The influence of environmental concerns and psychosocial factors on electric motorbike switching intention in the global south

Nguyen-Phuoc, Duy Quy; Nguyen, Nguyen An Ngoc; Tran, Phuong Thi Kim; Pham, Huong Giang; Oviedo-Trespalacios, Oscar

DOI
10.1016/j.jtrangeo.2023.103705

Publication date
2023

Document Version
Final published version

Published in
Journal of Transport Geography

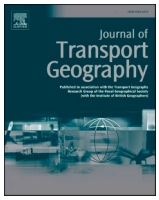
Citation (APA)
Nguyen-Phuoc, D. Q., Nguyen, N. A. N., Tran, P. T. K., Pham, H. G., & Oviedo-Trespalacios, O. (2023). The influence of environmental concerns and psychosocial factors on electric motorbike switching intention in the global south. *Journal of Transport Geography*, *113*, Article 103705. https://doi.org/10.1016/j.jtrangeo.2023.103705

Journal of Transport Geography 113 (2023) 103705

Contents lists available at ScienceDirect

Journal of Transport Geography

journal homepage: www.elsevier.com/locate/jtrangeo



The influence of environmental concerns and psychosocial factors on electric motorbike switching intention in the global south

Duy Quy Nguyen-Phuoc [a], Nguyen An Ngoc Nguyen [b], Phuong Thi Kim Tran [c], Huong-Giang Pham [d,*], Oscar Oviedo-Trespalacios [e]

[a] Faculty of Road and Bridge Engineering, The University of Danang - University of Science and Technology, 54 Nguyen Luong Bang Street, Lien Chieu District, Danang City, Viet Nam
[b] Department of Tourism, Sport and Hotel Management, Griffith University, 170 Kessels Rd, Nathan QLD, 4111, Australia
[c] Faculty of Tourism, University of Economics – The University of Danang, 71 Ngu Hanh Son, Danang City, Viet Nam
[d] Faculty of International Economics, Foreign Trade University, 91 Chua Lang Street, Dong Da, Ha Noi, Viet Nam
[e] Delft University of Technology, Faculty of Technology, Policy and Management, Section of Safety and Security Science, Jaffalaan 5, 2628 BX Delft, the Netherlands

ARTICLE INFO

Keywords:
Electric motorcycles
Carbon emissions
Switching intention
Trust
Knowledge
Responsible innovation

ABSTRACT

Motorcycle riding is the principal mode of travel in low- and middle-income countries (LMICs). Motorcycle-based transport is regarded as highly problematic today due to reliance on fossil-based fuels, which contributes to climate change. Additionally, emissions from fuel combustion release air pollutants in urban areas, resulting in public health issues. Unfortunately, in LMICs, functioning and widespread public transport infrastructure will not be feasible in the near future due to economic and social tensions. As such, encouraging a mode shift from conventional motorcycles to electric motorcycles (EMs), a more sustainable transport mode, is a reasonable strategy for many jurisdictions. However, to develop effective programs to increase the adoption of EMs, it is necessary to have a better understanding of motives and barriers that determine the switching intention to EMs. To cover this gap, this investigation aims to develop a conceptual research model based on the Behavioural Reasoning Theory to explore the antecedents of the switching intention. Data from 751 conventional motorcycle users in Vietnam were used to test the model using partial least squares structural equation modeling (PLS-SEM). The moderating roles of trust and knowledge were also examined in this study. The results showed that 'reasons for' have no direct effect on the switching intention; however, this variable affects the intention indirectly via global motives. In contrast, 'reasons against' show a negative direct impact on the intention, and no indirect effect is found. The findings provide interesting insights for governments and the electric vehicle industry.

