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# Effects of Chinese Firms' Innovation on New Energy Vehicles Purchases

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**Abstract:** As energy shortages and environmental pollution intensify, innovation in new energy vehicles is considered a major priority. They present an important opportunity to change the direction of China's automobile industry while reducing greenhouse gas emissions. Following various launches of new energy vehicles, the problem of product homogenization is emerging, and automobile companies are contemplating how to increase their market share. This study investigates a few questions that have been left unanswered in previous research, which are mainly focused on the value and price of new energy vehicles. We focus on the effect of new energy vehicle companies' innovative behaviors on consumers' purchasing intention in the Chinese market. Innovative behaviors are defined here as the rationalization or modernization choices firms make with respect to products, marketing, service, technological, and cultural factors. The study verified the structural equation model constructed using survey data. Our study of 479 surveyed customers shows that consumers' perceived value is positively (+) correlated with a higher degree of innovation by a firm. In general, the relationship between innovation behavior and consumers' perceived risk shows negative results, however, the relationship in this research showed contradictory results. The only negative (−) effects on product purchase were observed in marketing and technological innovation; these factors increase perceived risk by increasing the tendency of consumers to choose to purchase a new energy vehicle despite feeling uneasy about the innovation despite uncertainties about the innovation of new energy vehicles. Our results present the relationship between innovative behaviors of new energy vehicle firms, consumers' perceived value, consumers' perceived risk, consumers' innovative affinities and characteristics, and finally, purchase intention to explore the influence of innovation factors on consumers' purchase intention of new energy vehicles. These findings should assist new vehicle firms in understanding Chinese consumers' purchase intentions.

**Keywords:** China; firms innovation; new energy vehicle; purchase intention



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## 1. Introduction

Previous research indicates that firm innovation theory included product perspectives, process perspectives, and diversified perspectives [1–3]. Most of these studies assessed the effects of innovation through an internal lens focused on the choices and performance within the firms. Ultimately, however, a firm's innovation choices are made in order to maximize the purchase intention and behavior of consumers. In order to assess how innovation affects consumers' behavior we focused on the Chinese new energy vehicles (NEV) market.

The reason why we chose the Chinese NEV market is because this market in China is currently growing incredibly fast but companies are struggling to sell their products. Energy consumption and the associated levels of carbon emissions keep growing, due in part to the continued rise in rates of vehicle ownership in China [4,5]. Globally, exhaust emissions account for more than 60% of urban air pollutants, and transportation emissions are expected to account for 50% of global greenhouse gas emissions [6]. Meanwhile, China

continues to import oil as it cannot produce enough domestically to fulfill orders from its industrial sector. All this means there are serious concerns over the country's energy security, and if there are no restrictions on vehicle use in China, the future sustainability of the automobile industry remains in doubt [7]. Green energy has the potential to reduce greenhouse gas emissions while presenting an opportunity for the development of China's vehicle industry; however, sustainable development requires consumers to have social awareness and acceptance of the sustainable features of products [8]. The problem remains that despite government incentives, the NEV average comprised is only 6.85% of sales in 2018–2021 (these data are calculated based on the sales of automobiles and NEV in China in the past four years). According to government data, by the end of 2021, the number of automobiles in China is 301.51 million, and the NEV is 7.84 million, the proportion of NEV is only 2.6%. (https://baijiahao.baidu.com/s?id=1721660129147550032&wfr=spider&for=pc) (accessed on 30 August 2022). The concept of firm innovation' may thus play an important role in NEV purchasing in China, this is because consumers believe innovation is important to NEV. Here the following research question arises: what kind of firm innovation factors influence consumers' purchase intention of NEV in China?

To answer this question, we divided China's NEV company innovation into five areas as established by Stock and Zacharias: product innovation, marketing innovation, service innovation, technological innovation, and cultural innovation [9]. We also draw on Sweeney and Soutar, Jacoby J. and Kaplan L., Gaolin Shi and Goldsmith and Hofacker to show the role of firms' innovation in the purchase of NEV in China [10–13].

This study establishes a theoretical model of innovative behaviors of NEV firms, consumers' perceived value, consumers' perceived risk, consumers' innovative affinities and characteristics, and finally, purchase intention. We also seek to understand the extent to which innovation factors influence consumers' purchase intention of NEVs. Finally, we segment the market of NEV and suggest ways for Chinese firms to develop their technologies, adjust policies and attract consumers.

Unlike previous studies, we examine firms' innovative behavior from the perspective of consumers' perceptions. In this study, we develop some new dimensions of firms' innovation, which makes firms more interested in other innovations (besides technological innovation), which is also our main contribution. Past analysis has suffered from difficulty in assessing the purchase intention impacts of innovation behavior of NEV firms due to an investigation of perceived value or perceived risk as single dimensions; instead, we consider both perceived value and perceived risk factors. Furthermore, there has been little consideration of the impact of moderating variables on consumers' purchase intention. This research considers the impact of innovation behavior of NEV firms on purchase intention through both value and risk channels, which avoids the inaccuracies that may be introduced by a single-dimension analysis. On the one hand, the innovative behavior of NEV firms will raise the perceived value, which plays an intermediary role in purchase intention; on the other hand, we all know that risk also determines purchasing behavior of consumers [14], so innovation behavior can mitigate negative impacts on purchase intention by affecting the intermediary factor of perceived risk. Firms seeking to enhance customers' purchase intention may take guidance from this research into the effects of perceived value and risk.

In light of the previous discussion, this study aims to shed light on the relationship between firm's innovation and consumers' purchase intention and to empirically establish their relationship. These relationships are evaluated in the context of Chinese NEV markets.

The structure of this paper is as follows: first, we present our analytical model. Subsequent sections address descriptive statistical analysis, reliability and validity analysis and through the data analysis, and determining the final model. Finally, the implications both for research and practice are identified.

