hand market. The latter represents people's worry about whether used EVs can work as well as expected [24].

On the other hand, consumption value theory describes individuals' fundamental desires or benefits they want to gain when buying a product [29,30]. Seeking value is often the basic objective that motivates one's consumption behaviour. In prior marketing studies, scholars have examined the impact of perceived value from various aspects. For instance, Gallarza et al. (2011) believed that recycled fashion products had four types of perceived

value: social, emotional, functional, and economic value [31]. Kim et al.'s (2021) study suggested that emotional value, social value, epistemic value, and environmental were predictors of purchase attitude [25]. Tymoshchuk et al. (2024) divided consumption value into hedonic value, utilitarian value, and environmental value [24]. Hu et al. (2023) found that people's psychological, environmental, and financial benefits could contribute to perceived value during EV consumption [14]. In the context of this study, we selected economic value and environmental value. Generally, saving money is a key driver for consumers to buy second-hand products, so economic value can not be ignored for expensive products like EVs [21]. Moreover, environmental/green value has been widely acknowledged as a potential determinant of green product purchase behaviour in prior literature [26]. Hence, it should be included in our model. Moreover, we also consider after-sales service as an additional variable since many used EV consumers are concerned about whether they can enjoy appropriate services similar to new EV consumers. After-sales service plays a critical role in consumers' decision-making process and is also a key front of return for the automotive industry [20]. Considering the two additional factors (after-sales service and brand trust), we employed a TPB variable "attitude" to replace "perceived value" and describe people's positive assessment of used EV consumption.

2.3. Hypotheses Development

A close look into consumers' perceptions and needs is imperative to enhance their purchase willingness. Hence, A conceptual model was constructed based on a general overview of previous literature, see Figure 1. The model describes consumers' behaviour intention from two aspects: one is the possibility of risk people may take when they choose to buy a used EV, and the other is how people's attitudes towards buying EVs are influenced. For the former facet, the model analysed the potential functional and financial risk. For the latter facet, the researcher postulated that people's attitudes might be affected by economic values, environmental values, brand trust, and after-sale services.

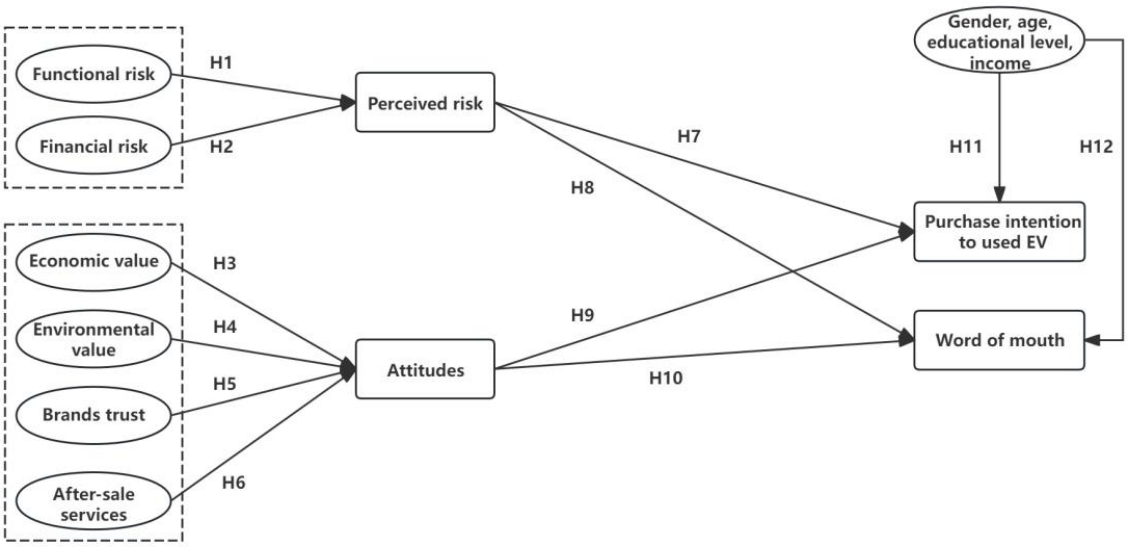

Figure 1. Conceptual model.

2.3.1. Functional Risk (FUR)

Functional risk, also called performance risk, refers to people's concern about whether a product can perform as well as expected [23]. Generally, consumers may worry that second-hand products do not work as well as new products [24]. In prior studies, researchers have investigated people's perceived functional risk towards used apparel and circular fashion products [24,25]. In the current study, we argued that customers tend to have a high-risk perception towards the performance of used EVs. The evaluation of a second-hand car's function is a widespread challenge. For a second-hand EV, consumers

must consider and evaluate many issues before purchasing, such as battery conditions, powertrain systems, onboard electronics, in-vehicle systems, etc. Moreover, used EVs often do not have a guarantee and warranty, meaning buyers must take risks when the machine does not function well. Lastly, there are no uniform standards for the assessment of used EVs, and this causes many people to lack confidence regarding the performance of used EVs. In this case, the possibility of functional risk will raise customers' risk awareness during consumption. Therefore, we proposed the hypothesis:

H1: *FUR positively influences PR.*

2.3.2. Financial Risk (FIR)

Financial risk (FIR), or economic risk, refers to the uncertainty or possibility related to the consequence of buying a product that may lead to investment loss or additional cost (when the product needs a repair or replacement) [32]. Many people argue that used EVs have a high probability of value reduction, which is the leading cause of their perceived FIR. Value reduction is a widespread problem for used EVs. Accessories and in-vehicle systems of EVs are often updated rapidly, meaning new EVs are much more advanced than their older counterparts. In this case, the rapid updating pace leads to a value reduction of used EVs [10]. The role of FIR has been mentioned in prior consumer behaviour research [23,25]. For example, Pires et al. (2004) argued that FIR was one of the top risks for online purchase behaviour [33]. Bashir (2018) highlighted that perceived FIR was a critical determinant of consumers' online trust in retailers and buying intention [34]. Jun (2020) stated that FIR might predict people's intention to stay at Airbnb places [35]. In the context of this research, when people feel that they may experience money loss or external costs for second-hand EVs, they will raise high-risk awareness. Thus, the following hypothesis was proposed:

H2: *FIR positively influences PR.*

2.3.3. Economic Value (ECV)

Economic value (ECV) refers to the perceived financial benefits people can gain during consumption [21]. This variable was derived from the perceived value Theory [26]. Sweeney and Soutar (2001) described it as the utility people gain from a product based on the reduction of its long-term and near-term costs. ECV was acknowledged as a vital predictor of pre-owned product consumption behaviour [36]. ECV is one main factor determining people's purchase intention, as they can generally enjoy low prices and costs during consumption [21]. This principle fits many second-hand products, including second-hand EVs. At present, EVs have become a popular private transportation tool and a substitution for gasoline vehicles in China. However, with the reduction of governmental subsidies, consumers have to pay a high price if they intend to buy an EV [7]. In this case, used EVs provide more affordable opportunities for those who want to buy an EV, as a new EV often depreciates at rapid speed when becoming pre-owned [10]. Previous literature has indicated that ECV could positively affect attitude and purchase intention [37,38]. In this paper, we deduced that if consumers expect to gain financial benefits from the consumption of used EVs, their attitudes will be positive. Hence, the following hypothesis was raised:

H3: *ECV positively influences ATT.*

2.3.4. Environmental Value (ENV)

Environmental value (ENV), also called green value, is people's perception of how a product can contribute to the environment [39]. Lin and Dong (2023) argued that ENV reflected consumers' assessment of whether a product was environmentally friendly [26]. Tymoshchuk et al. (2024) believed that people with a high level of ENV would pay close attention to environment-related issues and prioritise environmental conservation when making decisions [24,40]. In this study, we argued that buying second-hand EVs was

associated with two facets of ENV: One is embodied in EV products, and the other is embodied in second-hand products. First, compared with gasoline vehicles, EVs are green products, and their tangible benefits range from emission reduction and pollution contain to energy savings [15,41]. Second, using second-hand products can help prevent the initial consumption of natural resources and promote a circular economy [25]. In this case, buying second-hand items will prevent the throw-away consumption culture and benefit the environment [21,42]. In this article, when people believe that using pre-owned EVs is beneficial to the environment, they will hold a positive purchase attitude. Thus, the hypothesis was forwarded:

H4: *ENV positively influences ATT.*

2.3.5. Brand Trust (BT)

The variable "brand trust (BT)" has gained different definitions in previous brand studies [43]. For instance, Garbarino and Johnson (1999) argued that BT could be reflected in customers' confidence and trustworthiness towards service or product quality [44]. Delgado-Ballester et al. (2003) stated that BT emerged as a state when consumers believe a brand is reliable and secure, which describes the level of loyalty people have towards the brand [45]. In the current study, BT describes customers' trustworthiness towards used EV brands and trading platforms. Trust crisis is a common and critical issue that an EV must consider, and this problem results from three causes. First, many EV brands are young and have emerged no more than ten years ago. In this case, it is hard for car enterprises to build a complete brand image and brand identity. Second, China's enterprises are currently facing a fiercely competitive market, and many EV brands cannot live for a long time. Hence, customers may worry about whether they can enjoy the after-sale services and guarantees when purchasing a used EV. Third, the current market lacks unified standards or legislation to regulate related services and transactions of second-hand EVs, which causes customers to doubt the reliability of EV trading platforms. Previous studies have clarified the association between BT and consumers' purchase intention [43,46–48]. In this study, we assumed that consumers refuse to buy a used EV if they do not trust an EV brand. Therefore, we came up with the hypothesis:

H5: *BT positively influences ATT.*

2.3.6. After-Sale Services (ASS)

After-sales services (ASS) refer to the services provided after purchase to support consumers' usage of a product during its entire life cycle. Rigopoulou et al. (2008) argued that after-sales services embraced all process support in the transaction [49]. Shokouhyar et al. (2020) pointed out it included a cross-functional process carried out by various actors [50]. In fiercely competitive markets, after-sales services are acknowledged as a core strategy to capture and satisfy customers [51]. The logic behind the trend is that enterprises pay more attention to existing customers than attracting new ones [50]. ASS is a primary focus of second-hand EV buyers, as it involves several critical issues that affect customer satisfaction. The most common one is that used EV owners cannot enjoy the same welfare and services as new EVs, such as "Free battery replacement for life", "Free car warranty for life", "Free in-vehicle data", and so on. This means that second-hand EV owners must pay more charges and spend more time on maintenance. Prior literature has discussed different dimensions of ASS. For instance, Nasir et al. (2021) divided it into maintenance and skilled staff, spare parts availability, service delivery and service lead-time, communicative service and complaint handling [52]. Habib and Sarwar (2021) believed that it should contain spare parts and maintainers availability, warranties, pricing policy, technical coverage and so on [20]. In this study, we divided this variable into four dimensions: Spare parts availability, guarantees and warranties, technique support, and complaint handling. ASS is a user-oriented process for ensuring user satisfaction [50].