1. Introduction

In low- and middle-income countries, particularly in Southeast Asia, the mixed traffic flow is generally dominated by motorcycles (Eccarius and Lu, 2020). According to MotorCycles Data (2022), the ASEAN motorcycle industry accounts for over 25% of the global motorcycle market in production and sales units, following only China and India. As of 2019, the total number of registered motorcycles in Indonesia, Vietnam, and Thailand were 106 million, 62 million, and 21 million, respectively. Motorcycle popularity has grown in LMICs due to its low price, low operating cost, and great fuel economy. Additionally, this type of transport means is recognized to be more convenient than others for point-to-point travel in urban areas with a high proportion of narrow streets and a uniformly distributed road network (Guerra, 2019). Despite these benefits, the high level of motorcycle dependency also results in several disadvantages. Besides traffic congestion and traffic crashes, the most notable problem caused by motorcycles is the high levels of air pollution, which increases the incidence of respiratory diseases and shortens life expectancy. According to WHO (2021), in 2016, approximately 4.2 million premature deaths worldwide resulted from ambient air pollution, and around 91% of them occurred in low- and middle-income countries.

Shifting from Internal Combustion Engine (ICE) motorcycles to electric vehicles (EVs) would improve the quality of local air and reduce

* Corresponding author at: Faculty of International Economics, Foreign Trade University, 91 Chua Lang Street, Dong Da, Hanoi, Viet Nam
E-mail addresses: npqduy@dut.udn.vn (D.Q. Nguyen-Phuoc), an-nguyen.nguyen@griffithuni.edu.au (N.A.N. Nguyen), phuong.ttk@due.udn.vn (P.T.K. Tran), giang.pham@ftu.edu.vn (H.-G. Pham), O.OviedoTrespalacios@tudelft.nl (O. Oviedo-Trespalacios).

https://doi.org/10.1016/j.jtrangeo.2023.103705
Received 4 February 2023; Received in revised form 7 August 2023; Accepted 15 September 2023
Available online 4 October 2023

the environmental burden of such vehicles (Guerra, 2019; Eccarius and Lu, 2020). EVs, which rely on regular charging from the local electricity network, could support efforts to move away from fossil fuels (e.g., oil, coal, and natural gas), which are considered non-renewable energy resources. The mode shift to EVs also contributes to economic stability, given that fossil fuel prices and imports are increasingly volatile due to the unstable geopolitical situation. Governments worldwide have cooperated with the automobile industry to promote EVs as a key technology to combat the climate crisis by curbing fossil fuel consumption. For instance, at COP26, several participating nations (e.g., Denmark, Netherlands, Sweden, New Zealand) and automobile manufacturers (e.g., General Motors, Volvo, Audi, Ford) have agreed to set a new goal to go all-electric by 2040. In China, the national authority recently issued a mandate on automakers requiring that EVs constitute 40% of total revenue in 2030 (Hsieh et al., 2020). In South East Asia, the Indonesian Ministry of Energy and Mineral Resources established a goal to mitigate oil-fired transport energy, aiming to minimize its share by 20% in 2025.

In Vietnam, a typical Southeast Asian country, there is a large number of motorcycles on the road network. Reports show that there were 62 million registered motorcycles for a total population of 96 million in 2019, meaning that 2 out of 3 Vietnamese people owned a motorbike. This situation is likely to continue as public transport is not widely available, and cars are expensive considering Vietnam's income per capita. Currently, most major cities in Vietnam, such as Hanoi, Ho Chi Minh, and Danang, face 'alarming' air pollution levels, and motorcycle emissions are the primary reason for this major public health threat. The number of premature deaths due to motorbike emissions in Hanoi and Hai Phong city is higher than the fatalities associated with road crashes (Vu et al., 2013). The Vietnamese government has started taking action to address this issue. For instance, the government announced the intention to shift from Internal Combustion Engine (ICE) motorized two-wheelers to 100% electric motorcycles (EMs), especially in Hanoi and Ho Chi Minh, by 2030, the two biggest cities in the country. Vietnam officially committed to achieving net-zero emissions by 2050 at the United Nations Climate Change Conference (COP26).

