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Moderating Effect of Collectivism on Chinese Consumers' Intention to Adopt Electric Vehicles—An Adoption of VBN Framework

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Abstract: Vehicle electrification has been promoted as an effective way to tackle environmental issues and the energy crisis worldwide. Being the largest auto market, China witnessed a dramatic increase of sale volume and market share of electric vehicles recently, while the incentives kept decreasing. Normative factors have been found to effectively explain consumers' intention to adopt electric vehicles, but the mechanism remains to be discovered. One of the culture's orientations, namely collectivism, has been proved to have significant impact on consumption behaviors, but the influence of collectivism on intention to adopt electric vehicles in China needs further discussion. Based on 433 questionnaires collected from Chinese consumers, this study adopted the Value–Belief–Norm (VBN) framework and examined collectivism as a moderator variable on the relationship between personal norms and intention to adopt electric vehicles. Data were analyzed using IBM SPSS 27 and PLS-SEM (SmartPLS 3). The results show that the VBN framework successfully explains the intention to adopt electric vehicles of Chinese consumers, and collectivism has a significant positive moderating effect on the relationship between personal norms and intention to adopt electric vehicles. Insights and suggestions from theoretical and managerial perspectives on how to accelerate electric vehicle adoption are discussed for marketers, policymakers and industry practitioners.

Keywords: culture; collectivism; electric vehicles; personal norms; Value–Belief–Norm framework

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1. Introduction

Human action has been widely deemed as the main contributor to environmental problems [1–3]. Environmental degradation has been emerging as a global challenge faced by humankind in the last decades. Various issues such as air pollution, exhausting resources, biodiversity decrease, diminishing rainforests and worsening of water quality have been caused by environment problems. Scholars argue most of the environment problems are caused by human behavior [4,5]. The United Nations (UN) initiated “Sustainable Development Goals” (SDG) to support countries and regions all over the world to develop in a sustainable way, and 17 goals including affordable and clean energy, clean water and sanitation, sustainable cities and communities, climate action and responsible consumption and production have been proposed as common aims for everyone.

An energy crisis is also threatening sustainability development. The price of crude oil has surged dramatically by 65% in 2021 to USD 83 per barrel, and the price of gasoline also witnessed a significant rise in most regions and countries. China has become the country with the highest import of crude oil since 2018 [6], with more than 70% of the crude oil consumed in China being imported [7]. Transportation has drawn significant notice for consuming a majority of crude oil and emitting pollutive substances. According to statistics [8], transportation accounts for 16% of the total CO₂ emitted annually, being the third largest resource globally. Transition to cleaner-energy transportation has been promoted by governments, NGOs, industry and consumers. The advantages of electric

vehicles are prominent. One of the most important points that differs electric vehicles (battery electric vehicles, plug-in hybrid electric vehicles and hybrid electric vehicles) from conventional vehicles is that electric vehicles are more environmentally friendly: no need for petrol or diesel and low emission from their tailpipe. Governments in the world such as China, U.S., India and Japan, as well as the European Union, have been setting plans and enacting policies to guarantee fast transformation into transportation electrification.

Electric vehicles are a unique eco-innovative product for their high-involvement characteristic. Unlike curtailment behaviors such as car usage deduction and recycling, purchasing an electric vehicle could be more complex because it is more expensive, requires more information before making a decision, reflects the image of the consumer and has social values [9]. Two stems of motivational factors have been identified in the literature that influence the intention to adopt an electric vehicle, namely the functional and utilitarian attributes of electric vehicles and the motives for green environmental development [10]. The fact is, even though consumers have stronger propensity to protect the environment, low adoption of electric vehicles leads to discussion of key factors and antecedents of intention to adopt an electric vehicle. While functional factors such as cost and access to charging facilities have been found to influence the decision-making process, normative factors have emerged as a key antecedent [11–13]. EV sales in China skyrocketed in the last several years as government incentives kept declining, and it is challenging for rational-based frameworks to explain this scenario because EV sales surged as the costs were becoming higher. However, the literature has omitted how values, beliefs and norms could influence the intention to adopt an EV in China so far.

Adequate literature on adoption intention and behavior of electric vehicles has been published focusing on a large coverage of antecedents in the last two decades. Nevertheless, there are still gaps remaining. First, the diversity of frameworks adopted needs to be enriched. The majority of existing research utilizes rational theories such as the Theory of Planned Behavior [10,14,15] and Theory of Reasoned Action [16,17], and the Technology Acceptance Model has also been used by [18,19]. Since governments are cutting down the incentives to buy EVs and the sales are still increasing significantly, rational theories might encounter difficulty explaining the current phenomenon. On the other hand, even moral factors have been found to be important to consumers' adoption of EVs, and limited studies have employed moral-based theories, for example, the Value–Belief–Norm theory or Norm Activation Theory. Second, as the diffusion of EVs is accelerating, the perception of consumers might vary accordingly. One important aspect is the social influence effect. According to diffusion of innovation [20], the diffusion of innovative product is influenced by communication over time among individuals in a social system. He categorized consumers and their share of percentage as follows: innovators (1.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggard (15%). As per statistics revealed by CAAM [21], the market share of sale volume of EVs increased dramatically to 16.11% in 2021. Referring to the categorization proposed by diffusion of innovation, China is transferring from the stage of early adopters to early majority. Factors affecting social influence could have critical impact during the diffusion of EVs, and culture is one of them [22].

Culture has been shown to have influence on consumption behaviors [23], and the influence is vital in the context of attitudes and behaviors of sustainable consumption [24]. Furthermore, study on the influence of culture on how consumers make decisions on the purchase of high-involvement products is crucial with the emerging power of consumption, trend of globalization and technology advancement [9]. Stern et al. [25] highlighted that environmental behavior is influenced by how individuals perceive the organization structure of society. Specifically, collectivism has emerged as one of the most important culture orientations to influence pro-environmental behavior, because it distinguishes people's tendency towards a certain type of behavior from a self-construal level. Since pro-environmental behavior is usually altruistic, it considers the trade-off between personal benefit and greater benefit. People that receive effects from collectivism usually prioritize in-group benefits over personal benefits and value in-group harmony. They are more inclined to sacrifice

personal benefits for the greater good for other group members. Stern et al. [25] also found that individualistic people are less likely to perform environmentally friendly behavior, when personal norms are the only antecedent.

Research on the role of collectivism on consumers' intention to adopt electric vehicles is scant, and scholars have been calling for further study on the topic. Previous studies found mixed results: Dogan and Ozmen [26] and Novotny et al. [27] found a positive relationship between collectivism and intention to adopt electric vehicles, while Ashmore et al. [28] and Barbarossa and Pastore [29] asserted the effect is negative. Further study on the relationship between collectivism and intention to adopt electric vehicles is needed as suggested by Afroz et al. [30] and Adnan et al. [31]. Afroz et al. [30] inferred that the collectivist nature of consumers in Malaysia could be positively linked with electric vehicle diffusion, while He and Zhan [12] assumed individualistic culture could promote the translation from personal norms into intention to adopt electric vehicles in China. However, these are all speculations without empirical research. Saleem et al. [32] highlighted the collectivistic tendency of consumers could be influential to the interpretation process from personal norms to intention to adopt electric vehicles. Collectivists have a higher tendency to ascribe responsibility for their behaviors and receive influence of moral judgement during the decision-making process [33,34]. Adnan et al. [31] related the collectivistic nature of Malaysian consumers to the relationship between personal norms and the intention to adopt electric vehicles and assume collectivism might negatively influence the relationship. However, as most previous studies found a positive relationship between collectivism and intention to adopt electric vehicles, it is worth studying how collectivism could moderate the relationship between personal norms and intention to adopt electric vehicles.

To sum up, in order to shed light on the mechanism of electric vehicle acceptance of Chinese consumers using normative-based theory and clarify the effect of collectivism as a factor of social influence, this study aims to examine the intention to adopt electric vehicles in China by adding collectivism as a moderator to the Value–Belief–Norm framework.

2. Literature Review

2.1. Intention to Adopt Electric Vehicles

The intention to adopt electric vehicles could be approached as a propensity to purchase an electric vehicle in the private sphere. First, being emission free and costing less for driving makes electric vehicles an environment friendly product, and it has been suggested in a survey conducted in 2019 that 65.9% of respondents in China prefer an electric vehicle over a conventional vehicle because it is environment friendly [35]. Second, specific constructs on environmental psychology studies are also found to have a close relationship with intention to adopt an electric vehicle, such as environmental concern [36], personal norms [12,31,37] and environmental self-identity [29,38]. Based on the above reasons, the discussion of intention to adopt an electric vehicle would be conducted from pro-environmental behavior perspective. As a pro-environmental product needs to be purchased in the private sphere, electric vehicles are typically a high-involvement product. Compared to low-involvement products, a high-involvement product is costlier, and the decision-making process is more complex. As for cars, the purchasing behavior is complicated due to its high cost, long using time and differences in the perceptions of brands [39]. Research on high-involvement product adoption from the pro-environmental behavior perspective is scant [11], with the majority studies focusing on new energy vehicles/efficient energy system/home appliance, etc.

Electric vehicle sales volume in the Chinese market has witnessed a consecutive and dramatic increase in terms of electric vehicle sales volume in the last several years. The sale volume of electric vehicles in China in 2021 doubled and climbed to 2.88 million units, while it was only 1.2 million in 2020. By the end of 2021, the Ministry of Finance declared all incentives provided to electric vehicles would be terminated starting from 2023 [40]. It could be observed that despite the decline of incentive, the sale volume keeps rising. One possible explanation could be that intrinsic motivation has been the main driver for

intention and behavior to adopt an electric vehicle in China. According to the annual reports on ecological behavior of Chinese citizens, provided by the Policy Research Centre for Environment and Economy (PRCEE), Chinese citizens have a strong awareness of responsibility for environment protection; a survey conducted by Rakuten Insight [35] in 2019 suggested that 65.91% of Chinese consumers prefer electric vehicles over conventional vehicles because “it is environment friendly”.

Another reason that might have been omitted is the impact of the COVID-19 pandemic. Since the start of the pandemic in 2020, electric vehicles have become more popular. Several studies have focused on this phenomenon, and Bouman et al. [41] argued the pandemic makes people feeling more morally compelled and responsible to conduct sustainable acts. Lieven and Hügler [42] suggested that due to the pandemic, the environmental awareness of the public has increased and led to the skyrocket of electric vehicle sales. Wang and Wells [43] predicted that COVID-19 would lead to higher acceptance of electric vehicles among the public. To conclude, many studies have focused on normative and social influence due to the pandemic and argued the acceptance of electric vehicles would be positively affected.

Achtnicht et al. [44] stated that Germans on average are more willing to pay substantial amounts of money to prevent climate change, and Jansson et al. [45] also revealed that being high-involvement products as alternative fuel vehicles are, normative attitudinal factors appear to be more decisive compared to financial factors. Nayum et al. [46] and Haustein and Jensen [47] argued that intrinsic motivations to purchase an electric vehicle would be undermined by extrinsic motivations, such as exceeding financial incentives, and lessening financial incentives would make normative factors the major driving motives, which could be referred to in order to explain the dynamic of the Chinese auto market in the last five years.

In the context of China, interests in study of intention to adopt EVs have emerged in the last decades and various factors have been examined. Besides frameworks following the “utility maximization” theories that argue consumers are always rational, a few studies have recognized the importance of normative factors when discussing the diffusion of electric vehicles. Liao et al. [48] summarized in a literature review on consumer preference for electric vehicles the suggestion that personal norms and social norms are significantly influencing the preference of Chinese consumers towards electric vehicles. Du et al. [49] also depicted that both personal and social norms strongly influence Chinese consumers’ intention to buy an electric vehicle. The normative factor’s direct influence was proved to affect electric vehicle diffusion in China [50], while He and Zhan [12] stated beliefs (awareness of consequence and ascription of responsibility) and personal norms positively influence the intention to adopt electric vehicles of consumers in China. However, studies rarely focus on the role of culture on relationship between normative factors and the intention to adopt an electric vehicle in China.