## 2. Conceptualization and Research Hypotheses

### *2.1. Overview of the Theoretical Framework*

This study starts from the customers' perspective and bases its research variables on what consumers can subjectively perceive and judge. According to Stock and Zacharias and Junfeng Hao, five dimensions were selected: product innovation, marketing innovation, service innovation, technological innovation, and cultural innovation [9,15]. Purchase intention is a key component of consumer behavior. Several studies have shown that purchase intention has a significant impact on the final purchase behavior [16,17]. According to the benefit-risk analysis (BRA) model in consumer behavior research, an innovation's impact on the balance between consumers' value and risk perceptions will affect the acceptance of innovative behavior [18].

To determine the value of consumer perception of NEV in China, we used the 4-dimension classification method of Sweeney and Soutar (emotional value, functional value, economic value, social value) [10]. Regarding the measurement of perceived risk, we followed Jacoby and Jan Kaplan L. by dividing perceived risk into five distinct dimensions: economic, functional, physical, psychological, and social risks [11]. Since purchase intention belongs to the dependent variable, we used one-dimensional measurement values and the dimensions which were taken from Chen and Kim' paper [19]. Consumer innovation characteristics belong to the control variable in this research, which also is a contribution of this study, and in terms of measurement scale, we adopt the innovative one-dimensional view of a specific field of Goldsmith and Hofacker's paper [13].

### *2.2. Firms Innovative Behavior and Consumers' Perceived Value*

Junfeng Hao, in a study of the Chinese cosmetics market, showed that consumers' perceived value is significantly impacted by the innovative behavior of companies [15]. Based on this observation, we present the following hypothesis.

**Hypothesis (H1).** *The firm's five innovative behaviors (product, marketing, service, technological, and cultural innovation) all have a significant positive impact on consumers' perceived value. Detailed hypotheses can be viewed in Figure 1, H1a–H1e are research hypotheses.*

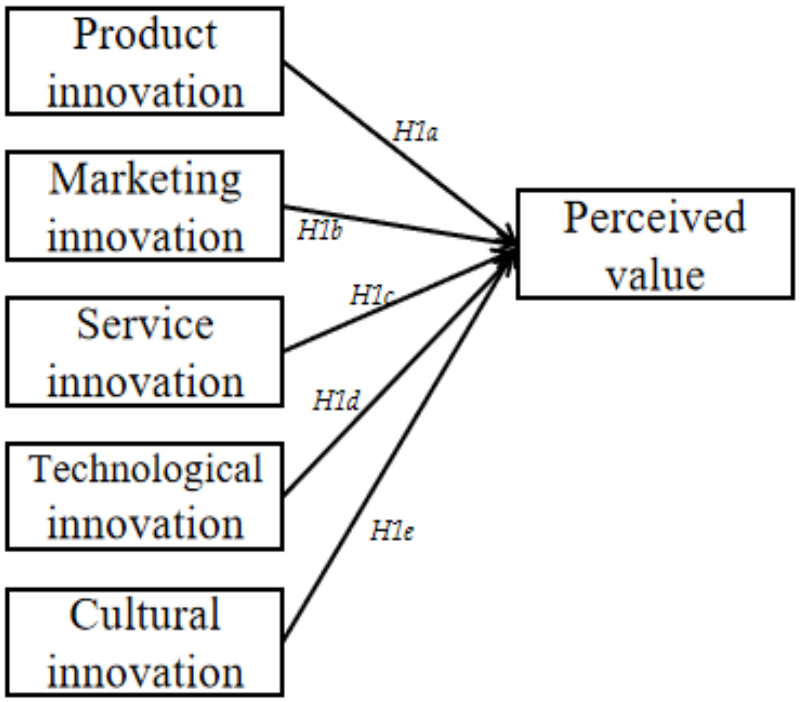


**Figure 1.** Conceptual model the relationship between firms' innovation and perceived value.

### *2.3. Firms Innovative Behavior and Consumers' Perceived Risk*

A firm's innovative behavior affects the perceived value of the target customer, while also affecting the perceived risk. Addressing consumer concerns about the quality and functionality of NEV can likewise reduce consumer concerns about risks. Consumers typically search for information about a target vehicle before making a purchase and may assess the probability of loss. The better and more complete this information, the more accurate the consumer's judgment. If a company increases the amount of product information that consumers acquire through innovative behavior management, consumers' perception of risk for the product will decrease. Therefore, we propose another set of hypotheses:

**Hypothesis (H2).** *The firm's five innovative behaviors (product, marketing, service, technological, and cultural innovation) all have a significant negative impact on consumers' perceived risk. Detailed hypotheses can be viewed in Figure 2, H2a–H2e are research hypotheses.*

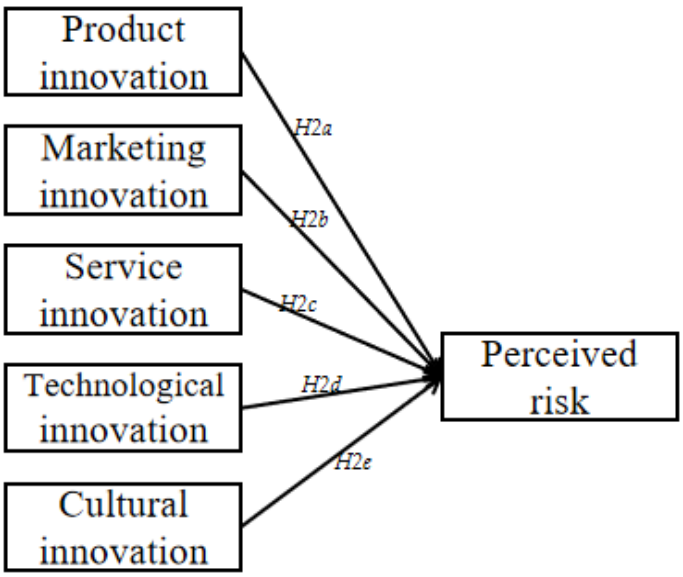


**Figure 2.** Conceptual model the relationship between firms' innovation and perceived risk.

### *2.4. Perceived Risk and Perceived Value*

Zeithaml believed that perceived risk was the non-monetary transaction cost that consumers pay for their purchase behavior, and the study posited that product value is a function of the risk consumers pay and the effect they get, and if the perceived risk was high, the cost would be larger and the perceived value would be lower [20]. Liyin Jin found the conclusion in the research, when analyzing the mediating effect of perceived value and perceived risk, the paper verified that consumers' perceived risk had a significant negative impact on perceived value [18]. Based on this, in this research we propose that consumers' perceived risk and consumers' perceived value relate as follows:

**Hypothesis (H3).** *Consumers' perceived value is negatively impacted by consumers' perceived risk.*

### *2.5. Perceived Risk, Perceived Value and Purchase Intention*

Perceived value positively affects consumers' purchase intention [21]. Ueland et al. established the BRA model in 2012, which was a model to study consumer willingness and consumer behavior, and they concluded that perceived value and perceived risk were important factors affecting purchase intention [22]. In 2006, Jiayao Chen et al. defined purchase intention as the psychological result of consumers' comprehensive evaluation of products under the influence of perceived value [23]. In addition, consumers' product perceived value evaluation had a positive impact on purchase intention, for example, Dong-

mei Zhao and Shuxian Ji established a structural equation model in 2010, they concluded through empirical research that consumers' perceived value had a significant and direct impact on purchase intention, and indirect impacts on purchase intention were driven by perceived risk through an effect on purchase attitude [24]. Ruochen Jiang et al. established a relationship model among perceived risk, customer trust, and purchase intention in 2013, with the goal of studying online group buying behavior, they found that under the influence of customer trust, purchase intention is negatively impacted by the consumers' perceived risk [25]. Yingyu Zhang et al. studied consumers' willingness to purchase fresh agricultural products by establishing an "online to offline" model in 2015, the article also confirmed that perceived value positively affected purchase intention, and perceived risk negatively affected purchase intention [26].

Customers' perceived risk and perceived value are intertwined and each have an impact on purchase intention. Based on this, the hypothetical relationship between consumers' perceived risk and perceived value, and purchase intention can be proposed as the following:

**Hypothesis (H4).** *Purchase intention is negatively impacted by significant levels of consumers' perceived risk.*

**Hypothesis (H5).** *Purchase intention is positively impacted by significant levels of consumers' perceived value.*

### *2.6. Consumers' Innovative Characteristics and Perceived Value, Perceived Risk*

Consumer decisions are influenced by individual characteristics and is complicated by the balancing of risks and benefits. Benefit and risk perceptions will vary from consumer to consumer [27]. High levels of innovative characteristics in consumers tallied with higher risk propensity, meaning these consumers were more willing to see themselves as opinion leaders and purchase new products earlier than others [28,29].

Innovation diffusion theory agrees that individuals with high innovation were more likely to have a positive attitude toward new technologies and more likely to adopt them [30]. Highly innovative individuals were also less likely to show reluctance toward new technologies [31,32]. In the current academic circles, most scholars used consumer innovation characteristics as independent variables to verify the relationship between innovation characteristics and new product adoption behavior. Of course, there were also some scholars who focus on the innovative characteristics of consumers in terms of purchasing attitude, purchasing intention, or information search. As an example, in 2004, Beldona's paper proposed that the relationship between consumer attitudes and online shopping intentions was strong when consumers were innovative [28]. In 2007, Yaping Chang and Donghong Zhu also verified that consumers' innovative characteristics would positively affect consumers' online shopping intention [33]. In addition, there were other research conclusions. For example, conservative consumers may be less willing to shop online than innovators. Ho and Wu conducted a survey of consumers' purchasing iPad in 2011 which assessed the effects on new product purchase intention from perceived product attributes and key consumer characteristics. This paper concluded that perceived product attributes significantly affect the purchase intention of new products, and the innovative characteristics of consumers played a moderating role in the process of purchase intention [34]. Some scholars believed that consumers' innovation characteristics can have a moderating effect on consumers' purchase intention, but we found that most of these studies are based on surveys of European and American consumers. Many prior studies of this area have drawn on data from Europe and the USA. However, there may be cultural differences in consumer behavior. Based on the above review, we believe that when the consumers' innovation characteristics are higher, the relationship between firm innovation behavior and consumers' purchase intention is stronger. Therefore, this research puts forward the following hypotheses:

**Hypothesis (H6).** *Consumers' innovative characteristics positively impact the purchase intention through a process of perceived value.*

**Hypothesis (H7).** *Consumers' innovative characteristics positively impact the purchase intention through a process of perceived risk.*

Based on the above hypotheses, the relationships between the variables have been summarized in Figure 3.