Vietnam has implemented a number of national and local measures to encourage EMs. However, such initiatives have had limited success as the adoption of EMs remains relatively low (Le et al., 2021). Only Hanoi city, the capital of Vietnam, has determined a (very modest) target for the adoption of EMs of 5% by 2030. This highlights that there are significant challenges for EMs growth in the region, which can impact sustainability targets. As such, a better understanding of the factors determining switching intention towards EMs is needed to guide the electrification of the fleet. Currently, there have been few studies examining factors affecting the adoption of EMs (Eccarius and Lu, 2020; Su et al., 2023); indeed, the main gap in the literature is the lack of understanding of the reasons for accepting and resisting EMs, particularly in the context of low- and middle-income countries where these vehicles are more popular. Additionally, previous literature has mostly concentrated motives for the adoption of EMs, whereas obstacles that may deter customers from using EMs have been rarely explored. The investigation of EMs' adoption from these dual perspectives will give us insights into the behavioural reasoning underlying users' decisions (Ryan and Casidy, 2018; Sahu et al., 2020). The present investigation addresses this gap.

The aim of this paper is to investigate users' behavioural reasoning processes related to switching to an EM in the future, using the behavioural reasoning theory (BRT) (Westaby, 2005). In this study, we explore the relative influence of various determinants of switching intention from conventional motorcycles to EMs, utilizing a single but well-established theoretical framework. A key consideration is that the present research is conducted in a low- and middle-income country, where EVs are seen to be a new transport mode. Therefore, users' trust in new technology, as well as knowledge about new EMs, might influence the switch intention. Three main research objectives are proposed on this study:

- To investigate how reasons (for and against) adopting EMs directly and indirectly affect (via global motives) EM switching intention.
- To examine the mediating role of reasons (for and against) on the relationship between environment concerns (as a belief) and EM switching intention.
- To determine whether these associations are moderated by users' trust in EMs and knowledge about this transport mode.

2. Background

2.1. Behavioural reasoning theory

Adoption of new technology can be explained using behavioural models (Chen et al., 2021). Electric motorcycles (EMs) are relatively new technologies in LMICs so technology acceptance theories are a good option to model adoption, e.g. theory of reasoned action (TRA), theory of planned behaviour (TPB), theory of choice (Chiu and Tzeng, 1999; Duann et al., 2001; Jones et al., 2013; Sun and Zhang, 2013; Sung, 2010), technology acceptance model (TAM) (Chen, 2013; Liu and Lai, 2020; Wu et al., 2015) and diffusion of innovation theory (Munkácsy and Monzón, 2018; Peine et al., 2017; Seebauer, 2015). However, the Theory of Planned Behaviour (TPB) is one of the most established and validated theories to study to assess a priori acceptance of technology. The thesis is that attitude, subjective norms, and perceived behavioural control determine the intention, which eventually will translate into actual behaviour (Eccarius and Lu, 2020). The TPB is also flexible enough to account for other factors related to the application.

Behavioural reasoning theory (BRT), developed by Westaby (2005), also provides a behavioural framework in the context of technology acceptance similar to the TPB. For example, the BRT suggests associations between beliefs or values, reasons (for and against), global motives (i.e., attitudes, subjective norms, and perceived behavioural control), intentions, and customer behaviours. BRT provides valuable insights, predicts intention more accurately, and explains differences in intention besides attitudes, norms, or perceived behavioural control (Eccarius and Lu, 2020). Using the BRT to study the intention to accept EMs has advantages over other behavioural models. First, distinguishes between an individual's reasons for and against a given behaviour. Conceptually, this offer better information as the reasons for refusal to accept innovation are not just the opposite of the reasons in favour. Second, BRT provides a more holistic interpretation of the cognitive processes behind the reasons (for and against), which enhances our understanding of the human's decision-making and other behaviours (Sahu et al., 2020). Third, BRT delineates the role of values or beliefs in user reasoning. In this study, understanding the role of beliefs in decision-making, such as environmental concerns and context-specific reasons, can help drive successful strategies to increase the adoption of EMs.