2.2. Normative Factors and Intention to Adopt Electric Vehicles

Normative factors including values, beliefs and norms have been identified as critical categories that are closely related to intention to adopt an electric vehicle [37]. Among those factors, personal norms are the one that has been drawing continuous attention in the literature. Personal norms have been found as critical constructs that predict the intention to adopt electric vehicles. Many studies found a positive relationship between personal norms and intention to adopt electric vehicles [51–55]. On the other hand, a contradictive result has been revealed by studies [14,46,47,56] suggesting there is weak or no relationship between personal norms and intention to adopt electric vehicles.

The Inconsistent relationship between personal norms and intention to adopt electric vehicles delineates the gap in the literature to further study factors that may moderate the relationship. Stern et al. [25] highlighted that environmental behavior is influenced by how individual perceive the organization structure of society, and individualistic people are less likely to perform environmentally friendly behavior, when personal norms are

the only antecedent. Adnan et al. [31] and He and Zhan [12] suggested the collectivistic nature of individuals might influence the translation from personal norms into intention to adopt electric vehicles; however, no study has been conducted so far. Song et al. [57] also advised future study to focus on the way collectivism influences intention to adopt an electric vehicle in China.

Even though several authors have been calling for more attention on the effects of culture on the intention to adopt an electric vehicle [58,59], relevant study is scant so far. Novotny et al. [26] conducted cross-cultural studies among 21 countries and found that national culture acts as a critical factor influencing the adoption of electric vehicles, and Qian and Yin [60] and Nelson et al. [61] investigated the effects of Chinese culture and the adoption of electric vehicles. The above studies all prove the effects of culture on the intention to adopt an electric vehicle. While China is a country with a high index in collectivism, it is pivotal to figure out how it relates with intention to adopt an electric vehicle.

2.3. Collectivism and Intention to Adopt Electric Vehicles

Cultural orientations have systematic meaningful contribution to pro-environmental behaviors, even though it is both positive and negative [62]. There is no agreed definition of culture in the literature so far. Kluckhohn [63] explained culture by saying “culture is to society what memory is to individuals”. According to Hofstede [64] (p. 6), the definition of culture is “a collective programming of the mind which distinguishes one group from another.” The individualism–collectivism dimension has become one of the most critical syndromes for cultural studies [65], because it concerns how people consider the relationship between the self and others. Moreover, Greenfield [66] argued that the individualism–collectivism indices are the “deep structure” of culture. People in collectivist cultures are inclined to be interdependent within organizations (groups, families, tribes and nations), and they deem the goal of the organizations they are affiliated to as priority [65]. Their behaviors are significantly influenced by the norms and beliefs of the organization, and they tend to sacrifice their personal benefit for the achievement of public benefit [67], while on the other hand, in individualistic culture people are inclined to prioritize self-interest and show less concern about group interest. Barbarossa et al. [68] stated eco-friendly products such as hybrid electric vehicles receive influence from cultural dimensions.

Collectivism is a factor influencing the decision-making process and consumption behavior [69]. Based on their nature, collectivism/individualism plays a critical and influential role in forming pro-environmental attitudes [17]. Studies have shown individualism–collectivism significantly moderates the influence of environmental orientation on pro-environmental behavior [70,71]. White et al. [72] suggested people who view themselves as interdependent self-construal are more inclined to act sustainably. Due to the interdependent-self nature of collectivists, prioritizing greater benefit and minimizing emission to the environment by driving an electric vehicle align with their values, even though barriers might exist such as price premium and range anxiety, mentioned before.

Intention to adopt an electric vehicles has a relationship with collectivism, as has been suggested by many studies. For people with low environmentalism, collectivism positively influences their intention to adopt a hybrid electric vehicle [26]. Novotny et al. [27] stated collectivism as a culture orientation positively influences electric vehicle adoption through a cross-cultural study among 21 countries. Collectivism is also found to influence the intention to adopt an electric vehicle positively [19,73]. Collectivism and altruism could contribute to a higher degree of environment concern, which leads to propensity to adopt fuel-efficient vehicles in Switzerland [74]. A positive and direct relationship between collectivism and intention to adopt an electric vehicle is also found by McLeay et al. [75] and Nelson et al. [61]. However, Ashmore et al. [28] suggested collectivism negatively influences the intention to adopt an electric vehicle in China, because people from collectivistic culture would perceive a Toyota Prius with negative symbolic meanings. However, the result is questionable because, being an entry-level car, negative symbolic meaning from a status perspective could be derived from the ownership. Collectivistic culture orientation has

been observed to have significant moderating influence on relationship between norm and sustainable behaviours [76]. Ali et al. [77] studied the moderating role of collectivism and argued it positively influences the relationship between status motivation and intention to adopt an electric vehicle. Saleem et al. [32] highlighted the urgency to discover the moderating effect of collectivism on the relationship between personal norms and intention to adopt electric vehicles.

Hofstede et al. [64] claimed the dimension of individualism–collectivism is particularly important for investigating the influence of norms because it concerns the perceived relationship between members in a culture. While the relationship between personal norms and intention to adopt electric vehicles has been discussed with mixed results, the moderating effect of collectivism on the relationship remains to be discovered. A negative moderating effect of collectivism has been found on the relationship between personal norms and pro-environmental behavior using a meta-analysis approach [78]. The explanation is that while personal norms are internalized moral obligations, collectivism acts as an external/societal intervention and undermines the interpretation from personal norms to intention, while on the contrary, individualism's advocacy of personal goals is prioritized and hence facilitates the transition from personal norms to intention.

Adequate studies have shown the significant relationship between collectivism and intention to adopt an electric vehicle, but the moderating effects of collectivism on the relationship between personal norms and intention to adopt an electric vehicle are worth study, based on the contradictive results above, because personal norms have been identified as critical constructs to predict the intention to adopt an electric vehicle. Personal norms stress the internal standards that align with intrinsic values and beliefs [79], while collectivists value in-group harmony and are willing to sacrifice for the greater benefit [65]. Fischer et al. [80] argued people in collectivistic culture are more inclined to change their personal norms and align with group norms to avoid conflict with other group members when there is divergence. It could be inferred that, under the context that personal norms align with greater benefit and in-group harmony, collectivism might have positive effects; if personal norms contradict with greater benefit and in-group harmony, it is possible it has negative influence.

In a nutshell, personal norms have been identified as predictive constructs for intention to adopt an electric vehicle, and the moderating effect of collectivism on the relationship needs investigation.

2.4. Underpinning Frameworks on Intention to Adopt Electric Vehicles

2.4.1. Overview

Considering the urgency to diffuse electric vehicles, an increasing interest and number of studies have emerged in last 5 years [81]. Taking the route of pro-environmental behavior analysis, the most adopted frameworks are the theory of Planned Behavior by Ajzen [82] (see [14,15,83] for reference), the Value–Belief–Norm theory by Stern [84] (see [32,37,45,85] for reference) and the Norm Activation Model by Schwartz [86] (see [87,88]). Other theories include the Theory of Reasoned Action [89] (see [16,17] for reference), Diffusion of Innovation theory [20] (see [90]), Technology Acceptance Model [91] (see [18]), etc. The summary has been listed in Table 1.

Two approaches could be observed from theories utilized for studies on the intention to adopt electric vehicles: moral and rational. While TPB as a rational approach theory assumes consumers to be rational and self-interest driven, it supposes that by changing consumers' attitudes and facilitating action barriers, consumers are expected to conduct pro-environmental behaviors. In most of the studies on intention to adopt an electric vehicle, adopting TPB aims to locate the needs and desires of rational consumers and tries to satisfy them [92]. The other approach from a moral perspective believes that consumers are not always rational, and their ecological values and beliefs would form internalized moral obligations that lead to pro-environmental behavior. In studies adopting normative theories, symbolic meanings of electric vehicle, consumer self-identity [29] and

emotions [93] are incorporated to identify which and how values, beliefs and norms would result in intention to adopt electric vehicles. Jansson et al. [37,45] stated normative studies could effectively predict and explain the formation of intention and behavior to adopt electric vehicles.

Table 1. Theory adopted for study on intention to adopt EVs.

Type	Theory	Author	Country
Rational, self-interest	Theory of Planned Behavior	Shalender and Sharma [14]	India
		Liu Rong et al. [15]	China
		Tu and Yang [83]	China
		Moons and De Pelsmacker [90]	Belgium
		Adnan et al. [31]	Malaysia
		Hamzah and Tanwir [10]	Malaysia
		Higuera-castillo et al. [17]	Spain
Moral based	Value–Belief–Norm theory	Alzaharani et al. [16]	Saudi Arabia
		Jansson et al. [45]	Sweden
		Saleem et al. [32]	Pakistan
		Nordlund et al. [85]	Sweden
		He and Zhan [12]	China
New technology products	Norm Activation Model	Javid et al. [88]	Pakistan
		Wang et al. [18]	China
		Wu et al. [19]	China
		Moons and De Pelsmacker [90]	Belgium
New technology products	Technology Acceptance Model	Wang et al. [18]	China
		Wu et al. [19]	China
New technology products	Innovation Diffusion Theory	Moons and De Pelsmacker [90]	Belgium
		Moons and De Pelsmacker [90]	Belgium

From a practical perspective, the dramatic increase of electric vehicle sales in China and declining incentives provided by the government point out a fact that the utility maximization theories and rational consumer assumptions are limited and do not explain the real situation. From a theoretical perspective, researchers have been calling for studies adopting normative factors such as values, beliefs and norms to examine consumers' intention to adopt electric vehicles. Thus, this study would adopt the Value–Belief–Norm framework for study.

2.4.2. Value–Belief–Norm Framework

Stern [25] developed VBN theory by incorporating NAM theory [86] and New Ecological Paradigm (NEP) and value theory [94,95]. The VBN framework believes that values (biospheric, altruistic and egoistic) directly influence beliefs, which are NEP [96], the awareness of consequences (AC) and ascription of responsibility (AR), and beliefs influence personal norms, and personal norms directly influence pro-environmental behavior. The theory postulates a causal chain serial framework and suggests environmental behavior is influenced by personal norms, and personal norms are dependent on an individual's beliefs, which are NEP, AC and AR, and values directly affect beliefs.

In the framework of VBN, value means “a desirable trans-situational goal varying in importance, which serves as a guiding principle in the life of a person or other social entity” [97]. Steg et al. [98] adopted three types of values based on Schwartz's universal values scale [97] when using the VBN framework to examine pro-environmental behaviors, which are biospheric values, altruistic values and egoistic values, to represent both self-enhancement and self-transcendence dimensions. Biospheric values refer to how the individual concerns the quality of nature and the environment for its own sake, without considering the welfare and interest of other human beings [99]. Altruistic values differ from biospheric value because it takes the interest and welfare of others into consideration. Ego-

istic values focus on an individual's own interest rather than others when making decisions. NEP developed by [96] concerns "the propensity to take actions with pro-environmental intent" [84]. In the scale of NEP, 15 items measure how respondents care for the environment and perceive the relationship between humankind and nature, and emphasizes on five aspects [96], namely balance of nature, human domination, human exemption, ecological catastrophe and limitation of growth. Two other beliefs mentioned in the VBN framework are awareness of consequences and ascribed responsibility. Awareness of consequences indicates the consciousness level of adverse consequences of an individual for not acting pro-environmentally [94]; while ascribed responsibility could be explained as the feeling of being responsible for negative results caused if not acting pro-environmentally [100]. Personal norms refer to the sense of feeling obligated to perform a specific action [101]. Figure 1 shows the structure of the VBN framework.

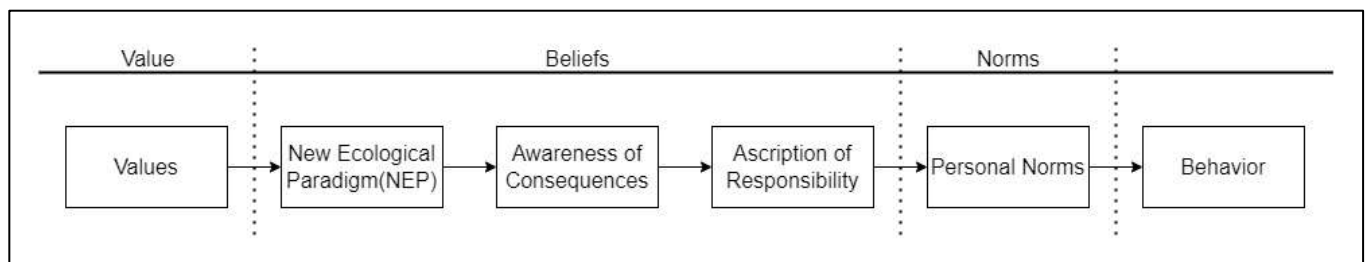


Figure 1. VBN framework by Stern [84].

