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Electric Car Purchase Intentions in Vietnam's Emerging Economy: The Moderating Role of Technology Discomfort

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ABSTRACT

Pro-environmental consumption has emerged as a significant global trend over the past decade, particularly evident in the increased consumer interest in electric vehicles (EVs). Despite extensive research on EV adoption, limited attention has been given to technology-related factors, particularly the discomfort associated with adopting new technologies. To address this gap, the present study investigates the moderating effect of technology discomfort on electric car purchase intentions in Vietnam, an emerging economy. Utilizing a sample of 516 potential EV buyers, this study examines how technology discomfort influences the mediating effects of pro-environmental attitudes and pro-environmental self-identity on purchase intention. The findings reveal that technology discomfort significantly moderates these mediation relationships, underscoring its crucial role in consumers' decision-making processes regarding EV adoption. This study provides valuable insights for policymakers, automotive manufacturers, and marketers aiming to promote electric vehicle adoption in emerging markets.

1. INTRODUCTION

Climate change and other ecological consequences have become contemporary global issues widely debated in the 21st century [1]. Asian countries are projected to contribute nearly one-third of greenhouse gas emissions by 2030 due to their slow transition from traditional vehicles to environmentally friendly alternatives [2]. Vehicles used in transportation have become one of the primary sources of global CO_2 emissions [3]. These ecological concerns have raised significant questions dating back to the global sustainable development agendas initiated in the 1970s. During the 1970s and 1980s, calls for action predominantly targeted corporate and governmental strategies rather than consumer behaviors. However, sources of environmental impacts extend far beyond production activities alone [4]. This study emphasizes that environmental consequences prompt stakeholders to consider additional actions informed by their awareness to improve environmental conditions. Ecological scholars have urgently advocated comprehensive actions to ensure the sustainability of our planet [5]. Such calls are timely, directly addressing the current context in which nature faces numerous environmental threats that endanger our prosperity and well-being.

Environmental attitudes and actions encompass three key dimensions: ecological limits, balance of nature, and human domination [6]. It is strongly recommended that humans act as proactive and decisive agents capable of making significant changes to restore environmental balance. The concept of the balance of nature refers not only to nature's resilience against harmful substances but also to how humans can sustain their livelihoods without compromising environmental stability. Different demographic groups exhibit varying degrees of understanding and concern for environmental protection [7]. For instance, women, Black individuals, and economically disadvantaged groups tend to display stronger pro-environmental attitudes, as they are more directly impacted by environmental consequences.

Electric vehicles have been recognized as one of the pro-environmental initiatives that help address environmental consequences. This emerging pro-environmental trend has received significant attention, particularly in countries that are top contributors to CO_2 emissions, such as China, the USA, and India [8].

This study contributes to the literature in several ways. First, applying the Stimulus-Organism-Response (SOR) framework to investigate pro-environmental intentions provides a comprehensive analysis, enabling an understanding of the continuous causal relationships among external factors, internal processes, and individual-level responses. Second, examining the moderating effect of technology discomfort further broadens the existing understanding of pro-environmental responses. It provides deeper insights, confirming that the mechanism suggested by SOR theory may not necessarily lead to a pro-environmental response when technology discomfort is present. These findings call for further academic and practical actions to address consumer

concerns regarding the technological configuration of electric vehicles.

2. THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

2.1 Theoretical framework

Prior studies have applied various behavioral perspectives and theories to explain individual-level behavior or behavioral intention within the environmental field [9, 10]. Behavioral intention and attitude have been the primary focus of environmental studies [11]. Previous research has concentrated on attitudes or intentions because these are direct and critical predictors of actual behavior. The Stimulus-Organism-Response (SOR) theory provides a holistic framework for analyzing pro-environmental behavioral intentions.

The Stimulus-Organism-Response (SOR) framework was introduced by Mehrabian and Russell [12], who suggested that behaviors are outcomes resulting from internal processes triggered by external factors. The SOR framework helps explain continuous processes that transition from external factors to cognitive responses [13].