Environmental concerns refer to people's awareness of environmental problems and their support for the efforts needed to address them (Newman and Fernandes, 2016). Environmental concerns also include users' emotional reactions to environmental issues, such as anxiety and dislike (Milfont and Gouveia, 2006; Yeung, 2004). Generally, environmental concerns are divided into two categories: concerns over specific ecological problems (e.g., attitudes towards waste management or water pollution) and comprehensive and pervasive concerns (e.g., views on various environmental issues and attitudes about the relationship between people and the environment) (Dunlap and Van Liere, 1978). This study takes a comprehensive and universal perspective on ecological issues when examining environmental concerns, considering that previous research has investigated the impact of consumers' environmental concerns on their decision to choose environmentally-friendly products, such as organic food (Hoffmann and Schlicht, 2013), renewable energy (Bang et al., 2000) and electric vehicles (Chen et al., 2018; Chen et al., 2021; Ng et al., 2018).

2.2. Trust and knowledge (product knowledge)

Trust is described to be "a willingness to rely on an exchange partner in whom one has confidence" (Moorman et al., 1993). Trust arises whenever a two-way relationship is characterised by vulnerability, uncertainty, and dependence (Bradach and Eccles, 1989). Trust is an essential factor in technology adoption (Buckley et al., 2018; Nordhoff et al., 2019; Kelly et al., 2022). On the other hand, product knowledge is defined as "the amount of accurate information held in memory as well as self-perceptions of product knowledge" (Rao and Sieben, 1992). Customer's acceptance of new products depends on their product knowledge. With the variety of product types and information in today's market, customers tend to depend upon existing product knowledge to judge products' qualities and subsequently make a purchase decision (Fu and Elliott, 2013). To assess knowledge, we will consider perceptions of knowledge in the present study.

2.3. Switching intention

According to Ye and Potter (2011), users' switching intention refers to the inclination of users to partially reduce or completely cease their utilization of a specific information technology product. Simultaneously, the switching intention involves shifting their focus towards alternative products that better cater to their specific needs, thereby satisfying their requirements more effectively. In the context of social media, switching typically involves users partially replacing current services instead of completely abandoning them (Keaveney and Parthasarathy, 2001). This implies that users utilize both services simultaneously but gradually rely more on one of them. Based on previous studies, this study defines "switching intention" as the user's gradual or complete discontinuation of conventional motorcycles over time, accompanied by an increased usage of electric motorcycles (EMs). Therefore, we do not strictly define user switching as completely abandoning their current transport mode (Peng et al., 2016).

3. Hypothesis development

3.1. Global motives → switching intention

Intention is a well-validated and frequently used indicatosr of behaviour (Sahu et al., 2020; Chen et al., 2021). The intention of using a new product or service will very often result in the consumers acquiring or purchasing such product or service in the future (Claudy et al., 2013). The BRT (and others well-establishd theories such as TPB and TAM) assumes that intention strongly predicts customer behaviour. In this study, the intention to switch to EMs acts as the dependent variable. Traditionally, most popular psych-social theories of behaviour such as the TPM explain that subjective norms, attitude, and perceived behavioural control are important antecedent factors of intention (Westaby, 2005). In the BRT, Westaby (2005) classifies these three antecedent factors as global motives as they constitute a broad concept of predictive value in many behavioural contexts. Attitude represents a person's positive or negative evaluation of a behaviour's performance from a global standpoint. Subjective norms assess social pressure that an individual perceives from their important people to engage in a behaviour. Perceived behavioural control represents how a person thinks they are in control of performing a behaviour or finds the behaviour easy or challenging (Ajzen, 1991). In the research context of energy, previous studies have determined the influence of global motives (e.g., attitudes) on the intention to accept or use green energy and products (Wiser, 2007; Hansla et al., 2008; Batley et al., 2000; Claudy et al., 2013; Nguyen et al., 2023), including EMs (Chen et al., 2021). Thus, we propose the following hypotheses:

H_1: Subjective norms positively affect switching intention to EMs.