Actually, prior studies have highlighted the impact of ASS on user satisfaction in different situations [52,53]. Based on the above discussion, we proposed the hypothesis:

H6: *ASS positively influence ATT.*

2.3.7. Perceived Risk (PR)

The term "perceived risk (PR)" describes the negative feelings experienced by consumers when making a purchase [27]. The negative feelings mainly include anxiety, disappointment, and dissatisfaction, which are caused by the potential adverse consequences when using consumer goods or the possibility of price loss [21,54]. Consumers may have a doubtful attitude towards used EVs in China. One reason is that used EV transactions are still not mainstream in the Chinese car market, and the trading volume of used EVs is much lower than their gasoline counterparts, as well as new EVs. Furthermore, there is a lack of supervision and unified prices and regulations during EV transactions, which will also raise consumers' concerns and arouse negative emotions. In this study, we assumed that people will perceive the potential risks from terrible aftersales services, price reduction, and lack of government support and charging facilities when making a purchase decision. In prior consumer behaviour studies, PR was a popular prerequisite for reduced purchase willingness, and it has been defined in different scenarios [55]. Jacoby and Kaplan (1972) stated that people might suffer six types of risk during purchase: performance, physical, financial, self-image, social, and psychological [27]. In the context of second-hand products, Lou et al. (2022) pointed out that consumers might be unwilling to buy used luxury goods due to a fear of inauthenticity and sanitary issues [21]. Kim et al.'s (2021) research indicated that PRs were negative predictors of intention to purchase pre-owned apparel [25]. This finding was also validated in research by Koay et al. (2022) and Featherman et al. (2021) [23,27]. On the other hand, people's negative experiences and evaluations of second-hand goods can also be shared with their surrounding groups, and this will impede others from buying these goods [24]. Hence, we proposed the following hypothesis:

H7: *PR negatively influences purchase intention (PI).*

H8: *PR negatively influences WOM.*

2.3.8. Attitude (ATT)

The term "attitude (ATT)", derived from the TPB model, is usually used to describe one's subjective assessment or expectations of a specific behaviour. ATT is defined as people's favour or disfavour towards an object or phenomenon, which determines the basic direction of their consumption behaviour [25]. This factor is popular when representing people's perceived value or benefit during consumption. For instance, Zamil et al. (2023) argued that ATT contained cognitive and affective dimensions, which could be influenced by a series of perceived values [13]. The link between ATT and consumption behaviour has been verified in numerous studies. For example, Vafaei-Zadeh et al. (2022) found that a positive ATT could enhance people's purchase intention for EVs in Malaysia [2]. Kim et al.'s (2021) study indicated that consumers' product ATT is a critical trigger for their intention to purchase circular clothes [25]. Lin and Dong's (2023) research also revealed the role of ATT in affecting people's purchase intention for sustainable home appliances [26]. In the current study, attitudes represent the degree to which the consumer has a favourable or unfavourable appraisal when buying a second-hand EV. When people believe buying second-hand EVs will result in positive outcomes, their buying intent will be high, and they will be more likely to recommend the product or service to others [25,37,56,57]. Thereby, we hypothesised that:

H9: *ATT towards used EVs positively influence PI.*

H10: *ATT towards used EVs positively influence WOM.*

2.3.9. Word of Mouth (WOM)

The concept of "word of mouth (WOM)" was developed in the 1960s and has become a popular marketing terminology today. Several marketing researchers have given its definition. One of the earliest definitions is from Katz and Lazarsfeld (1966), who argued it denoted the exchanging of marketing information among customers and played a significant role in shaping their purchase intentions during consumption [56]. Another researcher, Johan Arndt, defined it as "The direct verbal communication between a receiver and a transmitter regarding brands, products or services" in 1967 [58]. In other words, WOM refers to an individual's recommendations of a product to their surrounding groups. Word of mouth contains oral and informal people-to-people communication [59]. Nowadays, the rapid development of Internet technology has enabled people to receive information sources through a wide range of ways, such as websites and mobile phone applications, rather than simple person-to-person [56]. In this case, WOM is more influential in affecting people's decision-making process. In prior customer studies, word of mouth has been proven to be an influential variable in measuring purchase behaviour [24,60,61]. In this study, we forwarded WOM as an outcome variable in the proposed framework.

2.3.10. Demographic Variable

In addition, we added four demographic variables as potential triggers of purchase intention to used EVs. The impact of demographic variables on purchase intention has been validated in previous consumer behaviour studies. Some highlighted their moderating effects. For instance, Makanyeza et al. (2021) found that education levels served as a moderator between consumer rights awareness and purchase intention in the hotel industry [62]. Chakraborty et al.'s (2022) study indicated that income and education could play a moderating role [63]. Some argued that demographic variables had a direct impact. For example, Meet et al.'s (2024) study revealed that gender, education, and income were positive predictors of Gen Z's green purchase intention [64]. Le et al.'s (2023) research unveiled that informants with different incomes and ages showed distinct purchase orientations to EVs [12]. Sun et al. (2021) found that consumers' prior knowledge level could arouse their positive WOM of a brand [65]. Tymoshchuk et al.'s (2024) study suggested that gender, education, and income were significant determinants of WOM for used apparel. Besides, some arguments indirectly suggest the role of demographic characteristics on EV adoption or purchase. Ju and Kim (2022) pointed out that millennials exhibit a tendency to harbour disapproval of EVs and even resist the adoption of EVs [66]. Moreover, Male consumers who possess a high level of education are more likely to purchase EVs [12]. Based on the above elaboration, we assumed that age, gender, income and education could serve as control variables for PI and WOM in the context of used EVs. Besides, some demographic variables, such as age and education, may play a moderating role in the relationship between PI and WOM and their prerequisites [24,67,68]. Hence, we hypothesised that:

H11a: *Gender positively influences PI and WOM.*

H11b: *Age positively influences PI and WOM.*

H11c: *Education level positively influences PI and WOM.*

H11d: *Income level positively influences PI and WOM.*

H12a: *Age plays a moderating role in the relationship between PI and WOM and their prerequisites.*

H12b: *Education plays a moderating role in the relationship between PI and WOM and their prerequisites.*

3. Methodology

3.1. Measurement Development

The conceptual model contained ten latent variables. Each latent variable was measured by three to four observed variables. We used a five-scale Likert Table to measure these observed variables (where "1" denotes strongly disagree and "5" denotes strongly agree). All questions were derived and adapted from prior literature, see Table 1. The items of FUR were developed by Tymoshchuk et al. (2024), and the FIR scale was adapted from Jun (2020) and Kim et al. (2021) [24,25,35]. The items of ECV and BT were based on Lou et al. (2022) and Dam (2020), respectively [21,43]. We employed the questions from Lou et al. (2022) and Tymoshchuk et al. (2024) to measure the variable ENV [21,24]. In the case of ASS, four items were concluded by Habib & Sarwar (2021), Thalji (2022), and Adusei and Tweneboah-Koduah (2019) [20,69,70]. Four items developed by Esmaeilzadeh (2020) were used to measure PR, while the ATT scale was developed by Joshi et al. (2021) and Kim et al. (2021) [25,37,71]. The scale of WOM was taken from Tymoshchuk et al. (2024) and Birkmeyer et al. (2021) [24,56]. For PI, the items from Lou et al. (2022) research were adopted [21].

Table 1. Variables and measurement items.

Construct	Measurement Item	Reference
FUR	FUR1: I am concerned that used EVs are not durable. FUR2: I am concerned that used EVs cannot be employed for a long time. FUR3: I am concerned that used EVs are more likely to be broken than general EVs.	[24]
FIR	FIR1: I am worried that used EVs would depreciate faster than I expected. FIR2: I am worried that used EVs are overpriced, considering the quality. FIR3: I am worried that buying used EVs would cause money losses. FIR4: There is a price bubble in used EVs.	[25,35]
ECV	ECV1: I can afford more other items since I pay less for used EVs. ECV2: I can purchase more other items with the same money if I purchase used EVs. ECV3: I believe that I pay a fair price when buying used EVs.	[21]
ENV	EV1: Buying used EVs helps save energy. EV2: Using used EVs has a positive impact on the environment. EV3: Used EVs have more environmental benefit than new EVs. EV4: Buying used EVs can help fight against waste culture.	[21,24]
BT	BT1: I trust the used EV brand. BT2: I deem that I can trust the used EV trade platform completely. BT3: The used EV brand is reliable. BT4: The used EV trade platform is reliable.	[43]
ASS	ASS1: The spare parts of used EVs are available if they need to be replaced. ASS2: I can enjoy guarantee and warranty services if buying a used EV. ASS3: I can enjoy reliable and immediate technical support services if buying a used EV. ASS4: My complaint will receive immediate handling and a solution if buying a used EV.	[20,69,70]
PR	PR 1: The risk of purchasing a second-hand EV is high. PR 2: The likelihood of unexpected problems with purchasing a second-hand EV is high. PR 3: The degree of uncertainty related to purchasing a second-hand EV is high. PR 4: Overall, the possibility of adverse consequences associated with purchasing a second-hand EV is high.	[71]
ATT	ATT1: Buying used EVs is a wise idea. ATT2: I have a positive emotion about buying used EVs. ATT3: I am interested in buying used EVs. ATT4: All in all, I believe it is worthwhile to buy used EVs.	[25,37]

Table 1. *Cont.*

Construct	Measurement Item	Reference
WOM	WOU1: I would like to introduce used EVs to my surrounding groups. WOU2: I am willing to recommend used EVs to my surrounding groups. WOU3: I would like to share the experience of using used EVs with others. WOU4: If a person asks me for suggestions on used EVs, I would provide high recommendations.	[24,56]
PI	PI1: I intend to purchase used EVs in the future. PI2: I am probably going to buy a used EV. PI3: I am willing to buy a used EV.	[21]

3.2. Questionnaire Design

A questionnaire survey was conducted for data collection purposes. The questionnaire was structured into three distinct sections, each serving a specific objective. The first section commenced with a concise introduction outlining the research's primary aim and an attempt to foster a fundamental comprehension of the study's backdrop among participants. Moreover, this section has another sentence, "The confidentiality, anonymity, and voluntariness of participation in the study were ensured for all respondents", which aims to foster trust and encourage open and honest responses [72]. The subsequent section was devised to gather demographic information from the respondents, including their gender, age, monthly income, and educational levels. This section was followed by a question probing participants' perceptions regarding the potential of the used electric vehicle (EV) market in China. The third and final section aimed to measure all identified variables based on a series of items mentioned above.

3.3. Sampling and Data Collection

This study focused on potential EV consumers in China. For this purpose, we made several criteria to find appropriate respondents. The criteria contain four parts: First, participants should have EV driving experiences or be familiar with EVs. Second, participants should be young or middle-aged groups with a certain consumption power. Third, they are willing to contribute their real thoughts to this study. Fourth, they should be Chinese since our study targeted China's EV market. In addition, informants with related knowledge of consumer behaviour, marketing, or EV technology are more welcome to participate in this survey. Since this study requires a large sample size and the informants should be familiar with EVs, we employed a convenience sampling method to recruit participants who meet our criteria. First, we searched the interest groups related to EV driving or EV purchase on hot social network applications in China (e.g., Xiaohongshu, Sina Weibo) and found appropriate participants in these groups. Second, we used online survey platforms that provide recruitment services, which can help us find respondents who meet the criteria quickly and accurately.