Many studies have adopted VBN theory to analyze pro-environmental behaviors such as acceptability of energy policies [98], sustainable transportation [102], fair trade consumption [103], green transportation policy [104] and sustainable tourism [105]. The majority of studies revealed that VBN explains a considerable variance of behaviors and is illustrative to understand and predict pro-environmental behavior. It is worth noting that among the constructs in the VBN model, personal norms appear to be the variable that explain the variance most.

VBN has been used to predict purchase behavior/intention of high-involvement products such as electric vehicles. As Jansson et al. [106] argued, even though eco-innovations (such as electric vehicles) are expensive and highly involved with other aspects, it is carried out within a moral domain, with other aspects being influential as well. Studies [32,37] adopt the VBN framework and effectively predict and explain the intention of consumers to adopt alternative fuel vehicles in Sweden and Pakistan, while other studies incorporate additional factors. Jansson et al. [37] incorporated habit and knowledge with VBN to predict the intention to adopt alternative fuel vehicles, Nordlund et al. [85] added constructs from NAM into VBN to investigate the intention of consumers to switch to hybrid/electric vehicles and Nayum et al. [46] integrated VBN with TPB and Barbarossa et al. [68] combined green self-identity with VBN. After reviewing all studies, it could be illustrated that (1) as a normative framework, VBN is capable to being adopted for an electric vehicle purchase intention study, and (2) incorporation of other factors is suggested to increase the ability of the VBN framework to explain the formation of intention.

Value

The value orientation of PEB, as argued by Stern et al. [107], could be sorted into egoistic, altruistic and biospheric values. Three kinds of value orientations are all concerned with environmentalism but with different underlying bases: egoistic attitude consumers concern costs and benefits of pro-environmental behavior at a personal level; consumers with an altruistic attitude care about environmental problems concerning the benefit to others; biospheric attitude consumers conduct pro-environmental behaviors concerning the benefit for all living species in the ecosystem, regardless of the costs and benefits to consumer themselves.

As mentioned above, values act as guiding principles for the individual when making decisions. It could be inferred that values reflect what people desire and what kind of person they want to be like. People with biospheric values evaluate the cost and benefit of their behavior on the ecosystem [108]. Altruistic values drive people to act based on the evaluation of the effect of their behavior on the benefit and wellbeing of other people. It is suggested that altruism positively influences pro-environmental behaviors [109]. On the other hand, egoistic values focus on self-interest and personal gains and have been found to negatively related to environmentalism [110]. In the VBN framework, Stern [84] argued that biospheric values, altruistic values and egoistic values influence belief directly.

Being the critical guidance to people's behaviors, personal values act as relatively stable and consistent goals that people desire and obey [97]. It has been widely discussed how values significantly influence consumer behaviors [107,111]. Biospheric values could be predictive to how an individual values the environment to his or her life [112]. NEP measures how people evaluate the effects or adverse effects by acting or not acting pro-environmentally [96]. Since people with high biospheric values would give more priority to environment protection and resource preservation, it could be inferred that biospheric values significantly influence NEP.

Hypothesis 1 (H1). *Biospheric values are significantly related to the New Ecological Paradigm.*

Altruistic values concern the effects of an individual's behavior on other people's benefits [107]. Jansson [37] and Saleem et al. [32] all revealed that altruistic values are positively related to NEP. Since protecting the environment is beneficial to all residents in the community, it could be suggested that altruistic values align with opinions that actions protecting the environment should be encouraged. This study hypothesizes that consumers' altruistic values will significantly relate with their NEP.

Hypothesis 2 (H2). *Altruistic values are significantly related to the New Ecological Paradigm.*

Divergence between egoistic values and the other two (biospheric and altruistic values) is that egoistic values are self-enhancement-related and tend to exploit and dominate nature and the environment's resources for personal benefit. Based on this difference, it could be assumed that egoistic values negatively relate with NEP because an individual with egoistic values would evaluate the perceived gains and costs from a self-interest perspective, and if the cost exceeds the benefits to the individual, they would not act pro-environmentally [106].

However, the scenario changes in the discussion of high-involvement products. Rahman [113] and Saleem et al. [32] suggested that when testing the relationship between egoistic values and NEP in the context of electric vehicle purchase intention, it turned out to be positive. Possible explanations could be that (1) electric vehicles help individuals with high egoistic value to gain status and reputation. According to cost signaling theory [114], purchasing a high-involvement product such as an electric vehicle while paying an amount of a price premium symbolizes the social status of the individual to others, and (2) highly egoistic individuals are interested in the saved incurring cost after purchase, even if some electric vehicles might be priced higher, and they aim to save more in future usage than the price premium at the moment of purchasing. Since, as discussed before, electric vehicles have symbolic meaning for owner and would be more fuel-efficient, it could be assumed that egoistic values positively influence NEP.

Hypothesis 3 (H3). *Egoistic values are significantly related to the New Ecological Paradigm.*

Belief

Belief consists of the New Ecological/environmental Paradigm (NEP) [96], awareness of consequence (AC) and ascription of responsibility (AR). Stern [84] believed that values

directly influence belief, through the consequence of NEP, AC and AR. NEP is a scale created to measure the ecological worldview of individuals, containing 15 items. Stern et al. [107] suggested that all three values are related to NEP, and while biospheric and altruistic values are positively related with NEP, egoistic values negatively influence NEP because they concern self-interest and desire dominance over the environment [115].

AC and AR are incorporated from NAM of altruism [86], and in VBN, Stern proposed that NEP directly influences AC, and AC affects AR directly. NEP measures the extent to which an individual understands the possible adverse results of acting/or not acting pro-environmentally, and AC refers to the belief that an individual is aware of the existing environmental issues and the probability that the issues would happen and the severe consequences. Since NEP contains items measuring the ecological worldview and how people evaluate the adverse result of not acting pro-environmentally, it could be argued that NEP has a relationship with AC, as it concerns an awareness of consequences. Stern [25] argued that as individuals have a deeper concern about the environment, they tend to have a stronger awareness of consequences.

Hypothesis 4 (H4). *The New Ecological Paradigm is significantly related to AC.*

Ascription of responsibility is explained by De Groot and Steg [100] as the feeling of being responsible for negative consequences caused if not acting pro-environmentally. The relationship between AC and AR has been tested to be positively related by [86,100]. Because if an individual is aware of the adverse consequence of not acting pro-environmentally, the responsibility could be attributed to not acting in an environmentally friendly way. Thus, this study proposes that AC positively relates to AR.

Hypothesis 5 (H5). *AC is significantly related to AR.*

Ascription of responsibility means an awareness of being held responsible for negative environmental impacts, and it may stimulate guilt and regretful feelings in individuals. Schwartz [86] believed that guilt and regret will make individuals feel more obliged to act pro-environmentally, from a moral perspective. In this study, consumers may feel morally obliged to purchase electric vehicles to reduce carbon emission to protect the environment because mass emission has led to hazardous pollution and corresponding environmental deteriorations. This study proposes that AR positively influences personal norms.

Hypothesis 6 (H6). *AR is significantly related to personal norms.*

Personal Norms

Schwartz [86] defined personal norms as feeling morally obliged to conduct certain behaviors. Personal norms have been included in the NAM and VBN model, reflecting that personal norms are internalized values and moral obligations [84,86]. It should be noted that personal norms are different from social norms. Social norms have been identified as a critical antecedent in the behavioral study domain and have been adopted by models such as TRA and TPB [82,89], while social norms have been defined as “an individual’s perception that most people who are important to her should (or should not) perform a particular behaviour”.

Most pro-environmental behaviors are not enjoyable: cycling means more effort and less comfort, recycling means more work to perform, shorter showing time means less joy, etc. Thus, conduction of pro-environmental behavior requires higher moral obligation, which would drive consumers to perform behaviors proactively and needless of external incentive or punishment. Stets and Carter [116] suggested people may feel guilty if they did not act in line with moral obligations. In the context of this study, personal norms have been identified as one of the most critical constructs to predict and explain the intention to adopt electric vehicles.

In this study, personal norms refer to the personal feeling of being morally obliged to purchase an electric vehicle. As has been found by much previous research, personal norms are a major predictor for electric vehicle adoption [12,37,52,85]. The stronger an individual feels morally obliged to purchase an electric vehicle, the more propensity for electric vehicle adoption. This study hypothesizes that personal norms influence the intention to adopt an electric vehicle.

Hypothesis 7 (H7). *Personal norms are significantly related to the intention to adopt an electric vehicle.*

Intention to Adopt Electric Vehicles

The dependent variable of the proposed framework is the intention to adopt an electric vehicle. The fundamental aim of the study is to provide insight into how to accelerate the diffusion of electric vehicles. However, due to the complexity of the decision-making process of automobile purchasing [39] and high involvement of character, it is hard to measure their actual purchase behavior. Intention has been recognized as a vital proxy for electric vehicle adoption, and many studies use intention as an indicator for actual behavior [12,68,117].

The behavioral intention, as Ajzen [82] described in the theory of planned behavior, could be an indication of how hard people are willing to try or are planning to perform a specific behavior. Ajzen [82] further declared that intention directly influences the behavior. Moreover, Kusumawati [118] argued that as the behavioral intention becomes stronger, the possibility of behavior implementation increases. It could be inferred that the dependent variable intention to adopt an electric vehicle could present how strongly consumers are willing to adopt an electric vehicle and partly demonstrate how the behavior could possibly be implemented.

Various studies both in single and cross-cultural contexts found that cultural orientation plays a critical role in consumer behavioral studies and further extends the research area to pro-environmental behaviors [119–121]. With the overarching aim of collectivism focusing on interdependent relationships with others, prioritizing group benefit over personal benefit, maintaining harmony within the group, etc., the salient relationship between collectivism and pro-environmental behavior has been illustrated by multiple research [122–124]. Studies [26,74,75] have also illustrated a positive relationship between collectivism and adoption of electric vehicles.

When proposing VBN theory, Stern [25] emphasized that individualism–collectivism values from culture theory could add the ability to explain relevant behaviors by carrying out empirical study. Similar to arguing that values are the basic foundation for beliefs and norms and are crucial to the framework, he further explained that individualism–collectivism values are critical because they concern “how society should be organized” [25] (p. 91). Both values and cultural orientations are important factors determining an individual’s beliefs, norms and intentions.

People with personal norms to act pro-environmentally are driven by an intrinsic moral obligation, but other factors might inhibit the translation from personal norms to intention to adopt electric vehicles, such as other people’s opinion and personal loss. If the significant others around an individual care for the greater benefit and prioritize group benefit, they are more inclined to support the adoption of electric vehicles, and then the individual may have more propensity to adopt an electric vehicle. Moreover, if the consumer is collectivist, he may be less reluctant to pay for the price premium of an electric vehicle because a sacrifice of personal benefit for the greater good is promoted. Moreover, Bandura [125] argued that collectivist individuals would derive higher efficacy because acting pro-environmentally is ethical and supported and would believe other individuals in the group would act accordingly in the same way, which would increase the perceived collective efficacy. It could be further inferred that the higher the collectivism, the stronger the moderating effect it has. This study proposes that collectivism moderates the relationship between personal norms and intention to adopt electric vehicles.

Hypothesis 8 (H8). *Collectivism moderates the relationship between personal norms and intention to adopt electric vehicles, and the moderating effect is stronger when collectivism is higher.*

In summary of the hypotheses mentioned above, the framework is demonstrated in Figure 2 below.