In the existing literature, stimuli have taken various forms, as there is no universally accepted understanding of the concept. Stimuli can include events, phenomena, and contextual conditions related to the environment [14], consciousness [15], climate cognition [16], pro-environmental responsibility [17], and environmental concern or knowledge [18]. These studies investigate such stimuli as starting points that initiate cognitive processes and ultimately lead to specific behaviors.

In the Stimulus-Organism-Response (SOR) framework, the "Organism" refers to individuals' internal cognitive processes [19]. The organism mediates the relationship between stimuli and responses and may encompass emotions [16], green attitudes [18], and other cognitive factors. The final component of the SOR framework is the "Response," which represents the direct outcome of internal cognitive processes. Responses can include conservation intentions [20], responsible behaviors [21], and low-carbon travel choices [16].

2.2 Hypothesis development

2.2.1 Environmental concerns

Environmental concerns can be understood as the perception of the environmental consequences of production or consumption [22]. Accordingly, existing literature confirms that humans are not only the culprits but also the victims of ecological consequences [23]. Preservation and pollution are priorities among environmental issues [24]. People pay attention to the actions or behaviors of entities that may harm the environment [25]. This type of concern refers not only to threats to nature but also to the benefits for humanity [26]. As suggested by Change [4], anthropocentric altruism best represents environmental concerns among value orientations.

A number of studies have investigated environmental concerns in various countries, including Turkey [27], Israel [28], the USA [29], and Canada [30]. More specifically, materialistic individuals tend to pay greater attention to local environmental issues, whereas post-materialistic individuals are more concerned with international environmental events and their consequences [27].

2.2.2 Pro-environmental responsibility

Individuals who recognize the harm or threat posed by environmental problems tend to be more aware of their responsibility to protect the environment. Consequently, “safeguarding the environment is a core aspect of their self-conceptions” [7]. People with stronger environmental values are more likely to care about environmental degradation and perceive it as an important dimension of their self-identity. This awareness results from feelings evoked when individuals observe or learn about negative environmental outcomes. They may feel personally responsible for these outcomes and thus attempt to address the issues [31]. In other words, individuals who prioritize environmental protection often view such actions as integral to their personal mindset.

2.2.3 Environmental attitudes

A large-scale survey conducted across different regions worldwide revealed that citizens recognize an urgent need for actions addressing environmental consequences. Pro-environmental behavior can be predicted by cognitive mechanisms supporting environmental dimensions, such as reducing CO_2 and other greenhouse gas emissions [32]. Environmental attitudes are shaped by individuals’ concerns about their surrounding environment, particularly when they clearly perceive how environmental problems threaten their lives, for example, through job losses or adverse health outcomes [33]. People with varying demographic characteristics hold different views on environmental problems, as their lives are impacted differently. For instance, economically disadvantaged individuals are reportedly more likely to respond to environmental issues since they are often among the first to bear the burdens resulting from environmental degradation [7].

According to the Theory of Planned Behavior, intention is strongly related to attitude [34]. Numerous studies have provided ample evidence of the influence of environmental attitudes on behavioral intentions across various groups [35, 36]. Specifically, attitudes toward the environment predict individuals' willingness or readiness to engage in pro-environmental actions [37].

Therefore, we hypothesize that:

H1a: Pro-environmental attitude mediates the impact of environmental concerns on electric car purchase intentions.

H1b: Pro-environmental attitude mediates the impact of pro-environmental responsibility on electric car purchase intentions.

2.2.4 Pro-environmental self-identity

Pro-environmental self-identity is defined as “the extent to which one sees oneself as a type of person whose actions are environmentally friendly” [38]. Three values shape the perceptions of individuals who demonstrate high levels of concern about environmental issues: social-altruistic, biospheric, and egoistic values [39]. Egoistic values refer to strong beliefs deeply rooted within cognitive mechanisms. They suggest that individuals who criticize others for environmentally unfriendly behaviors should themselves adopt pro-environmental thinking and actions [40]. Altruistic values suggest that when individuals recognize negative impacts affecting others, a cognitive mechanism driven by moral obligation may encourage them to take action or change their behaviors [41]. In other words, individuals with altruistic values deeply appreciate actions benefiting others and

perceive these actions as integral to their self-concept. This principle has been applied to environmental issues in numerous studies [42, 43]. Finally, biospheric values refer to concern for the welfare and interests of non-human entities.