Once the questionnaire was developed, we carried out a pilot study (n = 40) prior to the formal survey. The objective of the pilot study was to identify and rectify unclear and ambiguous expressions in the questionnaire. Based on the received feedback, the researchers modified the questionnaire to ensure it conveyed the information in the most comprehensible and concise manner. The revised questionnaires were created via an online platform called "Wenjuanxing", one of China's most popular questionnaire design tools. Finally, we distributed the online questionnaire through its link to participants in this survey.

4. Results

Finally, our survey yielded 431 legitimate replies for further analysis. The data analysis process includes three sections. First, we conducted a descriptive analysis to demonstrate participants' demographic information. Second, we analysed the measurement model

using several indexes. Third and lastly, we conducted a path analysis to test the structural relationships in the proposed model.

4.1. Sample Characteristics

Table 2 demonstrates the demographic data of informants. The collected data contains 53.6% males and 46.4 females. Regarding age, none was below 20, 25.3% were between 20 and 29, 24.6% were between 30 and 39, 36.0% were between 40 and 49, and 14.2% were above 50. Their educational level was divided into five groups: under junior high school (16.5%), high school (34.3%), diploma (38.7%), bachelor's degree (10.2%), master's degree and above (0.2%). In terms of monthly income after-tax, the five intervals below 423 USD, 423–846 USD, 846–1270 USD, 1270–1763 USD, and above 1763 USD accounted for 20.2%, 29.9%, 20.0%, 22.0%, and 7.9%, respectively. Besides, nearly half of the respondents argued that China's used EV market had a huge potential.

Table 2. Respondents' demographic information.

Attribute	Value	Frequency	Percent
Gender	Male	231	53.6
	Female	200	46.4
Age	Below 20	0	0
	20–29	109	25.3
	30–39	106	24.6
	40–49	155	36.0
	Above 50	61	14.2
Educational level	Under junior high school	71	16.5
	High school	148	34.3
	Diploma	167	38.7
	Bachelor's degree	44	10.2
	Master's degree and above	1	0.2
Monthly income after tax (USD)	Below 423	87	20.2
	423–846	129	29.9
	846–1270	86	20.0
	1270–1693	95	22.0
	Above 1693	34	7.9
The market potential of used EVs in China	Very small	42	9.7
	Small	74	17.2
	Moderate	118	27.4
	Huge	111	25.8
	Very huge	86	20.0

4.2. Measurement Model

The measurement model was tested using the following indicators: internal reliability, composite reliability, convergent validity, and discriminant validity, which were demonstrated in Tables 3 and 4. In terms of internal reliability, Tavakol & Dennick's (2011) study suggested that Cronbach's Alpha value of latent variables should be over 0.7 [73]. In this case, all variables in the proposed model were assumed to have excellent internal consistency. Moreover, the measurement model exhibited satisfactory levels of composite reliability, as the corresponding indicators of CR exceeded 0.7. On the other hand, the convergent validity of the model was reflected on two critical indicators: average variance extracted (AVE) and standardised factor loadings, which are recommended to be over 0.5 and 0.7, respectively [74]. Hence, the two indicators of our model could meet the criteria. Lastly, the model's discriminant validity was often measured by the comparison between the square root of constructs' AVE and the equivalent correlation (numbers in the diagonal). Based on this, the measurement model shows good discriminant validity [75].

Table 3. Reliability and validity.

Construct	Cronbach's Alpha	Variable	Standardised Factor Loading	AVE	Composite Reliability
FUR	0.794	FUR1 FUR2 FUR3	0.671 0.767 0.840	0.581	0.805
FIR	0.866	FIR1 FIR2 FIR3 FIR4	0.724 0.829 0.790 0.813	0.624	0.869
ECV	0.803	ECV1 ECV2 ECV3	0.732 0.733 0.830	0.587	0.810
ENV	0.882	ENV1 ENV2 ENV3 ENV4	0.766 0.824 0.802 0.844	0.655	0.884
BT	0.862	BT1 BT2 BT3 BT4	0.759 0.823 0.749 0.807	0.616	0.865
PR	0.912	PR1 PR2 PR3 PR4	0.836 0.881 0.840 0.839	0.720	0.912
ASS	0.852	ASS1 ASS2 ASS3 ASS4	0.734 0.806 0.734 0.815	0.598	0.856
ATT	0.866	ATT1 ATT2 ATT3 ATT4	0.779 0.787 0.761 0.828	0.623	0.868
WOM	0.866	WOM1 WOM2 WOM3 WOM4	0.734 0.836 0.747 0.841	0.626	0.870
PI	0.831	PI1 PI2 PI3	0.777 0.776 0.823	0.628	0.835

Note: Square roots of AVE are on diagonal. AVE = averaged variance extracted.

Table 4. Discriminant validity.

Construct	AVE	FUR	FIR	ECV	ENV	BT	PR	ASS	ATT	WOU	PI
FUR	0.581	(0.762)									
FIR	0.624	0.580 ***	(0.790)								
ECV	0.587	0.475 ***	0.477 ***	(0.766)							
ENV	0.655	0.497 ***	0.456 ***	0.469 ***	(0.809)						
BT	0.616	0.508 ***	0.490 ***	0.469 ***	0.516 ***	(0.785)					
PR	0.720	0.195 ***	0.122 *	0.238 ***	0.136 *	0.185 ***	(0.849)				
ASS	0.598	0.528 ***	0.548 ***	0.440 ***	0.416 ***	0.435 ***	0.140 **	(0.773)			
ATT	0.623	0.522 ***	0.572 ***	0.619 ***	0.483 ***	0.585 ***	0.210 ***	0.566 ***	(0.789)		
WOM	0.626	0.582 ***	0.542 ***	0.510 ***	0.431 ***	0.527 ***	0.137 *	0.504 ***	0.506 ***	(0.791)	
PI	0.628	0.495 ***	0.519 ***	0.403 ***	0.501 ***	0.463 ***	−0.025	0.479 ***	0.533 ***	0.466 ***	(0.792)

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; the square root of AVE is on diagonal; AVE = averaged variance extracted.