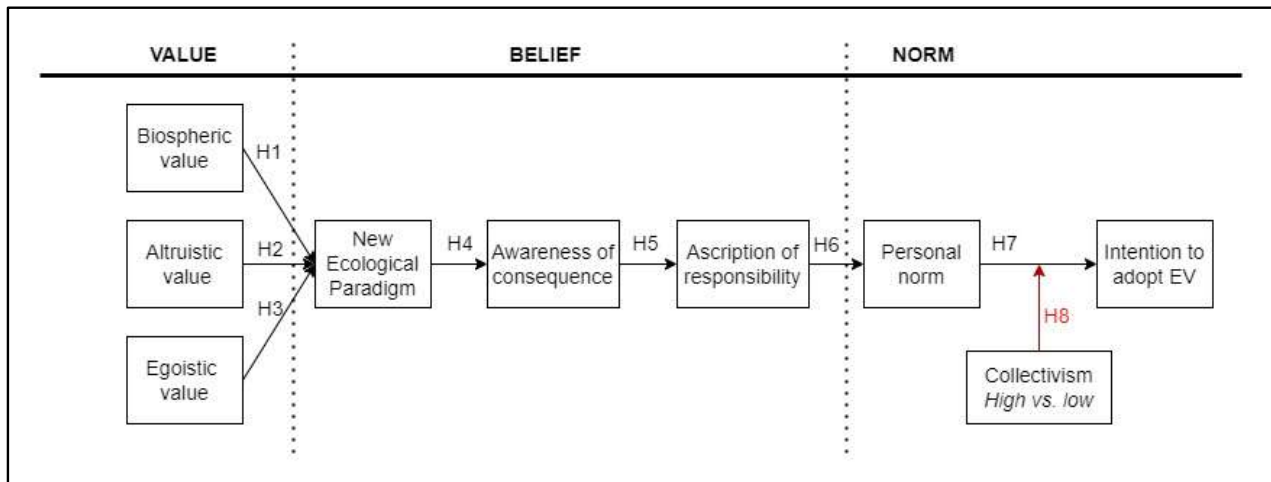


Figure 2. The proposed framework by the author.

3. Method

3.1. Sampling Method and Sample Size

Non-probability sampling approach was selected for this study because the population is individuals who are 18 years old or above. Probability sampling approach could not guarantee all participants meet the criterion. Multi-stage sampling is suitable for this study, comprising purposive sampling and convenience sampling. In the initial stage, respondents who were not eligible for this study were excluded, and then to those who meet the criterion, convenience sampling was adopted for data collection. Due to COVID-19 pandemic, central and local government in China are locking down public areas for pandemic concern and encouraging people to conduct work and research online. Hence, this study used online questionnaire. In the statement of questionnaire, it was stated that “Kindly be informed that if you are 18 years old and above, you are eligible to answer this questionnaire and thank you for your interest”. The advantage of convenience sampling is it consumes less time and effort compared to other methods, while the limitations are low likelihood of representativeness of sample and low control over the content of sample. Even though there are critiques on convenience sampling for lacking representativeness, in this study it is acceptable because after initial purposive sampling, all participants are eligible, and representativeness could be promoted with enough sample size.

Hair et al. [126] suggested Gpower as an effective method for minimum sample size calculation. Linear multiple regression in *t*-test family was used because of the nature of structural equation modelling analysis with partial least square estimation theory [126,127]. By running Gpower 3.1.9.7 (program written by Franz Faul, Universität Kiel, Kiel, Germany), two-tailed calculation was chosen, and the effect size was set to 15% because it was common in marketing research [126]. Confidence level of this study is 95% ($\alpha = 0.05$) and power is 95%. Total number of predictors of this study is 9. Minimum sample size for this study as suggested by Gpower is 89. However, larger sample size produces higher credibility [128]. Kline [128] further argued minimum sample size for factor analysis should range from 30 to 460. After promotion online several times, 435 questionnaires were collected in the end.

3.2. Measurements

Values (biospheric, altruistic and egoistic) were adopted from Steg et al. [98], consisting of twelve items with four items for each of the three values. NEP was adopted from Dunlap et al. [96] and consists of 15 items. Behavior-specific measurements of AC (5 items), AR (5 items) and personal norms (8 items) are adopted from Jansson et al. [45], because behavioral-specific measurement is more effective to predict behavioral intention than general measurement [129]. Intention to adopt electric vehicles (4 items) was adopted from Nordlund et al. [85], and collectivism (5 items) was adopted from McCarty and Shrum [124]. A total number of 9 constructs and 54 measurements are included in this questionnaire. All items use 7-Likert scale. Since the population are Chinese local citizens and speak Mandarin as their first language, the questionnaire was translated into Mandarin by a Chinese professor specialized in foreign language literature. Table 2 illustrates the definition, measurement and source of each construct.

Table 2. Definition and measurement of research model.

Measurement	Definition	Measurement	Source
Biospheric values	Biospheric values reflect a concern for the environment in itself, without a clear link to human beings.	BV1 Preventing pollution: protecting natural resources.	[98]
		BV2 Respecting the earth: harmony with other species.	
		BV3 Unity with nature: fitting into nature.	
		BV4 Protecting the environment: preserving nature.	
Altruistic values	Altruistic values reflect guiding principles that motivate individuals to contribute to the wellbeing of others or of society as a whole.	AV1 Equality: equal opportunity for all.	
		AV2 A world in peace: free of war/conflict.	
		AV3 Social justice: correcting injustice, care for the weak.	
		AV4 Helpfulness: working for the welfare of others.	
Egoistic values	Egoistic values reflect a focus on the costs and benefits a choice has on someone's resources and on power or achievement.	EGV1 Influence: having an impact on people and events.	
		EGV2 Social Power: control over others, dominance.	
		EGV3 Wealth: material possessions, money.	
		EGV4 Authority: the right to lead or command.	
New Ecological Paradigm	Fundamental belief about the interconnection between people and the environment.	NEP1 We are approaching the limit of the number of people the earth can support.	[96]
		NEP2 Humans have the right to modify the natural environment to suit their needs (RC).	
		NEP3 When humans interfere with nature, it often produces disastrous consequences.	
		NEP4 Human ingenuity will ensure that we do NOT make the earth unlivable (RC).	
		NEP5 Humans are severely abusing the environment.	
		NEP6 The earth has plenty of natural resources if we just learn how to develop them (RC).	
		NEP7 Plants and animals have as much right as humans to exist.	
		NEP8 The balance of nature is strong enough to cope with the impacts of modern industrial nations (RC).	
		NEP9 Despite our special abilities, humans are still subject to the laws of nature.	
		NEP10 The so-called "ecological crisis" facing humankind has been greatly exaggerated (RC).	

Table 2. Cont.

Measurement	Definition	Measurement	Source
		NEP11 The earth is like a spaceship with very limited room and resources.	
		NEP12 Humans were meant to rule over the rest of nature (RC).	
		NEP13 The balance of nature is very delicate and easily upset.	
		NEP14 Humans will eventually learn enough about how nature works to be able to control it (RC).	
		NEP15 If things continue on their present course, we will soon experience a major ecological catastrophe.	
Ascription of responsibility	The belief of being responsible for negative consequences caused if EVs not adopted.	AC1 Driving a car fueled by electricity decreases the greenhouse effect.	
		AC2 Global warming is a problem for society.	
		AC3 The continued increase in the use of fossil fuels such as oil/petrol/diesel is a problem.	
		AC4 The quality of the environment will improve if we decrease the use of fossil fuels such as oil/petrol/diesel.	
		AC5 The depletion of fossil fuels such as oil/petrol/diesel is a problem.	
Ascription of responsibility	The belief of being held responsible for over-consuming fossil fuels and not adopting EVs.	AR1 I feel partly responsible for the increase in the use of fossil fuels such as oil/petrol/diesel.	[45]
		AR2 Not only the government and the industry are responsible for the increase in the use of fossil fuels such as oil/petrol/diesel; I am too.	
		AR3 I am partly responsible for the fossil oil problems in society today.	
		AR4 I feel partly responsible for global warming.	
		AR5 In principle, sole individuals like me cannot contribute to the decrease of the use of fossil fuels such as oil/petrol/diesel (RC).	
Personal norms	A moral obligation felt by an individual if not adopting EV or consuming fossil fuels.	PN1 I feel a moral obligation to conserve fossil fuel and protect environment no matter what other people do.	
		PN2 I feel that it is important to travel as little as possible by car using fossil fuel.	
		PN3 I feel a moral obligation to drive an electric car instead of a conventional car.	
		PN4 People like me should do everything they can to decrease use of fossil fuels such as oil/petrol/diesel.	
		PN5 I feel guilty when wasting fossil fuels such as oil/petrol/diesel.	
		PN6 I would be a better person if I drove using electricity.	
		PN7 I personally feel that it is important to think about the environment in my everyday behavior.	
		PN8 If I were to replace my car today, I would feel a moral obligation to replace it for a car fueled by electricity.	
Intention to adopt EV	The propensity of consumer to adopt EV in future.	INT1 I intend to buy/switch to an EV in the nearest future.	[85]
		INT2 I intend to buy/switch to an EV next time I switch car.	
		INT3 I am convinced I will own an EV in 5 years.	
		INT4 I am convinced I will own an EV in 10 years.	

Table 2. Cont.

Measurement	Definition	Measurement	Source
Collectivism	A culture orientation that prioritizes the group over the individual.	COL1 I work hard for the goals of a group, even if it does not result in personal recognition.	[124]
		COL2 I am a cooperative participant in group activities.	
		COL3 I readily help others in need of help.	
		COL4 I do what is good for most of the people in the group, even if it means that I will receive less.	
		COL5 I often share items and moments with others.	

Note: RC means the item is reverse coded.

Besides measurements for all constructs in the study, 8 socio-demographic questions are included in the questionnaire for data collection, covering gender, age, education, marital status, personal monthly income, household car ownership, number of children and location of residence. The objective to collect socio-demographic information is to understand the background of respondents and to detect if there is anything abnormal to the data. The socio-demographic variables are not collected with the aim to test the relationship with other variables or set them as control variables in this study. There have been adequate studies focusing on the influence of demographic and economic variables to adoption intention of EVs; hence, this study did not include it as research objective.

3.3. Data Analysis

Researchers are advised to choose appropriate type of SEM according to the objective of study. If the study is confirmatory and aims to test or compare a theory, CB-SEM is suitable for adoption; if the study is designed in order to explore and develop current theory with modifications, PLS-SEM should be deployed. In this study, the research objective is to explore the effects of constructs based on VBN framework, so PLS-SEM will be used and SmartPLS was selected for data analysis. The PLS-SEM is suitable for this study because it is compatible with theory exploration studies, and Hair et al. [130] stated PLS-SEM should be used only when hypotheses are proposed with profound theoretical underpinnings, which may guarantee the results are explainable. Assessment of measurement model and structural model will be conducted to examine the path coefficient and moderation, and mediation effects will be investigated.

3.4. Data Collection

Before collecting data, a pilot study was conducted. The questionnaire was sent to three scholars with Ph.D. title and specialized in marketing discipline for validity assessment. Then, the questionnaire was sent to a professor of literature for translation assessment because the questionnaire would be distributed in Mandarin. The questionnaire was distributed to people above 18 years old, and 50 questionnaires were collected for pilot study. The Cronbach' alpha value was analyzed using IBM SPSS 27 (IBM Corporation, Armonk, NY, USA). The total reliability of the questionnaire is 0.940 and should be considered acceptable for data collection to receive consistent answers [131].

Due to the movement control policies and pandemic threats, the questionnaires were distributed online through social media platforms. The collection was aimed at people who are above 18 years old, and only those who met this criterion were encouraged to participate. In total, 441 questionnaires were collected after several stages of promotion, and 6 subspurious responses (straight line answers with selecting "1", "4" or "7" to all questions) were removed as suggested by Hair et al. [132]. Using IBM SPSS 27, a descriptive analysis was performed, and 2 outliers were deleted with Z-score higher than 4 (rule of thumb advised by Hair et al. [133]). Finally, 433 responses were collected for data analysis. Reverse coding has been conducted since there are reversed worded items in the questionnaire.