So, we hypothesize that:

H2a: Pro-environmental self-identity mediates the relationship between environmental concerns and electric car purchase intentions.

H2b: Pro-environmental self-identity mediates the relationship between pro-environmental responsibility and electric car purchase intentions.

2.2.5 Technology discomfort as a moderator

Environment-related attitudes have a weak impact on behavioral intentions towards the environment [44]. It is challenging to translate environmental attitudes into actual environmental practices or behaviors [45]. Furthermore, attitudes toward the environment have been found to exert only a weak influence on Chinese individuals [46]. These studies provide nuanced insights into the relationship between environmental attitudes and behavioral intentions. Specifically, although attitudes can predict intentions within the environmental domain, their impact may not always be significant. For instance, intentions within the travel industry among British individuals are not notably affected by their environmental attitudes [47].

Additionally, although pro-environmental self-identity can predict behavioral intention, it is not a strong determinant [38]. Similarly, in the context of the UK, previous study [48] confirmed a weak relationship between pro-environmental self-identity and behavioral intention across various green domains, such as eco-driving and energy consumption.

An interesting finding from reference [49] confirmed that younger people are less likely to use technology due to related concerns and fears. Users may feel that they do not have full control over technology, especially new technologies [50]. This discomfort also includes awareness of the risks associated with using specific technologies [51]. Further, the study revealed that technology discomfort reduces the intention to use technology. Technology discomfort moderates the relationship between behavioral intention and actual usage behavior [52]. It can cause anxiety or perceived risk among users, leading them to behave differently from desired outcomes, such as hesitating to adopt new technologies [53].

In other words, existing research provides inconclusive evidence regarding the relationships between pro-environmental attitudes and behavioral intentions, as well as between pro-environmental self-identity and behavioral intentions. More importantly, the proposed factor of technology discomfort challenges assumptions in the existing literature, which implicitly suggest that individuals have similar perceptions or attitudes toward technology, especially new technologies.

Further, as suggested by Technology Acceptance Model, the users' attitude towards the ease of use and the usefulness will be a predictor of technology usage [54, 55]. So, we cannot make a similar assumption about the technology with traditional cars when users encounter a new technology system.

Therefore, we hypothesize that:

H3a: Technology discomfort moderates the impact of pro-environmental attitudes on electric car purchase intentions.

H3b: Technology discomfort moderates the impact of pro-environmental self-identity on electric car purchase intentions.

3. METHOD

3.1 Instrument development

Following the desk study, a quantitative survey is conducted to empirically test the relationships proposed in the theoretical framework. A self-administered survey questionnaire was developed based on validated measurement scales from previous literature, as well as a synthesis of key constructs and hypotheses.

The survey targets two major metropolitan areas in Vietnam- Hanoi and Ho Chi Minh City- with an expected sample size of 500 respondents. These responses were analyzed to identify key factors influencing participants' intentions to adopt electric cars in Vietnam. These were the most developed cities in the country, with high average income levels. Additionally, the consumption of automobiles in general, and electric vehicles in particular, is significantly higher in these cities compared to other regions.

Data collection in these two cities will take place at car showrooms and large residential complexes, using a systematic random sampling approach. This means that the researcher will distribute questionnaires to one out of every two individuals entering a showroom or the entrance of a residential complex (excluding children).

The sample size was designed to ensure demographic diversity in terms of age, gender, education level, marital status, and occupation.

The development of the survey questionnaire follows these steps:

Step 1: The key concepts were first defined and clearly interpreted. Following this, the process of measuring these core concepts is implemented. The researcher selects reputable academic sources to establish valid measurement scales.

Step 2: The researcher adjusts the selected measurement scales to align with the research topic and the specific context of Vietnam. This process begins with a thorough review of the scale items, followed by a comparison of these items with the conceptual definitions. Adjustments include refining existing items and adding new ones where necessary.

Step 3: The selected scale items were translated from English to Vietnamese and then back-translated to ensure the face validity of the measures. This process was carried out by the research team. Additionally, an independent academic scholar was invited to review the translations for accuracy.