We also presented the indicators related to the model's goodness-of-fit. The CFA results suggested a good fit for both measurement model (chi-square/df = 1.862, normed-fit Tucker–Lewis Index (TLI) = 0.938, and comparative-fit index (CFI) = 0.946, the root mean square residual (SRMR) = 0.040, the root mean square error of approximation (RMSEA) = 0.045) and structural model (chi-square/df = 1.894, TLI = 0.921, and CFI = 0.928, SRMR = 0.067, RMSEA = 0.046).

4.3. Structural Model

Table 5 and Figure 2 show the hypothesis testing results. It can be found that eight out of fourteen hypotheses were supported. First, FUR had a direct impact on PR ($\beta = 0.199$, $p < 0.01$), but FIR ($\beta = 0.014$, $p > 0.05$) showed no significant effect. Thus, H1 was supported, and H2 was rejected. Moreover, ATT was significantly influenced by three variables: ECV ($\beta = 0.349$, $p < 0.01$), BT ($\beta = 0.289$, $p < 0.01$), and ASS ($\beta = 0.295$, $p < 0.01$), except ENV ($\beta = 0.092$, $p > 0.05$), meaning that H3, H5 and H6 were supported while H4 was rejected. PI was significantly affected by PR ($\beta = -0.136$, $p < 0.01$) and ATT ($\beta = 0.596$, $p < 0.001$), supporting H7 and H9. Meanwhile, WOM was positively influenced by ATT ($\beta = 0.569$, $p < 0.001$) rather than PR ($\beta = -0.028$, $p > 0.05$), so H8 was rejected, and H10 was supported. Regarding demographic variables, only income showed a significant impact on PI ($\beta = -0.158$, $p < 0.01$), so H11 was partially supported, and H12 was rejected.

Table 5. Path analysis results.

Hypothesis	Path Direction	Standardised Coefficient	T Statistics	*p* Value	Result
H1	FUR → PR	0.199	2.790	0.005	Supported
H2	FIR → PR	0.014	0.201	0.840	Not Supported
H3	ECV → ATT	0.349	6.789	0.000	Supported
H4	ENV → ATT	0.092	1.819	0.069	Not Supported
H5	BT → ATT	0.289	5.669	0.000	Supported
H6	ASS → ATT	0.295	6.179	0.000	Supported
H7	PR → PI	−0.136	−2.877	0.004	Supported
H8	PR → WOM	0.028	0.596	0.522	Not Supported
H9	ATT → PI	0.596	14.489	0.000	Supported
H10	ATT → WOM	0.569	13.681	0.000	Supported
H11a	Gender → PI	−0.008	−0.184	0.854	Not Supported
H11b	AGE → PI	0.007	0.145	0.885	Not Supported
H11c	EDUCATION → PI	0.066	1.495	0.135	Not Supported
H11d	INCOME → PI	−0.158	−3.501	0.000	Supported
H12a	Gender → WOM	0.030	0.676	0.499	Not Supported
H12b	AGE → WOM	−0.018	−0.408	0.683	Not Supported
H12c	EDUCATION → WOM	0.034	0.679	0.497	Not Supported
H12d	INCOME → WOM	−0.034	−0.762	0.446	Not Supported

4.4. Moderating Effects

Based on previous findings, we conducted a multiple-group analysis to check the moderating effect of age and education on the relationship between PR, ATT, PI, and WOM [12,66]. We incorporated five age groups into two groups: below 40 (young) and over 40 (old). Meanwhile, "under Junior high school" and "high school" were incorporated into low education level while "diploma", "bachelor degree", and "master or above" were merged into high education level. The results yielded from the multigroup analysis are demonstrated in Table 6 (young age group vs. old age group) and Table 7 (low education level vs. high education level). It can be found that the moderating role of education only existed in the relationship between ATT and PI, which means that customers with higher knowledge levels will be more likely to convert their positive attitudes into buying decisions. Besides, we observed that there are no differences between young age groups and old age groups in such path relationships.