H_2: Attitude positively affect switching intention to EMs.

H_3:Perceived behavioural control positively affect switching intention to EMs.

3.2. Reasons (for and against) → global motives, switching intention

The BRT considers context-specific reasons that might influence behavioural decisions (Westaby, 2005). Thus is one of the key advantages of using the BRT over other theories such as the TPB. Reasons refer to "the specific subjective factors people use to explain their anticipated behaviour" (Westaby, 2005, p. 100). Individuals can rely on reasons to explain their choices and limit cognitive conflicts, thereby increasing decision-making comfort and freedom (Kunda, 1990). Reasons are divided into two types, including 'reasons for' and 'reasons against' (Claudy et al., 2015; Claudy et al., 2013). The concept of 'reasons for' represents a set of positive factors, whereas 'reasons against' represents a set of negative aspects (Sahu et al., 2020).

According to BRT, reason is defined as an essential predictor of global motives (Westaby, 2005). Individuals form favourable judgments about a particular object (e.g., brand, product, person, event, etc.) when they can identify valid and relevant reasons (Westaby, 2005). The evaluation mechanisms play a decisive role in shaping the evaluation process (Hsee, 1996). Considering and identifying reasons can explain attitude formation (Bagozzi et al., 2003). The stronger the rationale for effectuating a behaviour, the greater the link between global motives and behaviour (Sahu et al., 2020). The causal relationship between reasons and global motives was also verified in previous studies based on BRT theory (Claudy et al., 2013; Claudy et al., 2015; Gupta and Arora, 2017; Wang et al., 2021a; Chen et al., 2021).

Arguably, the BRT can be considered as more comprehensive mainstream theories used in transport research (e.g., TRA and TPB), since it indentifies determinants of intentions stemming from context-specific reasons beyond what is presented by global engines (Sahu et al., 2020; Claudy et al., 2013). Westaby (2005) argues that "reasons can be powerful drivers of intention because people feel more comfortable with themselves when they have reasons that justify and defend their anticipated actions, even if their attitudes are not perfectly aligned with their intentions" (p.101). As demonstrated in technology adoption models, such as TAM (Davis et al., 1989) and UTAUT (Venkatesh et al., 2003), context-specific factors play an essential role in explaining intention. For example, consumers may have a positive attitude towards EMs, yet still decide against their use due to the lack of an appropriate operating mechanism. Previous studies have also identified the influence of reasons on the intention to perform a behaviour based on the BRT (Claudy et al., 2013, Claudy et al., 2015, Gupta and Arora, 2017, Wang et al., 2021a, Chen et al., 2021).

From the above discussion, the following hypotheses are proposed:

H_4: Reasons for switching to EMs positively affect subjective norms.

H_5: Reasons for switching to EMs positively affect attitude.

H_6: Reasons for switching to EMs positively affect perceived behavioural control.

H_7: Reasons for switching to EMs positively affect switching intention to EMs.

H_8: Reasons against switching to EMs negatively affect subjective norms.

H_9: Reasons against switching to EMs negatively affect attitude.

H_{10}: Reasons against switching to EMs negatively affect perceived behavioural control.

H_{11}: Reasons against switching to EMs negatively affect switching intention to EMs.