Step 4: The questionnaire is further refined through consultations with experts in the field of electric vehicles to enhance its relevance and clarity.

Step 5: A pilot survey involving 30 participants from the target population was conducted. This step assessed the questionnaire based on three key criteria: readability, clarity, and time efficiency.

Step 6: The final step involves revising the questionnaire based on pilot survey feedback and formatting it for readiness in the official survey. This step marks the completion of the questionnaire development process.

3.2 Construct measurement

Reliable measurement scales in the existing literature were screened and selected. For example, the measure for Environmental concern – EC has been adapted from reference [56]. Specifically, Environmental Concern (EC) was adapted from reference [56]. Environmental Knowledge (EK) was sourced from reference [57]. Environmental Self-Identity

(ESI) was drawn from reference [58]. Pro-environmental Responsibility (ER) utilized items from references [59, 60]. Pro-environmental Attitude was adapted from reference [61]. Purchase Intention was based on the scale by [62]. Technology Discomfort followed the framework by Parasuraman and Colby [63].

To ensure the face validity of the measurement scales, a rigorous back-translation procedure was conducted. The process began with a professional translator converting the original English items into Vietnamese. A separate, independent translator then translated the Vietnamese version back into English. This approach was employed to verify the accuracy and consistency of the translations.

Following this, a pilot test was conducted with 30 participants representing diverse age groups and genders. Participants were asked to evaluate the questionnaire based on several criteria, including clarity, ease of comprehension, consistency, and whether the questions effectively captured the intended meaning [64]. The majority of respondents confirmed that the items were both relevant and easy to understand.

Insights from the pilot test were instrumental in refining the questionnaire's length, structure, and wording before finalizing it for the official survey.

3.3 Data analysis

This study follows a two-step approach, beginning with an evaluation of the reliability and validity of the measurement scales, followed by hypothesis testing.

Before examining the hypothesized relationships, the construct reliability and validity of the scales were assessed. Cronbach's alpha and Average Variance Extracted (AVE) were computed to evaluate internal consistency and convergent validity. To ensure discriminant validity, Heterotrait-Monotrait Ratio (HTMT) and Cross Loadings were applied.

Once the measurement model was validated, hypothesis testing was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM). This method was selected due to the complex and qualitative nature of the conceptual model, as well as its ability to handle research problems involving latent constructs and intricate variable relationships. Unlike traditional parametric methods, PLS-SEM utilizes bootstrapping to generate P-values, making it particularly effective when dealing with non-normally distributed data and independent samples.

For data analysis, SmartPLS 4.0 was used, leveraging its robust capabilities to manage the study's analytical requirements efficiently.

4. RESULTS

4.1 Reliability and validity of measures

Table 1. Reliability and validity of measures

Constructs	Outer Loadings	Cronbach's Alpha
Environmental concern – EC (AVe = 0.686)		0.772
EC1: I think environmental problems have become more and more serious in recent years.	0.808	
EC2: I think human beings should live in harmony with nature in order to achieve sustainable development.	0.865	
EC4: I think individuals have the responsibility to protect the environment.	0.811	
Pro environmental attitude (AVE = 0.632)		0.805
PEA1: Environmental protection is a very important issue for me.	0.833	
PEA2: I would like to actively participate in an environmentalist group.	0.807	
PEA3: I think I would help to raise funds for environmental protection.	0.828	
PEA4: I often try to persuade others that the environment is important	0.705	
Perceived environmental responsibility – PER (AVE = 0.617)		0.689
PER1: I have altered the products owing to my environmental concerns	0.733	
PER2: My environmental concerns influence my purchase decisions.	0.792	
PER3: I would reduce the consumption of products that impact the environment	0.829	
Perceived environmental self-identity – PES (AVE = 0.745)		0.829
PES2: I feel proud to be an Eco responsible consumer	0.879	
PES3: Driving an EV makes me feel I am contributing to environmental protection	0.840	
PES4: Adopting eco-friendly products makes me feel like my intentional behaviors are rooted in central environmental values	0.869	
EV purchase intention – PI (AVE = 0.772)		0.876
PPI1: I intend to buy an electric vehicle.	0.822	
PPI2: Given the chance, I would buy an electric	0.861	
PPI3: I will consider switching to an electric vehicle that causes less pollution and is more energy efficient to protect the environment.	0.871	
PPI4: I am willing to purchase electric vehicles in the future	0.843	
Technology discomfort – TD (AVE = 0.670)		0.846
TD1: When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do;	0.825	
TD2: Technical support lines are not helpful because they don't explain things in terms I understand;	0.792	
TD3: Sometimes, I think that technology systems are not designed for use by ordinary people; and	0.895	
TD4: There is no such thing as a manual for a high-tech product or service that's written in plain language	0.756	