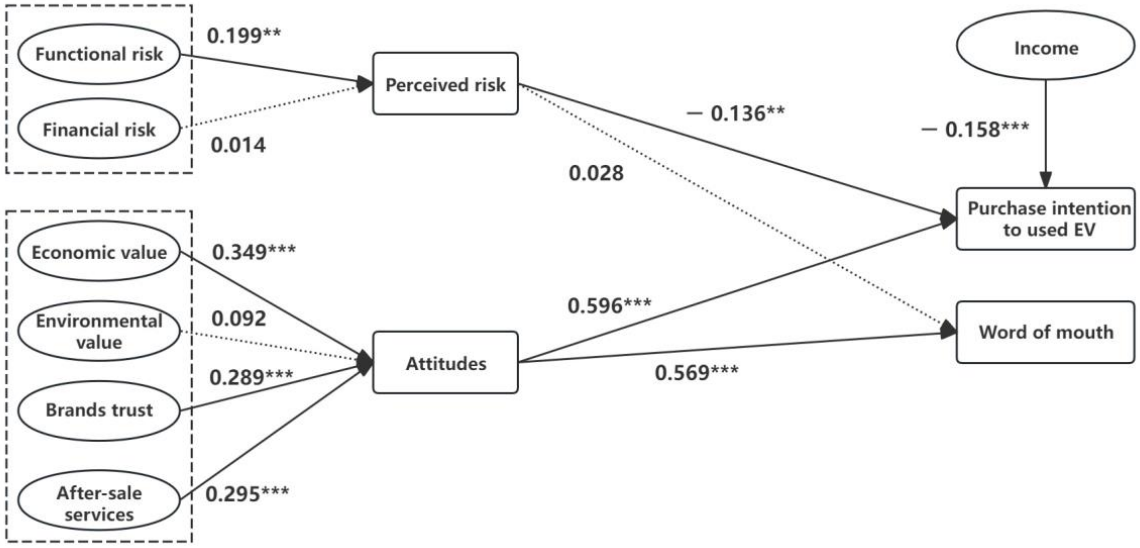

Figure 2. Path analysis. Note: ** $p < 0.01$; *** $p < 0.001$. The solid arrow denotes significant relationships, and the dashed arrow denotes non-significant relationships.

Table 6. Multigroup analysis (age).

Path Direction	Group 1 (Young)	Group 2 (Old)	Sig. Diff.
PR → PI	−0.149 *	−0.106 *	−0.043
PR → WOM	0.061	−0.018	0.034
ATT → PI	0.660 ***	0.626 ***	0.079
ATT → WOM	0.539 ***	0.626 ***	0.011

Note: * $p < 0.05$; *** $p < 0.001$.

Table 7. Multigroup analysis (education).

Path Direction	Group 1 (Low Level)	Group 2 (High Level)	Sig. Diff.
PR → PI	−0.114	−0.148 **	0.034
PR → WOM	0.092	−0.067	−0.104
ATT → PI	0.596 ***	0.700 ***	0.160 *
ATT → WOM	0.480 ***	0.598 ***	−0.118

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

5. Discussion

This paper proposed a model to reveal the mechanism of people's intention to purchase second-hand EVs in China. The model estimated the extent to which consumers' perceived risk and beliefs result in used EV purchase intention. PR and ATT are two pillars of PI, and the latter also had a significant impact on word of mouth. Moreover, one demographic factor, "income", also determined people's PI. FUR had a direct and positive impact on PR. On the other hand, ECV, BT, and ASS were three predictors of ATT. We then discussed the theoretical findings and proposed corresponding marketing strategies and legislation to enhance people's purchase intention of used EVs.

The research suggested a negative association between PR and PI. This finding is in line with Kim et al. (2021) and Qalati et al. (2021)'s research [25,76]. The result indicated that people's risk awareness was significant when people make consumption decisions, especially for second-hand products. Although a prior study identified several risks (functional, aesthetic, sanitary) that might drive people's purchase intention to second-hand products, we only found one type of risk (FUR) that was related to behaviour intention [24]. It may be because we targeted different second-hand products (clothes vs.

EVs). In practical situations, we should consider how to mitigate people's risk awareness during consumption.

ATT, derived as a TPB variable, is another instrumental pillar of PI. This result backed up Line and Dong's (2023) and Kim et al. (2021) studies, which gained similar findings in the situation of home appliances and recycled apparel buy intention [25,26]. Our findings indicated that consumers' likes or dislikes towards used EVs serve as a basis for their behaviour, which can also reflect the explaining power of the TPB model. Car sellers should consider how to arouse consumers' positive emotions and make them feel worthy to purchase used EVs. In our model, "attitude" was associated with three variables: economic value, brand trust, and after-sales services, which can echo specific measures and strategies that promote used EV consumption. On the other hand, ATT was also a trigger for WOM, which is in accordance with Birkmeyer et al. (2021) and Foroudi et al. (2022) research [56,57]. This manifested that an EV brand that owns consumers' positive assessment is more likely to gain welcome in their circle of friends.

PR was determined by one variable: FUR. However, research by Koay et al. (2022) and Tymoshchuk et al. (2024) did not report a similar result [23,24]. This difference could be attributed to the subject of study, as the two prior studies targeted used apparel rather than EVs. FUR is particularly important in the EV context. Generally, it is hard to verify the authenticity of the vehicle's odometer reading and detect any potential mileage tampering. Moreover, individuals also have trouble examining the wear and tear or damage to the vehicle's exterior, interior, and Motor. On the other hand, consumers generally cannot enjoy a warranty when buying used EVs. In this case, FUR awareness will lower consumer purchase intent if it is not clear. Sellers are supposed to provide inspection certificates from professional institutions for used EVs. In this case, consumers can have a comprehensive understanding of EVs' basic status, maintenance records, accident history, and other information, which can mitigate their functional concerns. Policymakers need to educate the used EV consumers regarding the consumption process. An effective initiative is to distribute brochures related to used EV transactions and rights protection regulations for potential consumers.

We did not observe an association between FIR and PR. This finding contrasted with Koay et al.'s (2023) and Kamalul Ariffin et al.'s (2018) study, which suggested that FIR was a significant predictor of purchase intent for pre-owned clothes [23,77]. Although many reports indicated that used EVs often depreciate quickly once entering the market, we argued the fact was not one of the most important considerations for consumers. Consumers usually buy used EVs at a relatively low price, meaning they do not pay much for a used EV. Therefore, they may not care much about the value reduction of used EVs. Besides, consumers may be mentally prepared for the fact of value reduction.