4. Results and Findings

In social science studies, common method variance has been viewed as a problem affecting the credibility of research results and should be avoided. This study used both procedural and statistical remedies to avoid common method variance [134]. For the procedural remedy, all participants were informed the data would be completely confidential, and there are no right or wrong answers. For the statistical remedy, both Harman’s single factor test and common method factor analysis proposed by Liang [135] were conducted to detect if there is common method variance in the data. Harman’s single factor test conducts exploratory factor analysis by importing all variables and checking if the variance accounting for of any single factor exceeds a standard, for example 50% [134]. If the variance is higher than 50%, it could be suggested that the data are subject to common method variance; if the result is lower than 50%, the conclusion could be made that the data are not influenced by common method variance. IBM SPSS 27 was used for this study to conduct Harman’s single factor test with the collected data. The result after data processing was 22.184%, below the criterion set for 50%. Following Liang et al. [134,135], common method factor analysis was conducted by changing all indicators into single-indicator second-order constructs and relating the constructs with a method factor consisting of all the indicators of the principal constructs (Figure 3). The average substantive and method variance are 0.781 and 0.003, and the ratio is 28.5:1 (Appendix A). Even though many social science studies adopt Harman’s single factor analysis to detect common method variance, common method factor analysis paves another innovative and insightful way. In this study, both ways returned negative results, suggesting that common method variance is not a major concern in this study.

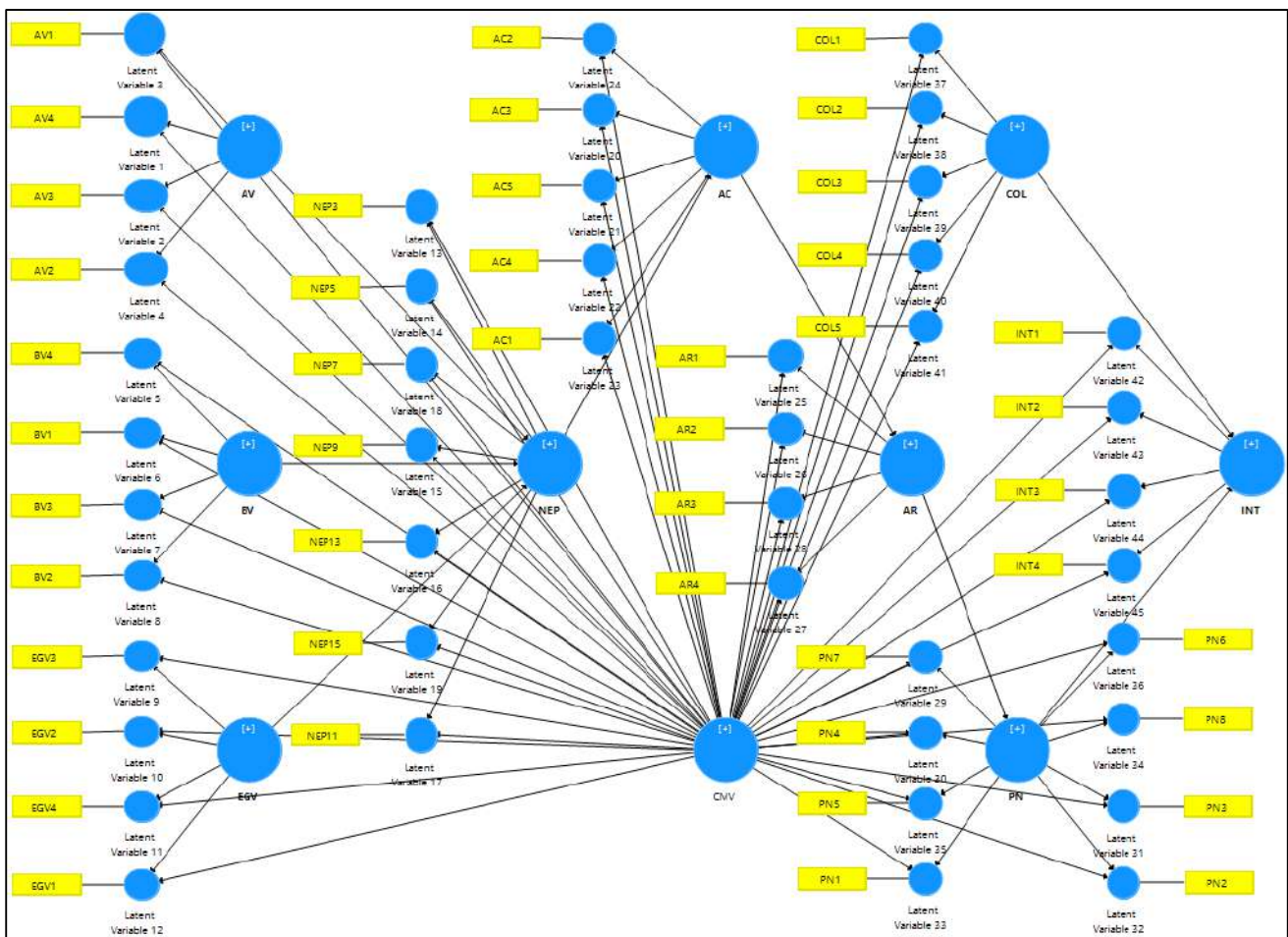


Figure 3. Common method factor analysis.

4.1. Demographic Distribution of Respondents

Respondents' profiles have been presented in Table 3. In terms of gender, there are 167 male respondents (38.4%) and 268 female respondents (61.6%). The majority of respondents were ages from 18–30 (251 respondents, 57.7%), followed by 31–40 (71, 16.3%), 41–50 (48, 11%), 51–60 (54, 12.4%) and above 60 (11, 2.5%). Moreover, 10 people hold a diploma from junior high school (2.3%), 9 people hold a diploma from senior high school (2.1%), 159 people hold a graduate diploma (36.6%) and 251 people hold a postgraduate diploma (57.7%), and there are also 6 respondents who chose others (1.4%). From a personal income perspective, 240 respondents have an average personal monthly income below CNY 5000 (55.2%), while 128 respondents were from CNY 5000–10,000 (29.4%), 59 respondents were from CNY 10,000–20,000 (13.6%) and 8 respondents were above CNY 20,000 (1.8%).

Table 3. Respondents' profiles.

Demographic Variables		Frequency	Percentage
Gender	Male	167	38.4%
	Female	268	61.6%
Age	18–30	251	57.7%
	31–40	71	16.3%
	41–50	48	11.0%
	51–60	54	12.4%
	Above 60	11	2.5%
Education	Junior school	10	2.3%
	High school	9	2.1%
	Undergraduate	159	36.6%
	Postgraduate	251	57.7%
	Others	6	1.4%
Personal income (RMB Yuan)	Below 5000	240	55.2%
	5000–10,000	128	29.4%
	10,000–20,000	59	13.6%
	Above 20,000	8	1.8%
Car ownership (household)	0	87	20.0%
	1	234	53.8%
	2	95	21.8%
	3 or more	19	4.4%
Marital status	Married	183	42.1%
	Single	252	57.9%
Number of kids	0	265	60.9%
	1	130	29.9%
	2	36	8.3%
	3 or more	4	0.9%
Location of residence	Urban area	302	69.4%
	Rural area	49	11.3%
	Village	84	19.3%

Regarding household car ownership, 234 respondents have one car in their family (53.8%), 95 respondents have two cars in their family (21.8%), 87 respondents do not have any car in their family (20.0%) and 19 respondents have three or more cars in their family (4.4%). Regarding marital status, 252 respondents are married (57.9%) and 183 respondents are single (42.1%). Regarding number of kids, 265 respondents do not have any children (60.9%), 130 respondents have one child (29.9%), 36 respondents have two children (8.3%) and 4 respondents have three or more children (0.9%). Regarding location of residence, 302 respondents live in an urban area (69.4%), while 49 respondents live in a rural area (11.3%) and 84 respondents live in a village (19.3%).

4.2. Measurement Model Assessment

For measurement model assessment, reliability and validity of measurements of each construct are examined. Composite reliability is used to evaluate the internal consistency reliability of the constructs [136]. For validity assessment, convergent validity is examined by assessing outer loadings and average variance extracted (AVE), while discriminant validity is examined using Fornell–Larcker criterion analysis, cross-loadings and Heterotrait–Monotrait (HTMT) ratio. The results are presented in Tables 4 and 5.

Table 4. Measurement model assessment results.

Constructs	Indicators	Outer Loadings	Cronbach's Alpha	Composite Reliability	AVE	\sqrt{AVE}
Awareness of consequence	AC1	0.548	0.811	0.872	0.585	0.765
	AC2	0.8				
	AC3	0.901				
	AC4	0.63				
	AC5	0.881				
Ascription of responsibility	AR1	0.849	0.833	0.799	0.799	0.894
	AR2	0.883				
	AR3	0.948				
	AR4	0.893				
Altruistic values	AV1	0.75	0.83	0.887	0.664	0.815
	AV2	0.756				
	AV3	0.873				
	AV4	0.872				
Biospheric values	BV1	0.909	0.901	0.931	0.772	0.879
	BV2	0.796				
	BV3	0.911				
	BV4	0.895				
Collectivism	COL1	0.809	0.848	0.891	0.622	0.789
	COL2	0.78				
	COL3	0.762				
	COL4	0.832				
	COL5	0.756				
Egoistic values	EGV1	0.775	0.828	0.88	0.652	0.807
	EGV2	0.87				
	EGV3	0.606				
	EGV4	0.939				
Intention to adopt EV	INT1	0.743	0.839	0.892	0.675	0.822
	INT2	0.851				
	INT3	0.873				
	INT4	0.813				
New Ecological Paradigm	NEP11	0.695	0.771	0.861	0.47	0.686
	NEP13	0.613				
	NEP15	0.71				
	NEP3	0.73				
	NEP5	0.668				
	NEP7	0.626				
	NEP9	0.745				

Table 4. Cont.

Constructs	Indicators	Outer Loadings	Cronbach's Alpha	Composite Reliability	AVE	\sqrt{AVE}
			0.871	0.898	0.527	0.726
Personal norms	PN1	0.741				
	PN2	0.809				
	PN3	0.781				
	PN4	0.742				
	PN5	0.685				
	PN6	0.652				
	PN7	0.613				
	PN8	0.763				

Table 5. Heterotrait–Monotrait (HTMT) ratio analysis results.

	COL	AC	AR	AV	BV	EGV	INT	NEP
AC	0.467							
AR	0.48	0.576						
AV	0.38	0.451	0.274					
BV	0.27	0.428	0.262	0.666				
EGV	0.117	0.114	0.082	0.116	0.073			
INT	0.385	0.246	0.332	0.072	0.109	0.09		
NEP	0.351	0.525	0.42	0.258	0.297	0.107	0.21	
PN	0.598	0.703	0.719	0.357	0.333	0.129	0.497	0.468

Note: COL = collectivism; AV = altruistic values; BV = biospheric values; EGV = egoistic values; NEP = New Ecological Paradigm; AC = awareness of consequence; AR = ascription of responsibility; PN = personal norms; INT = intention to adopt EV.

From the results demonstrated in Tables 4 and 5, it could be concluded that all constructs have satisfactory reliability (Cronbach's alpha and composite reliability above 0.7). In terms of convergent validity, Hair et al. [133] provided a rule of thumb suggesting that items with outer loadings higher than 0.7 could be satisfactory. Outer loadings between 0.4 and 0.7 should be considered for elimination. The majority of items have satisfactory outer loadings higher than 0.7, while several items have outer loadings between 0.4 and 0.7. Although they could be considered eliminated according to rule of thumb, Hair et al. [132] argued that if the elimination of indicators that have outer loadings between 0.4 and 0.7 could not increase the AVE of a construct, it could be retained. All constructs have an AVE higher than 0.5, except for NEP (0.47). Fornell and Larcker [137] advised that the validity of a construct is still adequate and acceptable if the composite reliability of the construct is higher than 0.6.

For discriminant validity, Fornell–Larcker criterion analysis is to compare the square root of AVE of a construct with its correlations with other constructs, and all constructs meet the criterion for Fornell–Larcker analysis with the highest value of square root of AVE compared with correlations with other constructs. The rule of thumb for HTMT ratio analysis is if the value is higher than 0.85, the discriminant validity is unacceptable; otherwise, it could be concluded the validity is discriminant [128]. As shown in Table 4, no value is higher than 0.85. Different from the Fornell–Larcker criterion analysis, which compares correlations between constructs, cross-loadings analysis focuses on each indicator of all constructs and examines if the loadings of any indicator to the other construct is higher than to its own construct [138]. After calculation by running the PLS algorithm, the results of cross-loadings analysis of all indicators in this study are presented (see Supplementary Files). It could be concluded that all indicators have higher loadings to their own constructs. All constructs have satisfying reliability and validity results after measurement model assessment, and the next step in structural model assessment will be conducted.