3.3. Environmental concerns ➔ reasons (for and against)

In addition to reasons and global motives, beliefs also play a key role in the BR. Beliefs affect a person' reasons to justify their intended behaviour (Wang et al., 2021a) and, ultimately, they will influence intention. Cognitive assessment (e.g., beliefs and values) affects an individual's self-protective behaviour (Westaby, 2005); hence, consumers' evaluation of expected behaviours can be influenced by their

beliefs and values. Environmental concerns are a form of belief (Chen et al., 2021), which includes the perception that human action could be either beneficial or detrimental to natural environment. Environmental concerns also involves believing that individuals need to be responsible for the environmental effects of their actions (Wang et al., 2021a). Some lines of thinking in psychology of attachment to the environment argue that individuals can perceive destroying the natural environment as a form of self-harm (Wang et al., 2021a). Previous research has also shown that people who have positive beliefs about the environment will readily accept the use of green products (Ricci et al., 2018). Additionally, customers with great environmental concerns tended to express a preference and favourable attitudes towards green products in general (Biswas and Roy, 2015; Minton and Rose, 1997), including electric vehicles (Wong-Parodi and Berlin Rubin, 2022; Ingeborgrud and Ryghaug, 2019; Adnan et al., 2018).

Previous research indicated a negative relationship between environmental concerns and reasons against green product consumption (e.g., He et al., 2018; Dhir et al., 2021; Chen et al., 2021). However, Bohn and Rogge (2022) highlights that there is scepticism among consumers about the actual contribution of electric vehicles to climate action. Such scepticism can play a role in low- and middle-income countries where citizens tend to lack information about green production and certification processes (Nuttavuthisit and Thøgersen, 2017). In the context of organic food, another eco-friendly product, Tandon et al. (2020a) empirically showed that health-conscious customers were more mindful of the risks associated with a product's credibility, stimulating consumers' processing of reasons against purchasing organic groceries. Thus, despite having environmental concerns, consumers are likely to lean towards self-preservation instead of believing in an uncertified option, resulting in stronger reasons against purchasing green products. In the present study, the intention to switch to EMs will be investigated as a form of green consumption behaviour, which is consistent with the main messages given by the industry and government. We argued that the general worldview or belief of environmental concerns is essential and should be considered an antecedent of the reasons for or against the intention to switch to EMs. Thus, this study proposes the following hypotheses:

H_{12}: Environmental concerns positively affect reasons for switching to EMs.

H_{13}: Environmental concerns positively affect reasons against switching to EMs.

H_{14}: Environmental concerns positively affect attitudes towards switching to EMs.

3.4. The moderating role of trust

Trust is the consumer's perceived service provider's ability to deliver the promised product attributes (Sirdeshmukh et al., 2002). Trust is one of the most critical contributors to fostering a steady supplier-consumer relationship (Handfield and Bechtel, 2002; Sahay, 2003). Trust is often considered important when companies try to influence consumer perceptions, attitudes, and behaviours (Berry, 1995; Moorman et al., 1993) but also when adopting new technologies (Kelly et al., 2022). 'Trust' is as a multi-dimensional construct, reflected by emotional, cognitive, and behavioural aspects, all of which substantially influence in consumers' choices (Fam et al., 2004). In research related to green consumption, trust is conceptualized as "a willingness to depend on a product, service, or brand based on the belief or expectation resulting from its credibility, benevolence, and ability about its environmental performance" (Chen, 2010). When the perceived value of a product is high, consumers tend to rely on that product and trust its attributes. When consumers trust the attributes of a product, purchase intention is enhanced (Lu et al., 2010). EMs are considered as a more environmentally friendly form of transport; thus, purchasing EMs is an environmental behaviour (Chen et al., 2021). Chen (2010) claimed that green trust will impact consumer purchasing behaviours in the climate action era. Consumers will likely purchase a particular product due to their ecological needs. Previous studies also evaluated the moderating role of trust in the relationship between the factors affecting the intention to use green products (Tandon et al., 2020b; Bonn et al., 2016). Therefore, this study assumes that trust serves as a moderator in the association between reasons, global motives and the intention to switch to EMs. Thus, this study proposes the following hypotheses:

H_{15a1}: Trust moderates the association between reasons for and switching intention to EMs.

H_{15a2}: Trust moderates the association between reasons against and switching intention to EMs.