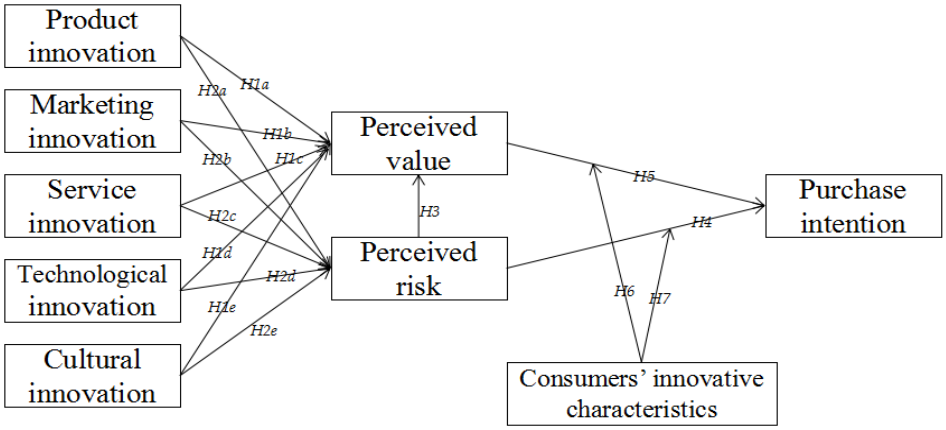


**Figure 3.** Conceptual model the relationship between firms' innovation and purchase intention.

## 3. Methodology

### *3.1. Data Collection*

To evaluate the proposed hypotheses, this study analyzed the data collected through an online survey from China in 2021. Since we need to consider the data collection of various geographic regions in China, we cannot provide more support, such as money, to go to the field if we use offline survey technology, and it would take more time. Therefore, this paper chose the platform called WenJuanXing to obtain data by forwarding the questionnaire through WeChat. We first made a questionnaire, released it to a small number of people, collected some possible design errors, and then revised the formal questionnaire. The second step is to authorize the questionnaire to the WenJuanXing platform, which would issue the questionnaire in six regions of East China, South China, West China, North China, Northeast China, and Central China. The online survey lasted for 3 days, and we got 616 data feedback. All data are from a group of people over 18 years old with driving licenses, some of them had already owned NEV, some of them owned non-NEV, and some of them were people who planned to buy an automotive. We collected 479 valid questionnaires out of a total of 616 received (77.76 percent). We excluded 137 deemed invalid due to response time (under 70 s was deemed to short and over 600 s too long). The final data were representative of the total population based on demographics (gender, age, education level, and monthly income). In terms of gender, 42.38 percent of respondent are male, while female—57.62 percent. The majority of respondents (75%) were relatively young below 35 years of age. For education level, those with bachelor's degrees accounted for 56.58 percent, followed by graduate degree holders (28.18 percent). Respondents with junior college degrees or below, comprised 10.65 percent, and senior high school graduates or below, accounted for 4.59 percent, over 80% of our respondents had a bachelor's degree or higher. In terms of monthly income, approximately 31.73 percent of the respondent ranged from 4000 yuan to 8000 yuan. The remaining 68.27 percent were distributed as follows: 30.9 percent had a monthly income of 4000 yuan (597.6$) or less; 21.71 percent earned 8000 yuan (1195.2$)–12,000 yuan (1792.8$), while 15.66 percent made more than 12,000 yuan (1792.8$) [USD to RMB exchange rate was 6.6945, On 21 June 2022].

### 3.2. Data Measures

In this study, independent sample t test (gender) and one-way ANOVA (age, education level, monthly income) were used to analyze the differences in the scores of people with different gender, age, education level, and monthly income in purchase intention. In the Table 1, there are significant differences in the purchase intention of people with different education level, in addition, although the p values of gender, age, and monthly income are all large than 0.05, they are all relatively small (less than 0.3). In order to obtain the true influence relationship between the focal variables (perceived value, perceived risk, purchase intention, consumers' innovative characteristics), it is necessary to control for the influence of gender, age, education level, and monthly income on purchase intention in the model below (although the F value of Model 1 is not significant and $R^2$ value is small).

**Table 1.** Results of independent sample t-test and one-way ANOVA.

| Variables | Level | Number | Purchase Intention | *t*/F | *p* |
|---|---|---|---|---|---|
| gender | male | 203 | 3.153 ± 0.858 | 1.619 | 0.160 |
| | female | 276 | 3.286 ± 0.917 | | |
| age | 1 | 168 | 3.232 ± 0.822 | 1.850 | 0.137 |
| | 2 | 191 | 3.166 ± 0.931 | | |
| | 3 | 78 | 3.221 ± 0.928 | | |
| | 4 | 42 | 3.524 ± 0.907 | | |
| education level | 1 | 22 | 3.716 ± 0.78 | 2.665 | 0.047 * |
| | 2 | 51 | 3.279 ± 0.905 | | |
| | 3 | 271 | 3.223 ± 0.838 | | |
| | 4 | 135 | 3.144 ± 0.993 | | |
| monthly income | 1 | 148 | 3.323 ± 0.866 | 1.397 | 0.243 |
| | 2 | 152 | 3.26 ± 0.878 | | |
| | 3 | 104 | 3.139 ± 0.903 | | |
| | 4 | 75 | 3.11 ± 0.957 | | |

Note: * means $p < 0.05$.

A construct which is empirically distinct has high discriminant validity. Three methods are widely used to determine this discriminant validity: Cross-loadings, the Fornell–Larcker criterion, and HTMT (Heterotrait–Monotrait ratio). Among them, the Fornell–Larcker criterion and HTMT are the most popular. From the perspective of this research, neither is not inherently superior or inferior, and the appropriate method needs to be selected according to the specific model dimension relationship, for this study, the conclusions of the two methods are consistent. In order to facilitate the statistics of this research, we choose the Fornell–Larcker criterion. According to the Fornell–Larcker criterion [35], all dimensions were developed based on the relevant literature (Tables 2 and 3). A five-point Likert-type scale—ranging from 1 = completely disagrees to 5 = completely agree—was used to measure all constructs.

**Table 2.** Results of the CFA analysis.

| Variables | Loadings |
|---|---|
| ***Product innovation*** | |
| NEV firms are launching new products quickly and there are more new cars on the market | 0.807 |
| NEV firms are producing vehicles with innovative and refined exteriors and interiors | 0.794 |
| NEV firms offer substantial innovation in automotive software, with capability for easy upgrades | 0.768 |
| NEV are becoming more intelligent | 0.798 |
| Composite reliability (CR) | 0.871 |
| Average variance extracted (AVE) | 0.627 |
| ***Marketing innovation*** | |
| NEV firms marketing model is very innovative, can be online car booking | 0.817 |
| NEV firms have diversified and innovative ideas geared toward promoting new products | 0.822 |