First, we first tested the reliability and validity of the measures of constructs. Based on values of outer loadings, we only maintained items which the value of outer loadings is higher than 0.7. As a result, items EC3, PES1 and PES5 were removed. Then, we run PLS-SEM algorithm again to test the reliability and validity of the measures. The minimum Alpha of all measures for is 0.689 (for PER). This is acceptable for the emerging topic. That means that these measures ensure high reliability. The lowest Composite reliability (CR) of all measures is 0.697. Values of AVE for all constructs are higher than 0.6. That means that items can well represent the variation of the construct they stand for. All outer loadings of all items are higher than 0.7. Further, the cross-loadings of all items in the current study reveal that all measurement items ensure discriminant validity because their outer loadings are higher than their cross-loadings in other constructs [65] while the maximum HTMT value is 0.778, lower than 0.9 [66]. Also, the SRMR value is 0.076 (< 0.08), meaning that the fit between the model and the data set is ensured. Thus, in the current study, the reliability and validity of all measures as well as model fit are ensured (refer to Table 1).

4.2 Hypothesis testing

To test all hypotheses in this research model, each variable will receive an average score of its measurement items. An analysis of structural equation modeling was applied to examine the causal relationship in mediation and the moderated mediation effect. Multi-collinearity is not a problem in the current research model because the maximum value of VIF of all items is 2.775.

This study runs bootstrapping with 5,000 sub-samples from the original sample.

Regarding testing the 3 hypotheses, we used PLS-SEM for mediation and moderation effect. The regression results are presented in Table 2. In terms of Hypothesis 1a, we found that pro-environmental attitude mediates the impact of environmental concern on purchase intention (significant at a 95% confidence level). Further, the impact of pro-environment responsibility on purchase intention is mediated by pro-environmental attitude (significant at a 95% confidence level). So, H1b is supported.

Table 2. Partial least square results

Control Variables	Full Model
Sex	-0.117
Edu	-0.055
Age	0.216
Moderating variable	
TD x PEA -> PPI	-0.067[a]
TD x PES -> PPI	-0.133[*]
Indirect effects	
EC -> PER -> PES	0.141[***]
EC -> PES -> PPI	0.103[**]
EC -> PEA -> PPI	0.040[*]
PER -> PES -> PPI	0.083[**]
PER -> PEA -> PPI	0.066[*]
EC -> PER -> PEA -> PPI	0.027[*]
EC -> PER -> PES -> PPI	0.034[**]
EC -> PER -> PEA	0.180[***]
R^2 adjusted	0.425

Significant at confidence levels of: a 90%, * 95%, ** 99%, *** 99.9%, n = 516

This study also showed that pro-environmental self-identity mediates the impact of pro-environment responsibility on purchase intention at a 99% confidence level. Additionally, pro-environmental self-identity mediates the impact of environmental concern on purchase intention at a 99% confidence level. In other words, both hypotheses 2a and 2b are supported.

This study also found that technology discomfort plays an important role in the proposed model. Specifically, technology discomfort significantly moderates the relationship between pro-environmental self-identity and purchase intention at a 95% confidence level. Similarly, the positive effect of pro-environmental attitude on electric car purchase intention diminishes when target customers experience discomfort with the technological aspects of electric vehicles. In other words, the influences of pro-environmental self-identity and pro-environmental attitude on purchase intention weaken as customers' discomfort with electric vehicle technology increases.