H_{15b1}: Trust moderates the association between subjective norms and switching intention to EMs.

H_{15b2}: Trust moderates the association between attitude and switching intention to EMs.

H_{15b3}: Trust moderates the association between perceived behavioural control and switching intention to EMs.

3.5. The moderating role of knowledge

Knowledge about a new product can help customers understand and evaluate the product attributes, which in turn support their cognitive processes and decision-making (Fu and Elliott, 2013). Product knowledge is considered the main factor influencing the evaluation and acceptance of a new product (Moreau et al., 2001). Product knowledge is regarded as one of the essential moderating variables in attitude-intention and subjective norms-intention relationships (Cowley and Mitchell, 2003; Malaviya and Sivakumar, 1998; Berger et al., 1994; Fu and Elliott, 2013). While low-knowledge consumers are inclined to endorse recommendations and suggestions of others, high-knowledge consumers usually evaluate products based on their own cognition (King and Balasubramanian, 1994). Also, Chang (2004) explained that consumers with low knowledge and high knowledge react differently to products and have different attitudes and purchase intentions. Knowledgeable consumers' behaviours are mainly determined by their beliefs as opposed to less knowledgeable ones, who are mainly affected by normative pressure from society (Fu and Elliott, 2013).

Consumers are increasingly interested in environmental protection activities and have more intention to use green products (Wang et al., 2019). As consumers have more knowledge about green products, they better understand the product's functions and attributes in relation to environmental protection (Wang et al., 2019). Additionally, an individual who has a better understanding of a product might have more reasons to choose that product and is likely to use it. The more interested and knowledgeable users are, the more likely they will have positive beliefs and attitudes, leading to greater intention to use certain products and services (Pagiaslis and Krontalis, 2014). Therefore, this study proposes to draw the moderation of knowledge between the links from reasons, global motives, to switching intention to EMs. As such, the following hypotheses are justified in this study:

H_{16a1}, H_{16a2}: Knowledge moderates the association between reasons (for and against) and switching intention to EMs.

H_{16b1}, H_{16b2}, H_{16b3}: Knowledge moderates the association between global motives and switching intention to EMs.

Fig. 1 represents the theoretical research framework of the study.

4. Method

4.1. Questionnaire design and sampling method

Before carrying out the field survey, a questionnaire is firstly designed in English. The survey questionnaire includes three main sections as follows:

- The first section: provides information about the research aim, research objectives and the rights of survey respondents.