**Table 2.** *Cont.*

| Variables | Loadings |
| --- | --- |
| NEV firms display innovation in sales activities, e.g., second-hand car replacement | 0.787 |
| Composite reliability (CR) | 0.850 |
| Average variance extracted (AVE) | 0.654 |
| ***Service innovation*** | |
| NEV firms offer more innovation in extending range (km) or battery life | 0.817 |
| NEV firms offer innovative service features like life-long free car wash service | 0.805 |
| NEV firms are innovative in offering free battery replacement | 0.798 |
| NEV firms are innovative in offering free software upgrades | 0.827 |
| Composite reliability (CR) | 0.885 |
| Average variance extracted (AVE) | 0.659 |
| ***Technological innovation*** | |
| NEV firms invest substantial resources in technology development and innovation | 0.801 |
| NEV firms possess a significant number of technology patents | 0.813 |
| NEV firms are leading the development in key technological areas, such as batteries and battery life extension | 0.779 |
| General charging pile technology for NEV firms is relatively innovative | 0.817 |
| Composite reliability (CR) | 0.879 |
| Average variance extracted (AVE) | 0.644 |
| ***Cultural innovation*** | |
| NEV firms have a strong culture of innovation | 0.836 |
| NEV firms are attentive to innovative culture and foster growth of the same | 0.772 |
| NEV firms actively promote the innovative culture of firms | 0.821 |
| Composite reliability (CR) | 0.851 |
| Average variance extracted (AVE) | 0.656 |
| ***Perceived Value*** | |
| People around the consumer are beginning to accept NEV | 0.770 |
| NEV are "high technology" products and offer an experience of interesting new technologies | 0.814 |
| NEV reduce fuel costs | 0.794 |
| NEV can contribute to environmental protection | 0.710 |
| Composite reliability (CR) | 0.856 |
| Average variance extracted (AVE) | 0.598 |
| ***Perceived Risk*** | |
| I am worried about the low value of NEV | 0.746 |
| I am worried NEV performance is not guaranteed | 0.726 |
| I am worried NEV batteries may be harmful to health | 0.773 |
| I am worried NEV models will be phased out too fast | 0.865 |
| I am afraid even if I buy NEV will not reduce carbon emissions | 0.722 |
| Composite reliability (CR) | 0.878 |
| Average variance extracted (AVE) | 0.590 |
| ***Purchase intention*** | |
| When buying a car, I will consider NEV | 0.821 |
| I recommend friends and family to buy a NEV | 0.823 |
| If the price of NEV rises, I will still consider buying | 0.791 |
| If someone recommends a non-NEV option, I will still consider buying a NEV | 0.800 |
| Composite reliability (CR) | 0.883 |
| Average variance extracted (AVE) | 0.654 |
| ***Consumers' innovative characteristics*** | |
| I am a more unconventional person with a strong inclination to accept new things like NEV | 0.754 |
| I am a creative person who like NEV | 0.787 |
| I do not reject NEV, even very optimistic about the future prospects of NEV | 0.775 |
| Among friends, I late or last to know about NEV | 0.761 |
| Among friends, I desire to be the first one to purchase an NEV | 0.806 |
| I am familiar with the brands of NEV before my friends know about them | 0.720 |
| When an NEV becomes available, I will take the initiative to buy it | 0.790 |
| When I want to buy a NEV, the opinions of the people around me will not influence me | 0.850 |
| Without more information about the product, I would also buy a NEV | 0.843 |
| Composite reliability (CR) | 0.936 |
| Average variance extracted (AVE) | 0.621 |

**Table 3.** Results of the discriminant validity analysis. (N = 479).

| Dimensions | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Purchase intention | **0.809** | | | | | | | | |
| Product innovation | 0.223 | **0.792** | | | | | | | |
| Marketing innovation | 0.348 | 0.515 | **0.809** | | | | | | |
| Service innovation | 0.361 | 0.579 | 0.610 | **0.812** | | | | | |
| Technological innovation | 0.396 | 0.525 | 0.486 | 0.648 | **0.803** | | | | |
| Cultural innovation | 0.303 | 0.405 | 0.555 | 0.584 | 0.540 | **0.810** | | | |
| Perceived value | 0.558 | 0.586 | 0.625 | 0.693 | 0.659 | 0.609 | **0.773** | | |
| Perceived risk | −0.507 | −0.086 | −0.188 | −0.120 | −0.191 | −0.145 | −0.339 | **0.768** | |
| Consumers' innovative characteristics | 0.638 | 0.369 | 0.451 | 0.484 | 0.498 | 0.444 | 0.692 | −0.296 | **0.788** |

Note: The values in bold on the diagonal are the arithmetic square roots of the AVE value of each dimension.

## 4. Results

### *4.1. Basic Statistics*

The results of each fitting index of the model are shown in Table 4; these results are obtained from AMOS after associating the sample data with the model. In the absolute fitting index, the chi-square degree of freedom ratio (CMIN/DF) and the GFI index are excellent fit, the RMR index and the RMSEA index are good fit. In the value-added fitting index, NFI index, the indexes of TLI and CFI are all excellent fit. In parsimony fitting index, the values of the PGFI index and the PNFI index are both higher than the standard value, all parsimony fitting index are excellent fit. Therefore, a good-to-excellent fitting with the data is observed across the integrated results from the absolute fitting index, value-added fitting index and parsimony fitting index. We conclude that the external quality of the model is good.

**Table 4.** Initial model fitting results.

| Type of Indicator | Absolute Fitting Index | | | | Value-Added Fitting Index | | | Parsimony Fitting Index | |
|---|---|---|---|---|---|---|---|---|---|
| Indicators | CMIN/DF | GFI | RMR | RMSAE | NFI | TLI | CFI | PGFI | PNFI |
| Standards | <3 | >0.9 | <0.08 | <0.08 | >0.9 | >0.9 | >0.9 | >0.5 | >0.5 |
| Fitting results | 1.611 | 0.919 | 0.032 | 0.036 | 0.928 | 0.967 | 0.971 | 0.762 | 0.82 |
| Fitting evaluation | excellent | excellent | Good | Good | excellent | excellent | excellent | excellent | excellent |

The significance level is $p < 0.05$ where (abs) $t > 1.96$. The significance level is $p < 0.01$ where (abs) $t > 2.58$. The significance level is $p < 0.001$ where (abs) $t > 3.29$. Table 5 shows the path coefficient and significance level results in this study.