4.3. Structural Model Assessment

4.3.1. Collinearity Assessment

The aim of structural model assessment is to examine the model’s ability to predict the relationships between the constructs of Hair et al. [132]. The procedure has been advised as five steps, which are (1) assess structural model for collinearity issues, (2) assess the significance and relevance of the structural model relationships, (3) assess the level of R^2 , (4) assess the effect sizes f^2 and (5) assess the predictive relevance Q^2 and the q^2 effect sizes [132] (p. 169) (see Figure 4). Moreover, this study would conduct mediation and moderation analysis to test relevant proposed hypotheses.

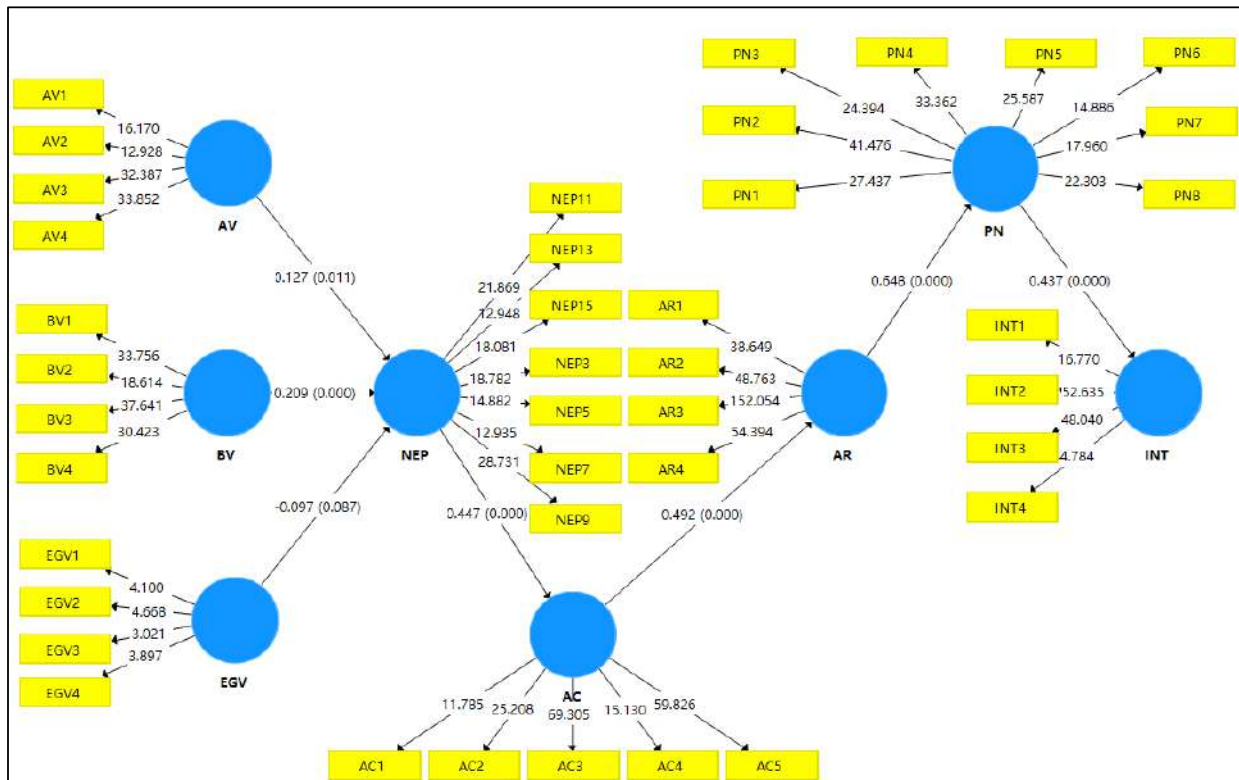


Figure 4. Structural model analysis.

Collinearity assessment is necessary since the path coefficients between constructs might be biased when significant collinearity exists among constructs. This is due to the OLS regression nature of path coefficients estimation in PLS-SEM [132]. SmartPLS 3 (Oststeinbek, Germany) is utilized to assess the collinearity among constructs to obtain the variance inflation factor (VIF) of constructs that point to the same construct. VIF indicates to what extent there is an error variance for the unique effect of a predictor. Using SmartPLS 3, the VIF values of all constructs have been analyzed and shown in Table 6.

Table 6. VIF of all constructs.

	New Ecological Paradigm	Ascription of Responsibility	Personal Norms	Awareness of Consequence	Intention to Adopt EV
Altruistic values	1.503				
Biospheric values	1.504				
Egoistic values	1.008				
Awareness of consequence		1			
Ascription of responsibility			1		
New Ecological Paradigm				1	
Personal norms					1

The rule of thumb to examine the value of VIF is, if the VIF is lower than five, the collinearity issue is avoided [139]. It could be concluded that there is no collinearity issue for the structural model assessment.

4.3.2. Path Coefficients between Constructs

Structural model path coefficients are standardized estimates to test structural model relationships. To test the significance of results, it is advised to use bootstrapping and examine the *t*-statistics and *p*-value. Hair et al. [126] suggested having 5000 bootstrap subsamples for final results preparation. Thus, this study set the subsamples number at 5000 in bootstrapping. After running bootstrapping in SmartPLS, the results are provided in Table 7 and Figure 4.

Table 7. Path coefficient table.

Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation	<i>t</i> -Statistics	<i>p</i> -Value
Altruistic values → New Ecological Paradigm	0.124	0.128	0.050	2.463 *	0.014
Biospheric values → New Ecological Paradigm	0.206	0.209	0.053	3.882 **	0.000
Egoistic values → New Ecological Paradigm	−0.097	−0.103	0.058	1.680 (n.s.)	0.093
New Ecological Paradigm → awareness of consequence	0.446	0.452	0.048	9.296 **	0.000
Awareness of consequence → ascription of responsibility	0.492	0.495	0.039	12.488 **	0.000
Ascription of responsibility → personal norms	0.648	0.651	0.031	20.924 **	0.000
Personal norms → intention to adopt EV	0.437	0.441	0.044	9.945 **	0.000

Note: n.s. = not significant; the path coefficient is significant at 95% confidence level (*) if *t*-statistic > 1.96 ($p < 0.05$), and the path coefficient is significant at 99% confidence level (**) if *t*-statistic > 2.58 ($p < 0.01$).

Results show that biospheric values ($\beta = 0.206$, $p < 0.01$) and altruistic values ($\beta = 0.124$, $p < 0.05$) have positive significant effects on the New Ecological Paradigm, while egoistic values ($\beta = -0.097$, $p > 0.05$) have a negative, insignificant effect. The New Ecological Paradigm ($\beta = 0.446$, $p < 0.01$) has a positive significant effect on awareness of consequence, and awareness of consequence ($\beta = 0.492$, $p < 0.01$) has a positive significant effect on ascription of responsibility. Ascription of responsibility ($\beta = 0.648$, $p < 0.01$) has a positive significant effect on personal norms. Personal norms ($\beta = 0.437$, $p < 0.01$) have a positive significant effect on intention to adopt EV.

4.3.3. Coefficient of Determination of Endogenous Constructs

Coefficient of determination (R^2) explains the extent of how the variance of the dependent variable could be attributed to any independent variables [130]. More specifically, the aim to conduct coefficient of determination is to measure the predictive accuracy of the research framework. Hair et al. [139] also highlighted that an R^2 value above 0.20 is considered high in consumer behavior research. Using SmartPLS 3, the R^2 is calculated by running the PLS algorithm. The R^2 of endogenous constructs in this study has been shown in Table 8. Comparing against the rule of thumb, the R^2 of awareness of consequence (0.20), ascription of responsibility (0.242) and personal norms (0.42) could be categorized as high, while the R^2 values of intention to adopt EV (0.191) and the New Ecological Paradigm (0.101) are not as high as other endogenous constructs, even though awareness of consequence (0.191) is very close to 0.2.

Table 8. R squared (R^2) for endogenous latent variables.

Construct	R Squared	R Squared Adjusted
New Ecological Paradigm	0.101	0.094
Awareness of consequence	0.200	0.198
Ascription of responsibility	0.242	0.240
Personal norms	0.420	0.418
Intention to adopt EV	0.191	0.189

4.3.4. Effect Size of Exogenous Constructs

Effect size (f^2) examines how a specific independent variable contributes to the variance in overall the R^2 value. As suggested by Cohen [140], the f^2 values of 0.02, 0.15 and 0.35, respectively, are considered small, medium and large. Table 8 illustrates the effect size of all exogenous latent variables. The highest f^2 value for all endogenous latent variables is the relationship between ascription of responsibility and personal norms, which is 0.723 (large). The other three relationships that have f^2 values which could be categorized as a medium effect are the relationship between awareness of consequence and ascription of responsibility (0.319), the relationship between the New Ecological Paradigm and awareness of consequence (0.250) and the relationship between personal norms and intention to adopt EV (0.236). Other relationships are considered as neither large nor medium. The results are shown in Table 9.

Table 9. Effect Size (f^2) for all exogenous latent variables.

Endogenous Latent Variables	Exogenous Latent Variables	f^2 Value	Effects
Personal norms	Ascription of responsibility	0.723	Large
Ascription of responsibility	Awareness of consequence	0.319	Medium
Awareness of consequence	New Ecological Paradigm	0.250	Medium
Intention to adopt EV	Personal norms	0.236	Medium
	Biospheric values	0.032	Small
New Ecological Paradigm	Altruistic values	0.012	Small
	Egoistic values	0.010	Small

4.3.5. Blindfolding and Predictive Relevance (Q^2) of Constructs

The last step in structural model assessment is predictive relevance (Q^2) assessment. The Stone–Geisser test [141,142] is used for predictive relevance evaluation. The rule of thumb for Q^2 value evaluation provided by Hair et al. [139] argues that if the Q^2 value of an endogenous reflective construct is greater than zero, it means that the exogenous constructs have predictive relevance for an endogenous construct. Table 10 indicates the Q^2 value for this study. All endogenous latent variables in this study have a Q^2 value larger than zero, so it can be concluded that all exogenous constructs in this research framework have predictive relevance for endogenous construct.

Table 10. Predictive relevance (Q^2) results of endogenous latent variables.

Construct	SSO	SSE	$Q^2 (= 1 - SSE/SSO)$
Personal norms	3464	2705.034	0.219
Ascription of responsibility	1732	1405.451	0.189
Intention to adopt EV	1732	1523.232	0.121
Awareness of consequence	2165	1916.638	0.115
New Ecological Paradigm	3031	2915.229	0.038
Altruistic values	1732	1732	
Biospheric values	1732	1732	
Egoistic values	1732	1732	

In summary, after conducting measurement model and structural model assessment, the results and findings suggest that the measurement model shows great measurement reliability and validity, while the structural model assessment demonstrates that the exogenous and endogenous constructs are well-related.

4.4. Moderation Analysis of Collectivism

4.4.1. Bootstrapping

A moderating effect occurs when a moderating variable changes the strength or even the direction of the relationship between two constructs [126]. Moderating effect is usually

presented in PLS-SEM as an interaction term by multiplying the exogenous variable and moderator variable, which is called a two-way interaction [126]. Hair et al. [126] suggested it is generally recommended to use a two-stage approach since it demonstrates high statistical power and could be applied to both formative and reflective constructs. Thus, this study would use a two-stage approach for the interaction term creation. By running bootstrapping in SmartPLS 3, the path coefficient of the interaction term, *t*-value and *p*-value and effect size are obtained. Kenny [143] depicted that 0.005, 0.01 and 0.025 would be large enough to be evaluated as small, medium and large. Table 11 and Figure 5 illustrate the results of moderating analysis. The path coefficient of PN*INT→INT is 0.187 (*p* < 0.01), and the effect size (*f*²) is large (0.046). It could be concluded that collectivism significantly moderates the relationship between personal norms and intention to adopt EV.

Table 11. Summary result of moderating analysis.