ECV was found to have a direct impact on attitudes, which was upheld by Chae et al. (2020), Park et al. (2023), and Joshi et al. (2021)'s research [37,38,78]. This means that used EVs are more affordable than new EVs in China's markets. Incorporating the above findings, we can conclude that people pay close attention to the price when they buy. After consumption, they care less about the value-preserving rate of used EVs. One explanation is that the value reduction of the used EV after consumption may be less than the benefit they enjoy when purchasing it. Sellers should highlight the price difference between used EVs and new EVs to deliver the message that buying used EVs can save money.

Unlike Kim et al. (2021) and Lin and Dong's (2023) study, ENV was not related to consumers' attitudes [25,26]. While many studies implied that environmental value was a critical driver for green product purchases, our study revealed that this factor did not have a significant impact on ATT. We argued that people showed more concerns on a substantial level than a psychological level during consumption. In this case, car sellers should deliver a message on how much benefits customers can gain rather than to what extent they contribute to the environment during consumption.

Then, we found that BT played a noteworthy role in affecting ATT, which was supported by Cuong (2020), Chae et al. (2020) and Dam (2020) research [43,47,78]. In the

above section, we have discussed three reasons that led to a lack of brand trust for used EV customers. This can be summarised into a sentence: both EV brands and used car trade platforms are new and need enough time to build consumer trust. Car sellers should ensure the authenticity and transparency of information launched on online platforms and offer convenient information inquiry channels through offline physical stores. Moreover, they can also construct smart trade platforms and integrate virtual reality (VR) technology to make EVs' information more clearly. Policymakers are supposed to offer more legal support for used EV transactions. For instance, they can regulate the qualifications of used EV trade platforms and raise the bar of qualification. Moreover, authorities can impose more punishment measures and surveillance on the EV transaction process. For example, workers in this industry are required to establish integrity archives.

Further, ASS also have a positive impact on ATT. This result mirrored Blut et al. (2018) and Nasir et al. (2021)'s research [52,53]. ASS are a crucial consideration for used EV consumers. However, many used EV consumers cannot enjoy ASS similar to those of new EV consumers. For sellers, they need to improve the quality of after-sales services. On the one hand, they can improve the communication channels between consumers and sellers. Constructing WeChat groups and a hotline is a good choice, which can receive customer feedback and complaints more easily. On the other hand, sellers can offer more personalised services, such as prolonging the warranty period and tracing and recording information on every sold EV.

Lastly, income was a significant and negative determinant of people's purchase intention, which aligned with Bauer et al.'s (2021) research [54]. This means that people with lower income levels are more willing to buy used EVs, and saving money is a key driver for people's purchase intent. Unlike new EV customers, used EV buyers focused more on material needs rather than spiritual needs. The finding can also echo the relationship between ECV and ATT derived in our study. In this case, car sellers can forward specific price incentive schemes for promotion, such as consumption vouchers, subsidies, discounts, extra fee services, and so on. Additionally, people with high education levels are more likely to be affected by ATT towards used EVs than those with during consumption

6. Conclusions

Greenhouse gas emissions are projected to have a far-reaching and devastating impact on various aspects of our planet and its inhabitants. Under such a background, authorities across the globe have taken initiatives to address the issue. EV adoption, a typical low-carbon lifestyle, is critical to achieving a more sustainable, environmentally friendly, and economically urban environment. This paper extended the topic and shed light on used EV consumption behaviour in China-one of the leading global EV markets. Going through the existing literature, we identified eleven variables to construct the research model that reveals the mechanism of people's consumption behaviour of used EVs in China. Then, we carried out an empirical study (n = 431) to check the structural relationships in the model. Finally, we found six variables that have a direct or indirect association with PI, which were PR, ATT, FUR, ECV, BT, and ASS. Finally, we discussed the findings and presented marketing strategies for EV promotion from car sellers' and policymakers' viewing angles. The knowledge contribution of this paper is as follows:

This article contributes to the existing body of knowledge in several ways. First, our study explored people's consumption behaviour in a new context of EVs. These days, EV adoption or purchase is a hot topic and has received attention from many scholars. However, research on used EV consumption is rare. This paper sheds light on the used EV consumption behaviour and fills the literature gap. Second, unlike other studies extending a well-known or classic model, we combined the perceived risk theory and consumption value theory to reconstruct a model by integrating several identified variables. Third, our study used a large sample size to describe China EV consumers' behaviour intentions. China has a global leading and flourishing EV market due to its robust economy,

government support, technological innovation, and vast amounts of consumers. In this case, our study's sampling population and sites are appropriate and representative.

In addition, the theoretical findings from our study can benefit different stakeholders, including EV consumers, car sellers, policymakers, and EV R&D enterprises in practical situations. Our findings and marketing strategies help car sellers attract and convert potential customers into paying clients. This not only boosts immediate sales but also lays the foundation for sustained revenue growth over time. In this case, sales companies will establish a competitive advantage in the used EV market. EV consumers can enjoy more substantial benefits and buy used EVs at more affordable prices. For policymakers, the proposed strategies can guide them in launching more effective legislation and regulating the used EV market, which enhances market efficiency and boosts economic growth. For EV R&D enterprises, an active EV market can facilitate innovation in new technology.

However, this article also has several limitations that need to be refined in future research. First, our sampling site was limited to China, and the sample population was all Chinese consumers. In this case, our findings and proposed marketing strategies may not be appropriate for other regions. This is because individuals living in other cultural contexts often have discrepant habits, lifestyles, and perceptions, and these elements can directly or indirectly affect consumer behaviour. Hence, we recommended surveying different countries or regions in the next step, and a cross-culture study is worthy to be conducted. Second, we recommended modelling the EV purchase mechanism from other perspectives. This paper only refers to several prior studies on used apparel, as nearly no studies are focusing on used EVs. Hence, researchers can consider other variables or theories for further investigation.

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