**Table 5.** Initial model path coefficient and significant level.

| Hypothesis | Estimated | Standard Error | *t* Value | *p* Value | Results |
|---|---|---|---|---|---|
| H1a | 0.128 | 0.039 | 3.242 | 0.001 | Supported |
| H1b | 0.126 | 0.042 | 3.018 | 0.003 | Supported |
| H1c | 0.18 | 0.045 | 3.969 | *** | Supported |
| H1d | 0.16 | 0.041 | 3.909 | *** | Supported |
| H1e | 0.127 | 0.04 | 3.165 | 0.002 | Supported |
| H2a | 0.051 | 0.054 | 0.934 | 0.35 | Not supported |

**Table 5.** *Cont.*

| Hypothesis | Estimated | Standard Error | *t* Value | *p* Value | Results |
|---|---|---|---|---|---|
| H2b | −0.124 | 0.058 | −2.161 | 0.031 | Supported |
| H2c | 0.053 | 0.062 | 0.847 | 0.397 | No supported |
| H2d | −0.131 | 0.056 | −2.356 | 0.018 | Supported |
| H2e | −0.018 | 0.055 | −0.317 | 0.751 | No supported |
| H3 | −0.206 | 0.039 | −5.252 | *** | Supported |
| H4 | −0.521 | 0.071 | −7.385 | *** | Supported |
| H5 | 0.609 | 0.07 | 8.736 | *** | Supported |

Note: *** means $p < 0.001$.

The data in Table 5 verifies most of our hypotheses, but the expected links between product innovation (H2a), service innovation (H2c), and cultural innovation on perceived risk (H2e) were not supported, and disconnection of these three paths is the appropriate measure. After disconnecting these three insignificant paths, operate it again in AMOS, and get the revised model fitting results as shown in Table 6. Table 7 shows the revised model's path coefficients and significance levels. Following the modification, each path of the model passes the significance test.

**Table 6.** Fitting results of modified model.

| Type of Indicator | Absolute Fitting Index | | | | Value-Added Fitting Index | | | Parsimony Fitting Index | |
|---|---|---|---|---|---|---|---|---|---|
| Indicators | CMIN/DF | GFI | RMR | RMSAE | NFI | TLI | CFI | PGFI | PNFI |
| Standards | <3 | >0.9 | <0.08 | <0.08 | >0.9 | >0.9 | >0.9 | >0.5 | >0.5 |
| Fitting results | 1.605 | 0.919 | 0.033 | 0.036 | 0.927 | 0.968 | 0.971 | 0.767 | 0.826 |
| Fitting evaluation | excellent | excellent | Good | Good | excellent | excellent | excellent | excellent | excellent |

**Table 7.** Modified model path coefficient and significant level.

| Hypothesis | Estimated | Standard Error | *t* Value | *p* Value | Results |
|---|---|---|---|---|---|
| H1a | 0.127 | 0.039 | 3.228 | 0.001 | Support |
| H1b | 0.127 | 0.042 | 3.056 | 0.002 | Support |
| H1c | 0.179 | 0.045 | 3.959 | *** | Support |
| H1d | 0.16 | 0.041 | 3.957 | *** | Support |
| H1e | 0.127 | 0.04 | 3.173 | 0.002 | Support |
| H2b | −0.09 | 0.046 | −1.955 | 0.050 | Support |
| H2d | −0.093 | 0.044 | −2.126 | 0.033 | Support |
| H3 | −0.206 | 0.039 | −5.28 | *** | Support |
| H4 | −0.52 | 0.071 | −7.339 | *** | Support |
| H5 | 0.608 | 0.07 | 8.706 | *** | Support |

Note: *** means $p < 0.001$.

### *4.2. Modulation Analysis*

We analyzed the data with SPSS21.0 to test the moderating effect of consumer innovation traits on the progression between perceived value/risk and consumer purchase intention using stepwise regression. Gender, age, education level, and monthly income were used as control variables; perceptual value and perceptual risk as independent variables; consumer innovative characteristics as moderator variables, and purchase intention

as dependent variables. We centralized and processed variables such as the perceived value and perceived risk, and the innovation characteristics of the consumers to avoid the impact of multi-collinearity on the test results. B represents the non-standardized regression results, t represents the test statistics of regression coefficients, and VIF represents the expansion coefficient, an index for confirming collinearity. Taking Table 8 as an example, model 1 only has control variables; model 2 includes control variables and perceived value; model 3 includes control variables, perceived value and consumer innovation; model 4 includes control variables, perceived value, consumer innovation, and perception. The interaction items of value and consumer innovation, from which we can know the changes in model fitting after adding perceived value, consumer innovation, and interaction items respectively. The fitting index increases the AIC. The analysis results show that the AIC gradually decreases. When the added variable has a greater impact on the dependent variable, the AIC value decreases more.

**Table 8.** The moderating effect of consumers' innovative characteristics from perceived value to purchase intention.

| Variable | Model 1 | | | Model 2 | | | Model 3 | | | Model 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B | *t* | VIF | B | *t* | VIF | B | *t* | VIF | B | *t* | VIF |
| Constant term | 3.284 | 13.479 *** | | 3.354 | 15.43 *** | | 3.248 *** | 16.387 | | 3.234 | 16.268 *** | |
| Gender | 0.126 | 1.476 | 1.088 | 0.027 | 0.357 | 1.103 | 0.024 | 0.344 | 1.103 | 0.026 | 0.374 | 1.104 |
| Age | 0.139 | 2.716 ** | 1.389 | 0.029 | 0.618 | 1.455 | 0.014 | 0.337 | 1.457 | 0.007 | 0.161 | 1.499 |
| Education | −0.096 | −1.695 | 1.116 | −0.049 | −0.962 | 1.124 | −0.01 | −0.223 | 1.132 | −0.008 | −0.163 | 1.135 |
| Monthly income | −0.104 | −2.176 * | 1.561 | −0.034 | −0.778 | 1.596 | −0.024 | −0.609 | 1.597 | −0.023 | −0.594 | 1.597 |
| PV | | | | 0.656 | 11.091 *** | 1.08 | 0.283 *** | 4.304 | 1.607 | 0.295 | 4.417 *** | 1.663 |
| CIC | | | | | | | 0.484 *** | 9.913 | 1.567 | 0.475 | 9.564 *** | 1.621 |
| CIC * PV | | | | | | | | | | 0.052 | 1.014 | 1.086 |
| F | 4.154 | | | 28.779 *** | | | 45.291 *** | | | 38.97 *** | | |
| R2 | 0.034 | | | 0.233 | | | 0.365 | | | 0.367 | | |
| ΔR2 | 0.034 | | | 0.199 | | | 0.132 | | | 0.002 | | |
| AIC | 1244.124 | | | 1135.403 | | | 1046.815 | | | 1047.773 | | |

Note: *** means $p < 0.001$, ** means $p < 0.01$, * means $p < 0.05$.