5. DISCUSSION AND IMPLICATIONS

5.1 Discussion of results

Electric car adoption intention is analyzed through the lens of SOR theory. Specifically, applying SOR theory provides a comprehensive explanation by exploring how environmental concern and pro-environmental responsibility (stimuli) influence electric car purchase intention (response) through the mediating effects of pro-environmental attitude and pro-environmental self-identity (organism). Additionally, this study extends the existing analytical framework by investigating the moderating role of technology discomfort on these relationships.

This study demonstrates that environmental concerns and pro-environmental responsibility are important external factors that may serve as starting points for pro-environmental behavioral intentions. Thus, the findings of this study support previous results reported [17, 18]. Furthermore, this research suggests that external factors, such as concerns and perceived duties, represent critical stimuli guiding subsequent pro-environmental actions at the individual level.

Second, the study confirms that potential environmental advocates tend to translate their concerns and sense of responsibility into pro-environmental attitudes and self-identity. Environmental concerns and responsibilities thus form essential preconditions for subsequent behavioral responses [44, 67].

Further, individuals' attitudes and self-perceptions regarding their relationship with the environment may encourage them to take action to mitigate environmental consequences [68, 69]. Thus, Vietnamese consumers can also serve as key environmental change-makers by advocating for environmental protection through their intention to purchase electric cars.

Lastly, this study contributes to the existing literature by examining the role of technology discomfort, given that fuel-powered and electric cars differ significantly in their technical configurations. By identifying the moderating effect of technology discomfort, the findings suggest that the mechanism proposed by SOR theory can be disrupted by technological factors. Specifically, despite clear pro-environmental attitudes and self-perceptions, potential customers might delay pro-environmental actions if they

experience discomfort with electric car technology. Therefore, this study addresses the previously unexplored relationship between attitudes/self-identity and purchase intention by incorporating technological factors.

5.2 Practical implications

This research offers several practical contributions. First, it suggests that electric car businesses should pay closer attention to potential customers' concerns regarding technological systems. This recommendation is particularly important because consumers, especially those highly familiar with traditional fossil-fuel vehicles, may perceive electric car technology as unfamiliar or overly complex.

Then, they may have unfavorable feeling about it. It could postpone their behavioral intention regarding purchase intention. To address this issue, training or additional information about electric cars' technology may be helpful to reduce their technology discomfort. Second, this study suggests that provision and advertisement of electric cars as one of key pro-environmental trends that fix our past consumption and production should be carried out. It can make people better understand how using electric cars not only can be an effective means to respond to environmental concerns, but also can be a signal of a responsible consumer. This study also recommends that governments may introduce more initiatives and support policies for electric cars. That may offer social, business and consumption benefits.

Consequently, customers may develop unfavorable feelings toward electric vehicles, potentially delaying their purchase intentions. To address this issue, providing training or additional information about electric car technology could help reduce consumers' technological discomfort. Second, this study suggests promoting and advertising electric cars as part of a broader pro-environmental trend aimed at correcting previous unsustainable consumption and production practices. Such efforts can help individuals understand that adopting electric vehicles is not only an effective way to respond to environmental concerns but also a reflection of responsible consumer behavior. Lastly, the study recommends that governments introduce more initiatives and supportive policies for electric vehicles, thereby creating social, business.

6. CONCLUSION

By investigating electric car purchase intention, this study offers some contributions. The findings demonstrate that pro-environmental behavioral intentions result from cognitive processes triggered by external stimuli, such as environmental concerns and responsibilities. Furthermore, this study identifies a moderating effect of technology discomfort. This novel finding extends the logic proposed by SOR theory, offering a more comprehensive explanation of a previously overlooked phenomenon. Finally, this study also shows the moderated mediation effects of pro-environmental attitude and pro-environmental self-identify.

This study is not without limitations. First, the exclusion of hybrid cars may limit the generalizability of the study's findings. Potential users' preferences could vary across traditional fuel vehicles, electric vehicles, and hybrid vehicles. Therefore, future research should further investigate behavioral intentions among potential car users by including these three vehicle types. Second, aside from differences in technological systems, brand trust might also play a helpful role. A car brand's reputation could mitigate concerns related to technological discomfort. Consequently, future research could further explore the influence of brand trust in relation to technology discomfort.

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