Relationship	Path Coefficient	<i>t</i> -Statistics	<i>p</i> -Value	Effect Size (<i>f</i> ²)	Remark for Effect Size
PN*COL→INT	0.187	4.183	0.000	0.046	Large

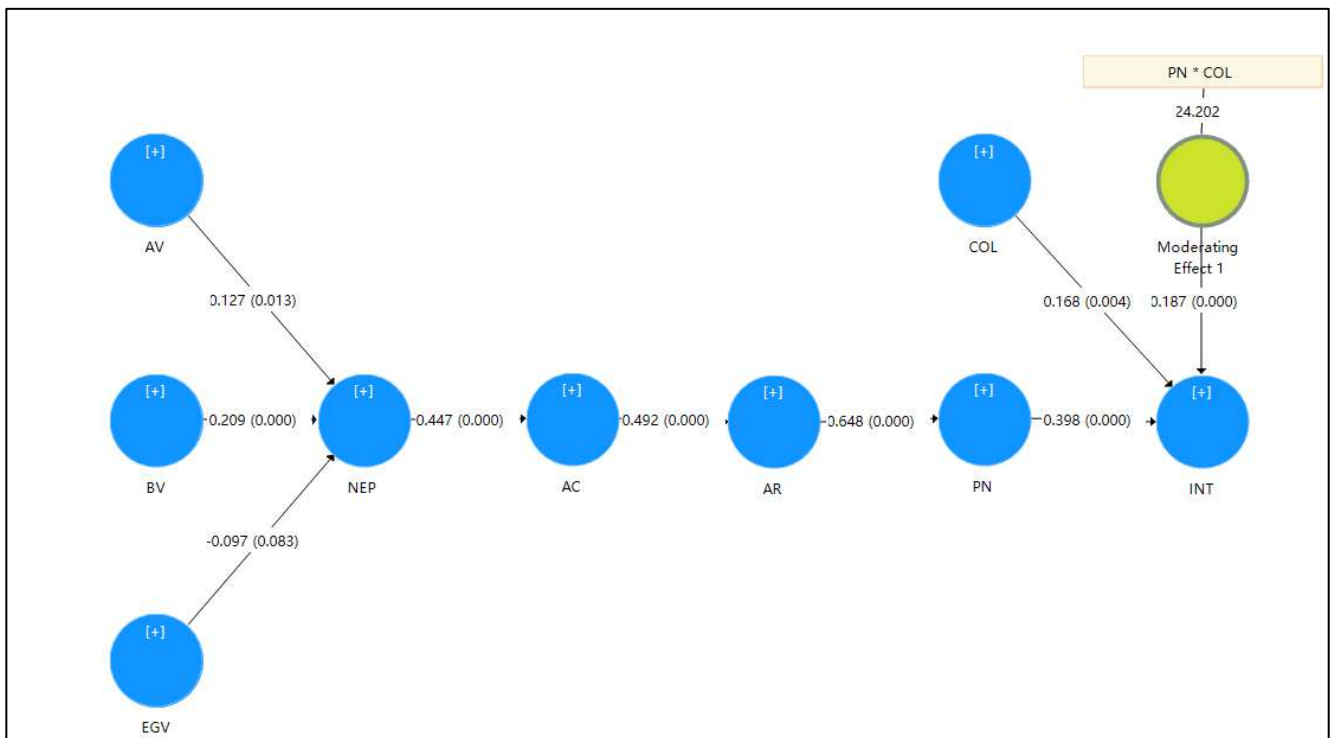


Figure 5. Structural model assessment results.

Figure 6 demonstrates the slope plot of the moderation effect of collectivism. To look into more detail at this graph, it indicates that when the personal norms of respondents are low (1 SD below median), there is little difference of intention to adopt EV between respondents with low and high levels of collectivism. However, on the other hand, when the personal norms of respondents are high (1 SD above median), high level of collectivism refers to a higher intention to adopt EV than respondents with low collectivism. However, for moderation effect analysis, it is critical to discover the influence of observed and unobserved heterogeneity in moderator variables [126], and failure to consider the effects of heterogeneity could lead to threat to the validity of the moderation effect results.

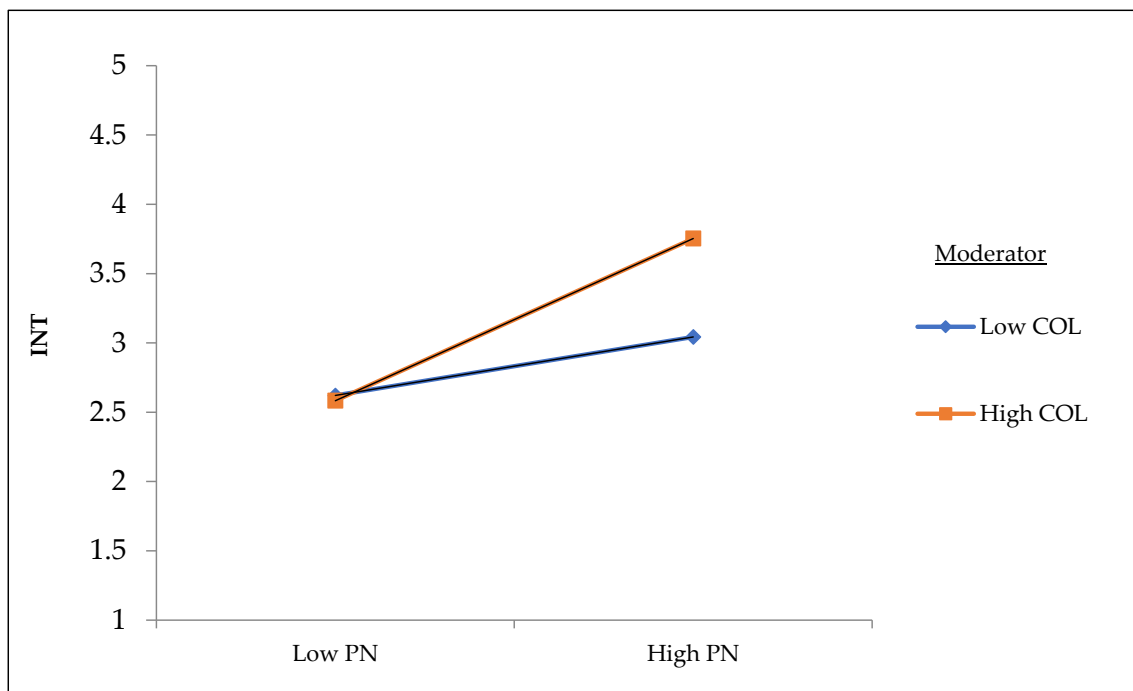


Figure 6. Slope plot of moderation effect.

4.4.2. Multigroup Analysis on High Collectivism vs. Low Collectivism

Multigroup analysis is frequently adopted to assess the heterogeneity in moderator variables. Since the aim of this study is to examine if there is a difference when comparing the path coefficient between personal norms and intention to adopt EV for respondents with high collectivism and low collectivism, two groups of respondents that are “High collectivism” and “Low collectivism” are identified and categorized based on the average value of collectivism. The dichotomization method has been frequently referred to for multigroup analysis to categorize samples into two groups when the moderator variable is a latent variable [132]. In order to achieve a more meaningful difference between groups, the polar extremes approach was adopted for multigroup analysis for this study. Referring to the moderator variable, which is collectivism (mean = 6.07, SD = 0.79, min = 4, max = 7), samples with average values of collectivism higher than 6.8 (mean + 1SD) are categorized as “High collectivism” (91 samples), while samples with average values of collectivism lower than 5.4 (mean – 1SD) are categorized as “Low collectivism” (86 samples). Samples with an average value of collectivism between 5.4 and 6.8 are neglected for multigroup analysis.

The permutation test “randomly exchanges (i.e., permutes) observations between the groups and re-estimates the model for each permutation [144]. Computing the differences between the group-specific path coefficients per permutation enables testing whether these also differ in the population” [126] (p. 294). As suggested by Hair et al. [126], permutation is more suitable for nonparametric multigroup analysis and yields better statistical properties; thus, this study would adopt permutation as the approach for multigroup analysis.

Similar group sample size of groups is a requirement for the permutation test [126]. Moreover, the sample size should meet the criterion for PLS-SEM analysis execution. In this study, there are 91 samples and 86 samples in two groups, and only one direct relationship is to be examined. According to the ten-times rule of thumb, the sample size meets the requirements for PLS-SEM and permutation test conduction. Before conducting multigroup analysis, measurement model invariance was tested.

Since this study focuses on how the level of collectivism of respondents moderates the relationship between personal norms and intention to adopt EV, only relevant constructs will be considered for the measurement invariance test. Table 12 indicates the sample size and measurement results for two groups. For better statistical performance, items with low

outer loadings are deleted (INT4, PN1, PN4, PN5, PN7). The statistics of Cronbach's alpha, composite reliability and AVE of personal norms and intention to adopt EV are all above the criterion and hence of reliability and validity for further structural model assessment (Cronbach's alpha value > 0.7, composite reliability > 0.8 and AVE > 0.6).

Table 12. Measurement results for high vs. low collectivism groups.

Group		High Collectivism	Low Collectivism
Sample size		91	86
Personal norms	Cronbach's alpha	0.861	0.845
	Composite reliability	0.906	0.891
	AVE	0.710	0.676
	Cronbach's alpha	0.850	0.726
Intention to adopt EV	Composite reliability	0.909	0.843
	AVE	0.769	0.644

The permutation test is conducted by selecting two groups (high and low in collectivism) with 5000 permutations, and a two-tailed test type is chosen with significance level set to 0.05. By applying the same measurement and setting to two groups, step 1 configural invariance is established. According to results provided in MICOM section under the quality criteria (see Table 13), compositional invariance is achieved with both permutation *p*-values higher than 0.05. Step 3 equality of a composite's mean value and variance across groups is not established, because both the mean and variance of original difference do not fall between 2.5% and 97.5%, and permutation *p*-value is less than 0.05 for intention to adopt EV (see Table 14). According to Hair et al. [126], partial measurement invariance is confirmed, and the study could proceed to conduct multigroup analysis.

Table 13. Permutation results for MICOM, Step 2.

	Original Correlation	Correlation Permutation Mean	5.00%	Permutation <i>p</i> -Values
Intention to adopt EV	0.997	0.997	0.992	0.278
Personal norms	0.997	0.998	0.994	0.191

Table 14. Permutation Results for MICOM, Step 3.

	Mean-Original Difference (High Col–Low Col)	2.50%	97.50%	Variance-Original Difference (High Col–Low Col)	2.50%	97.50%	Permutation <i>p</i> -Values
Intention to adopt EV	0.769	−0.295	0.303	0.56	−0.362	0.349	0.002
Personal norms	1.037	−0.294	0.3	0.062	−0.329	0.345	0.741

The results of the permutation test for difference between high and low collectivism groups are illustrated in Table 15 by assessing path coefficients in the final results. As there is difference and the difference is significant (permutation *p*-value < 0.01), it could be concluded that there is difference between the moderation effect of collectivism among respondents with high and low levels of collectivism. Furthermore, as the difference of the path coefficient is positive (high collectivism–low collectivism), it demonstrates that the higher the level of collectivism, the stronger the moderation effect.

Table 15. Path coefficients of permutation test.

Path	Original (High Col)	Original (Low Col)	Original Difference (High–Low)	Permutation Mean Difference (High–Low)	2.50%	97.50%	Permutation <i>p</i> -Values
PN → INT	0.619	0.307	0.312	0.001	−0.214	0.217	0.003

In summary, by conducting moderation effect analysis, this study confirms that collectivism significantly moderates the relationship between personal norms and intention to adopt EV through bootstrapping. Moreover, by conducting the permutation test, it is demonstrated that the higher the level of collectivism, the stronger the moderation effect collectivism has on the relationship between personal norms and intention to adopt EV.

4.5. Summary of Results

After conducting data analysis, the results of the proposed hypotheses are revealed in Table 16. All hypotheses are accepted except for H3, which relates to egoistic values.

Table 16. Results of proposed hypotheses.