The stepwise regression analysis in Table 8 shows that, in Model 4, both the perceived value of independent variables and the innovation characteristics of consumers positively impact purchase intention (B = 0.295, $p < 0.001$ and B = 0.475, $p < 0.001$, respectively). However, purchase intention was not significantly affected by the interaction between CIC and PV (B = 0.052, $p > 0.05$), indicating a lack of moderating effect from the innovation characteristic of consumers between the perceived value of independent variables and the purchase intention of dependent variables.

As shown in Table 9, in model 4, there is a significant negative impact on purchase intention by the perceived risk of independent variables (B = −0.427, $p < 0.001$). Inversely, there is a sizeable positive impact on purchase intention from the innovative characteristics of consumers (B = 0.518, $p < 0.001$). In addition, the interaction between CIC and PR positively influences purchase intention (B = 0.114, $p < 0.01$), which shows that the innovation characteristic of consumers positively moderates the relationship between the independent variable perceived risk and the dependent variable purchase intention.

The figures in Table 10 show that in model 4, both the perceived value of independent variables has a significant positive impact on purchase intention (B = 0.23, $p < 0.001$), while the perceived risk of independent variables has a significant negative impact on purchase intention (B = −0.404, $p < 0.001$). In addition, purchase intention is positively impacted by consumers' innovative characteristics (B = 0.421, $p < 0.001$). Purchase intention was not significantly affected by the interaction between CIC and PV (B = 0.056, $p > 0.05$), but it was impacted by the interaction between CIC and PR (B = 0.126, $p < 0.01$). In Tables 8 and 9, we consider the moderating effect of consumers' innovative characteristics from perceived value or perceived risk on purchase intention, while in Table 10, we consider

the moderating effect of consumers' innovative characteristics from both perceived value and perceived risk on purchase intention. The paper add the AIC value for the fitting index, from Tables 9 and 10, it can be seen that the AIC gradually decreases except in Table 8. When the added variable has a greater impact on the dependent variable, the AIC value decreases more.

**Table 9.** The moderating effect of consumers' innovative characteristics from perceived risk to purchase intention.

| Variable | Model 1 | | | Model 2 | | | Model 3 | | | Model 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **B** | ***t*** | **VIF** | **B** | ***t*** | **VIF** | **B** | ***t*** | **VIF** | **B** | ***t*** | **VIF** |
| Constant term | 3.284 | 13.479 *** | | 3.242 | 14.736 *** | | 3.182 | 16.984 *** | | 3.156 | 16.962 *** | |
| Gender | 0.126 | 1.476 | 1.088 | 0.094 | 1.226 | 1.09 | 0.039 | 0.588 | 1.094 | 0.053 | 0.813 | 1.1 |
| Age | 0.139 | 2.716 ** | 1.389 | 0.063 | 1.349 | 1.424 | 0.001 | −0.001 | 1.443 | 0.009 | 0.221 | 1.452 |
| Education | −0.096 | −1.695 | 1.116 | −0.066 | −1.285 | 1.119 | −0.003 | −0.073 | 1.132 | −0.003 | −0.067 | 1.132 |
| Monthly income | −0.104 | −2.176 * | 1.561 | −0.037 | −0.856 | 1.596 | −0.001 | −0.039 | 1.604 | 0 | 0.005 | 1.604 |
| PR | | | | −0.541 | −10.412 *** | 1.045 | −0.396 | −8.689 *** | 1.107 | −0.427 | −9.202 *** | 1.165 |
| CIC | | | | | | | 0.524 | 13.435 *** | 1.116 | 0.518 | 13.394 *** | 1.118 |
| CIC * PR | | | | | | | | | | 0.114 | 2.964 ** | 1.07 |
| F | | 4.154 | | | 25.757 *** | | | 59.69 *** | | | 53.262 *** | |
| R2 | | 0.034 | | | 0.214 | | | 0.431 | | | 0.442 | |
| ΔR2 | | 0.034 | | | 0.180 | | | 0.217 | | | 0.010 | |
| AIC | | 1244.124 | | | 1147.284 | | | 994.1776 | | | 987.3194 | |

Note: *** means $p < 0.001$, ** means $p < 0.01$, * means $p < 0.05$.

**Table 10.** The moderating effect of consumers' innovative characteristics from perceived value and perceived risk to purchase intention.

| Variable | Model 1 | | | Model 2 | | | Model 3 | | | Model 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **B** | ***t*** | **VIF** | **B** | ***t*** | **VIF** | **B** | ***t*** | **VIF** | **B** | ***t*** | **VIF** |
| Constant term | 3.284 | 13.479 *** | | 3.308 | 16.361 *** | | 3.218 | 17.34 *** | | 3.174 | 17.183 *** | |
| Gender | 0.126 | 1.476 | 1.088 | 0.021 | 0.292 | 1.103 | 0.019 | 0.285 | 1.103 | 0.036 | 0.561 | 1.111 |
| Age | 0.139 | 2.716 ** | 1.389 | −0.011 | −0.243 | 1.471 | −0.019 | −0.472 | 1.472 | −0.017 | −0.424 | 1.513 |
| Education | −0.096 | −1.695 | 1.116 | −0.034 | −0.715 | 1.125 | −0.001 | −0.017 | 1.132 | 0.002 | 0.058 | 1.136 |
| Monthly income | −0.104 | −2.176 * | 1.561 | 0.006 | 0.148 | 1.617 | 0.01 | 0.266 | 1.617 | 0.012 | 0.331 | 1.617 |
| PV | | | | 0.535 | 9.418 *** | 1.15 | 0.212 | 3.406 ** | 1.639 | 0.23 | 3.658 *** | 1.707 |
| PR | | | | −0.427 | −8.658 *** | 1.112 | −0.374 | −8.225 *** | 1.129 | −0.404 | −8.741 *** | 1.187 |
| CIC | | | | | | | 0.438 | 9.518 *** | 1.59 | 0.421 | 9.066 *** | 1.651 |
| CIC * PV | | | | | | | | | | 0.056 | 1.142 | 1.135 |
| CIC * PR | | | | | | | | | | 0.126 | 3.237 ** | 1.113 |
| F | | 4.154 | | | 40.228 *** | | | 53.969 *** | | | 43.949 *** | |
| R2 | | 0.034 | | | 0.338 | | | 0.445 | | | 0.458 | |
| ΔR2 | | 0.034 | | | 0.304 | | | 0.107 | | | 0.012 | |
| AIC | | 1244.124 | | | 1066.793 | | | 984.5217 | | | 977.6647 | |

Note: *** means $p < 0.001$, ** means $p < 0.01$, * means $p < 0.05$.

Therefore, consumers' innovative characteristics have no significant moderating effect between perceived value of independent variables and purchase intention of dependent variables, while consumers' innovative characteristics have significant positive moderating effect between perceived risk of independent variables and purchase intention of dependent variables (Table 11).

**Table 11.** Hypotheses test results.

| Hypotheses | Hypotheses Contents | Results |
| --- | --- | --- |
| H6 | Consumers' innovative characteristics have a positive impact on the process of the perception of value to consumers' purchase intention. | No supported |
| H7 | Consumers' innovative characteristics have a positive impact on the process of the perception of risk to consumers' purchase intention. | Supported |

## 5. Discussion and Conclusions

### *5.1. Discussion and Conclusions*

This study maintains that the innovation behaviors of companies have an impact on consumer perceptions. The five aspects of innovation (product, marketing, service, technological, and cultural innovation) significantly and positively impact the value perceived by consumers. NEV firms in China have demonstrated all aspects of innovation in recent years. In terms of product innovation, the industry has launched numerous NEV products giving more choices to consumers. In marketing, NEV firms have introduced new methods of payment. Technological innovations are seen in the number of technical patents, including the advanced battery technology of BYD Auto Co., Ltd. However, NEV firms need to continue these innovations to heighten consumers' perceived value and win more market share [36,37]. Second, the initial model does not provide sufficient evidence for H2a, H2c, or H2e. However, considering that innovation in products, services, and culture has a direct and significant impact on the consumers' value perception, and given that risk perception also has a direct and significant impact on value perception, it can be considered that innovative behaviors in products, services, and culture have an indirect and significant impact risk perception indirectly through their effects on perceived value [38]. Marketing innovation and technological innovation significantly negatively impact the risk perception of the consumer, while product innovation, service innovation, and cultural innovation have no significant impact on consumers' perceived risk. That is to say, the stronger the marketing and technological innovation of Chinese NEV, the lower the consumer risk perception [39]. However, we observe that innovation in products, services, and culture cannot play a role in consumers' risk perception of NEV. Two new Chinese NEV brands, KANDI and SKIO, have innovated toward a new lease model, moving away from the direct sales model, which can effectively share the one-time acquisition cost of NEV by changing direct sales to installment lease. In addition, they share the maintenance costs of vehicles by reducing procurement costs, making consumers feel safer in terms of economic risk (https://www.diandong.com/zixun/9886.html) (accessed on 7 March 2021). Ultimately, marketing innovations cannot replace the need for continued technological innovations [40]. As we found, customers have high-performance expectations of NEV. If these expectations are met, perceived risk can be reduced.

Product innovation likewise reduces perceived risk as each new generation of products gives greater assurance of quality [12].

Service innovations have a smaller role in impressing customers [12]. In China, big brands NEV has often been regarded as "toys" for the rich, who may not be affected by concerns about the quality of the free service. Cultural innovation is harder to measure and is less readily perceived by consumers and has no significant impact on consumers' perceived risk [41].

Third, we also make an innovative effort to examine whether consumers' innovative characteristics have a moderating effect in the process from perceived value, and perceived risk to purchase intention, we conclude that in the process between risk perception and purchase intention consumers' innovative characteristics will have a positive effect [42]. Our results showed a moderating effect from consumers' innovative characteristics on the process of risk perception and purchase intention, but we observe no significant moderating effect on the process between value perception and purchase intention. The innovation characteristics of consumers are reflective of inclinations to accept new ideas and try new

things-traits that will vary from person to person. It should be pointed out that income level has a huge impact on consumer behavior. For example, to low-income consumers, cost and fuel consumption are inevitably more likely to determine choices. Previous studies have indicated that innovative consumers differ from others in cognition and behavior [43]. Our research supports this in the context of NEV, where innovative consumers tend to want to benefit earlier from new advances. We expected that a consumer with an affinity for innovation would perceive a higher value and display an increased purchase intention, but our analysis does not support this. On the other hand, we did find that consumers with an affinity for innovation did perceive less risk in NEV, which means that consumers' purchase intention is influenced significantly by the effective reduction of perceived risk [43]. This progressive reduction in perceived risk may be one reason why the sales of NEV in China are increasing year by year.

The theoretical contributions of this article have two points. First, some scholars in the past divided firm innovation into five dimensions, namely product innovation, marketing innovation, service innovation, technological innovation, and cultural innovation, whether these five innovation dimensions are applicable to the field of NEV has not been researched by scholars. Second, this article uses consumers' innovative characteristics as a moderator variable of the model, which is an attempt by scholars in the past that has not been done. The practical contribution of this article is that NEV firms can reform their innovative behavior through the data and conclusions of this article, which is a good path for profitability.

### *5.2. Research Limitations and Further Directions*

Even though this research has valuable implications, it possesses some limitations. First, relying on WeChat social group due to research constraints, there is an inherent selection bias meaning our sample may not fully reflect the purchase intention of (potential) Chinese NEV consumers. The scope of the survey will be expanded in follow-up studies. Secondly, the applicability of our conclusions to other industries needs to be verified. Third, this research would benefit from comparative data from other countries for comparison, but no such studies exist at present. In future research, we expect to change these limitations.

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