Hypothesis	Content	Results
H1	Biospheric values significantly influence NEP	Accepted
H2	Altruistic values significantly influence NEP	Accepted
H3	Egoistic values significantly influence NEP	Rejected
H4	NEP significantly influences AC	Accepted
H5	AC significantly influences AR	Accepted
H6	AR significantly influences PN	Accepted
H7	PN significantly influence INT	Accepted
H8	Collectivism moderates the relationship between personal norms and intention to adopt an electric vehicles, and the moderating effect is stronger when collectivism is higher	Accepted

5. Discussion

5.1. Theoretical Implications

This article focuses on the influence of normative factors (value, belief and norm) and collectivism on Chinese consumers' intention to adopt electric vehicles. Due to the emergence of vehicle emission pollution and the energy crisis, it has become more critical to figure out what the factors are affecting the decision-making process of consumers. Even though many studies have approached this problem from rational perspectives, limited knowledge is known from a moral perspective. Moreover, as a collectivistic country, despite the well-known influence of culture orientation, articles have rarely analyzed the effect of collectivism and how it could be utilized to accelerate the adoption of electric vehicles. From a theoretical perspective, this study empirically tested the VBN model for electric vehicle adoption in the context of China. The VBN model has been tested with various pro-environmental products, and only limited studies investigate the intention to adopt electric vehicles. However, there has been no record of a VBN-based study of electric vehicle adoption in China. This study addresses the gap by adopting the VBN framework and adding collectivism as a moderator variable to examine the intention to adopt electric vehicles of Chinese consumers. As study results have disclosed, the VBN framework is suitable for the mechanism explanation, with all relationships significant except between egoistic values and NEP. This result depicts that even if previous literature argued that normative factors and moral-based frameworks are not suitable for the prediction of purchase intention of high-involvement products such as electric vehicles, the VBN framework has ability to explain the complex decision-making mechanism.

In terms of values, both biospheric values and altruistic values positively influence NEP, while the effect of egoistic values is insignificant. This is in line with previous

study results. Numerous research has proved that the relationship between biospheric values and NEP and altruistic values and NEP is positive [32,98], while past studies have returned contradictive results on the relationship between egoistic value and NEP, with Saleem et al. [32] suggesting a positive relationship and Steg et al. [98] indicating a negative relationship. That could explain the insignificant relationship found in this study, because both positive and negative evidence has been found before. It could be summarized that values, especially biospheric values and altruistic values, positively influence NEP. NEP is found to positively influence AC, which is in line with Chen [145] and Saleem et al. [32]. This suggests that an individual with higher NEP would be more aware of negative consequences and the results of behaviors that would lead to environmental degradation. AC positively influences AR, supporting the results of Saleem et al. [32] and Chen [145]. It could be suggested that an individual with higher AC would derive higher AR when considering adoption of electric vehicles. Furthermore, AR positively influences PN, and in the end, PN positively influences the intention to adopt electric vehicles, which is similar to many past studies.

The study also contributes to the sustainability development perspective. Being an environmentally friendly product, EVs reduce greenhouse gas emission and fossil fuel consumption. This is in line with Sustainable Development Goals (SDG) initiated by United Nations purposing “affordable and clean energy” and “climate action”. Personal norms as the factor directly influencing the intention to adopt EVs are critical for sustainability development and are affected by ascription of responsibility. Promotions and education should focus on how to stimulate the moral obligation of consumers, noticing that everyone is responsible for sustainability development and SDG, and emphasizing that the importance of the group benefit gained from sustainability development from a collectivistic perspective increases the tendency of an individual to act sustainably. Awareness of consequence influences ascription of responsibility directly, which means the consequences of actions that undermine the development of sustainability should be introduced to the public to increase ascription of responsibility. The New Ecological Paradigm influences awareness of consequence directly and is affected by biospheric values and altruistic values, which means an equal and friendly relationship between humans and the environment should be supported and how people concerned for the environment and wellbeing of others are decisive. All constructs included in the causal framework of VBN should be noticed and enhanced for the development of sustainability.

The positive moderation effect of collectivism on the relationship between PN and intention of electric vehicle adoption is significant. Although several studies have focused on the moderation effect of collectivism, this specific relationship has rarely been studied in China. To add, by using multigroup analysis, it is suggested that the higher the collectivism, the stronger the moderation effect. Since PN is the moral obligation perceived by the individual, collectivism as a critical culture orientation positively moderates the relationship because it involves how an individual perceives the relationship between individuals and society. As collectivists tend to prioritize the greater benefit to groups rather than personal interests, individuals might consider less about the costs and risks of electric vehicle adoption and focus more on the benefit electric vehicle adoption could have, for example, on reducing emission pollution and crude oil consumption. Another point is that since adopting electric vehicles has been promoted by the government as a pro-environmental and pro-social behavior, it could be deemed as “right” and ethical to do so. Collectivists would have higher efficacy because they believe other collectivists would follow the conduction of ethical behaviors [146]. He and Zhan [12] inferred the collectivist tendency of the Chinese consumer might hinder the translation of personal norms into intention to adopt electric vehicles, which is contradictive to the results of the current study. It could be caused by the neglect of the ethical consideration of acceptance of electric vehicles, and the authors speculated that collectivism would undermine the interpretation of any kind of personal norms into intention/behavior. However, the assumption needs to be further discussed depending on the nature of behavior.

The positive effect of collectivism on EV adoption could also be obtained by real-world statistics. Take the two biggest auto markets in the world, for example, China (annual car sale volume 20.5 million in 2021, no. 1 in the world) and the U.S. (annual car sale volume 15.1 million in 2021, no. 2 in the world). China is one of the most collectivistic countries with a collectivism index of 80, and the U.S. is the most individualistic country with a collectivism index of 9 [64]. The market share of EVs in China in 2021 is 16.1% while only 4.2% in the U.S [147]. Even if both the governments of China and the U.S. have been comprehensively supporting the diffusion of EVs, the penetration of EVs is significantly different. The significant difference of EV market share could act as evidence from the real world supporting the importance and the moderation effect of collectivism on the intention to adopt EVs.

To view things in a wider perspective, the theoretical findings of this study are useful to other countries and regions. Even though the VBN framework has been used to examine various pro-environmental products, only very limited studies have focused on EVs. This study revealed positive results supporting the feasibility of using the VBN framework for a study of consumers' intention to adopt EVs. Future research is encouraged to employ VBN and other normative-based frameworks to investigate consumers' intention to adopt EV and other high-innovative pro-environmental products in other regions. The moderation effect of collectivism on the relationship between personal norms and intention to adopt EVs could provide insight for studies on the effects of social influence and culture on intention to adopt EVs. It could be inferred that the differences of EV penetration among counties all over the world could be attributed to cultural reasons. For the translation from personal norms to intention to adopt EVs, higher collectivistic tendencies have a positive influence and lower collectivistic tendencies and lower individualistic tendencies negatively affect the translation. Considering the existing literature revealing the substantive effect of culture orientations including collectivism and individualism, further studies should focus on how cultural orientations are affecting the decision-making mechanism of consumers.

5.2. Managerial Implications

There are several managerial implications for policymakers and marketers in the automotive industry. Since the results of current study and past literature have demonstrated personal norms to be a direct influencing factor on consumers' electric vehicle adoption intention, it is evident that policies and market interventions should be tailored to improve consumers' personal norms. Norms should be promoted and emphasized to achieve higher personal norms among the public. Moreover, as AR is the antecedent of PN, it should also be strengthened to let more consumers know that citizens have a responsibility to preserve the environment by accepting electric vehicles. Other variables, such as values, NEP and AC, even though they do not directly influence PN, have indirect effects. Thus, policies and market interventions should pay attention to those aspects at the same time. Wang et al. [148] argued that government, industry practitioners and electric vehicle sellers should let consumers know that it is everyone's obligation to act in an environmentally friendly way.

The collectivist nature of Chinese consumers should not be omitted when designing marketing messages and policies. Dogan and Ozmen [26] suggested policymakers should create high environmentalism norms in collectivistic society to promote electric vehicles, and educational courses should be provided to the public. By identifying the influence of collectivism, marketers could design communication messages that activate the collective self and emphasis on group benefit, with the aim to strengthen the moral obligation consumers would feel. The implications also remind marketers and policymakers in other countries and regions to take cultural orientation of consumers into consideration. To strengthen the propensity to adopt EV of consumers who have moral obligation, market communication and policies emphasizing collectivism could be helpful.

5.3. Limitations and Future Directions

The current study has several limitations. Compared with the large population and variations of policies in different regions in China, the sample size is limited; hence, the results lack generalizability. Similarly, the effects of demographic factors are not considered. Future studies could either focus on a specific area/population or extend the sample size to obtain better generalizability. Furthermore, this study focuses on the moderator effect of collectivism. There are many different culture orientations besides collectivism, and other culture orientations might also play roles in the diffusion of electric vehicles. Upcoming research could take more relevant cultural orientation into consideration. In addition, with the fast-changing pace of the economy, the behavior of consumers keeps developing. This study adopts a quantitative approach and is cross-sectional and hence might neglect the latest findings in the change in consumers perceptions. Qualitative approaches and research methods, such as interviews and case studies, and quantitative approaches, such as longitudinal studies, should be conducted to gain more insight regarding consumer behavioral changes.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su141912398/s1>.

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Appendix A

Table A1. Common method factor analysis results.

Constructs	Items	Average Substantive Variance (R1)	R1 Square	Method Variance (R2)	R2 Square
Ascription of responsibility	AC1	0.527	0.277729	−0.024	0.000576
	AC2	0.807	0.651249	−0.031	0.000961
	AC3	0.908	0.824464	−0.086	0.007396
	AC4	0.621	0.385641	0.086	0.007396
	AC5	0.887	0.786769	−0.058	0.003364
Ascription of responsibility	AR1	0.854	0.729316	−0.123	0.015129
	AR2	0.876	0.767376	0.148	0.021904
	AR3	0.949	0.900601	−0.058	0.003364
	AR4	0.894	0.799236	−0.002	0.000004
Altruistic values	AV1	0.708	0.501264	0.179	0.032041
	AV2	0.787	0.619369	−0.047	0.002209
	AV3	0.881	0.776161	−0.018	0.000324
	AV4	0.877	0.769129	−0.023	0.000529

Table A1. Cont.

Constructs	Items	Average Substantive Variance (R1)	R1 Square	Method Variance (R2)	R2 Square
Biospheric values	BV1	0.917	0.840889	−0.086	0.007396
	BV2	0.778	0.605284	0.072	0.005184
	BV3	0.913	0.833569	0.155	0.024025
	BV4	0.901	0.811801	−0.039	0.001521
Collectivism	COL1	0.809	0.654481	−0.087	0.007569
	COL2	0.788	0.620944	0.139	0.019321
	COL3	0.759	0.576081	−0.033	0.001089
	COL4	0.825	0.680625	−0.022	0.000484
	COL5	0.76	0.5776	0.523	0.273529
Egoistic values	EGV1	0.818	0.669124	0.032	0.001024
	EGV2	0.895	0.801025	0.195	0.038025
	EGV3	0.659	0.434281	−0.404	0.163216
	EGV4	0.872	0.760384	−0.063	0.003969
Intention to adopt EV	INT1	0.732	0.535824	0.186	0.034596
	INT2	0.826	0.682276	−0.356	0.126736
	INT3	0.888	0.788544	0.212	0.044944
	INT4	0.839	0.703921	−0.304	0.092416
New Ecological Paradigm	NEP11	0.687	0.471969	−0.046	0.002116
	NEP13	0.659	0.434281	0.058	0.003364
	NEP15	0.75	0.5625	0.008	0.000064
	NEP3	0.764	0.583696	0.018	0.000324
	NEP5	0.729	0.531441	0.044	0.001936
	NEP7	0.548	0.300304	−0.067	0.004489
	NEP9	0.677	0.458329	−0.111	0.012321
Personal norms	PN1	0.781	0.609961	0.101	0.010201
	PN2	0.816	0.665856	−0.024	0.000576
	PN3	0.749	0.561001	0.019	0.000361
	PN4	0.766	0.586756	−0.01	0.0001
	PN5	0.717	0.514089	−0.013	0.000169
	PN6	0.593	0.351649	−0.021	0.000441
	PN7	0.657	0.431649	0.052	0.002704
	PN8	0.717	0.514089	0.049	0.002401
Average		0.781	0.621	0.003	0.022
Ratio (R1 Square/R2 Square)			28.46		

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