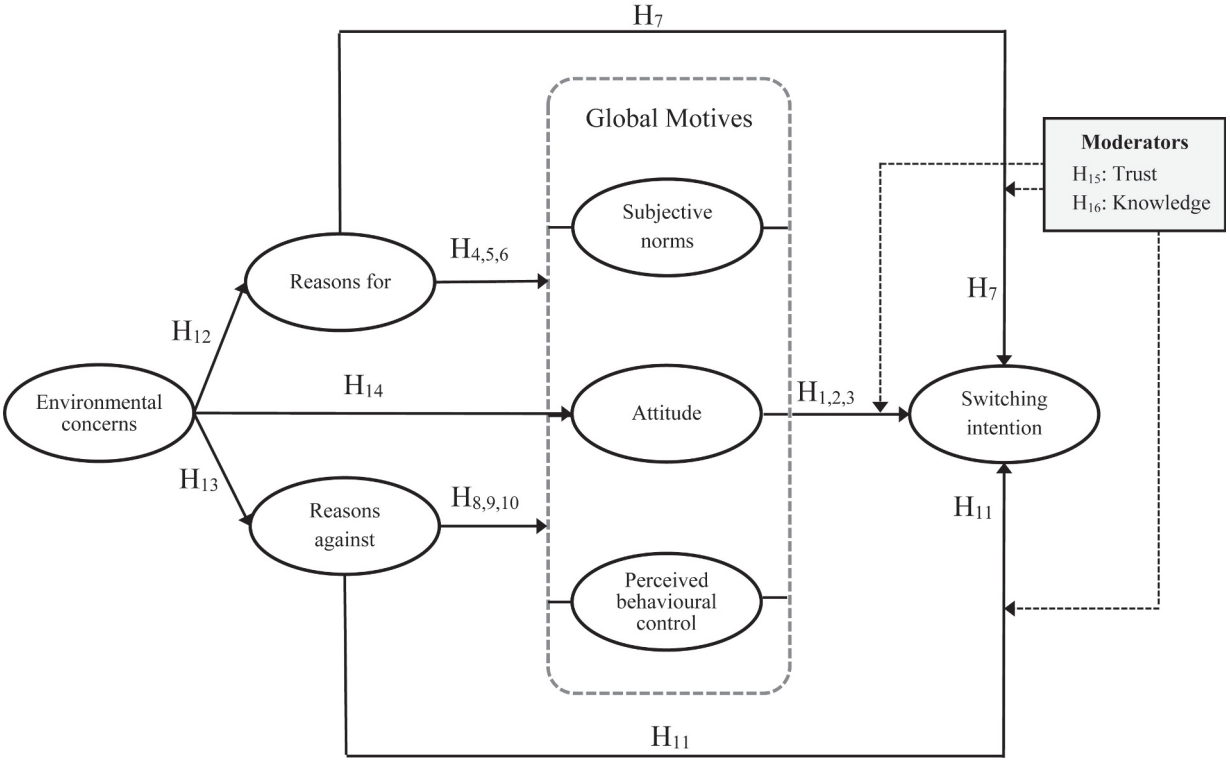


Fig. 1. Proposed conceptual model.

- The second section: presents a list of measurement items used to measure variables in the conceptual model. Most of the items, which are scored on seven-point scales ranging from 1 (Strongly Disagree) to 7 (Strongly Agree), are adopted from existing literature (Appendix A2).
- The third section: gives information about respondent demographics such as gender, age, education level and income.

To ensure the validity and reliability of measurement items in the questionnaire, an initial version was sent to a panel of five transport experts in Feb 2022 for pretesting. The experts were requested to assess the relevance of each measurement item to its respective construct using a 4-point rating scale (1 - not relevant, 2 - somewhat relevant, 3 - quite relevant, 4 - very relevant) (Bertea and Zaiţ, 2013). The majority of measurement items received agreement from the experts, with some comments provided regarding duplicated items, wording, grammar, and sentence structure. After being revised based on the experts' comments, the original English questionnaire was translated into Vietnamese by a professional translator. The new version was then back-translated into English by a different translator to guarantee semantic equivalence. Next, a pilot test was conducted with 30 undergraduate students from the University of Danang in the first week of March 2022. These students were asked to complete the paper-based questionnaire and report if any of the questions were unclear or confusing. The average time required to complete the survey was also evaluated. At this stage, the language of the survey questions was slightly changed, and the revised version was ready for the full-scale survey.

The data collection process was conducted face-to-face to validate the developed research model and hypotheses. In this study, the survey's target population was individuals who had not owned an electric motorcycle. As such, the convenience sampling method was used to collect data since this method was particularly effective in the case the survey population was substantial (Song et al., 2012). The field survey was conducted in two large cities in Vietnam (i.e., Hochiminh and Danang) from 4th April 2022 to 19th May 2022. A total of five well-trained research assistants in each city approached public areas such as malls, public transport stations, coffee shops or parks and invited people to participate in the survey. Only participants willing to participate in the survey and answer 'No' to the screening question ('have you ever owned an electric motorcycle') were recruited. To increase the response rate, a small amount of money (around $1) was paid to participants when they completed the questionnaire.

Additionally, in order to have a sample that was relatively representative of the broader population, the comparison of gender and age distribution between the sample and the Vietnamese adults (16–69 years old) was conducted during the data collection. In the absence of available data regarding the specific traits of motorcyclists in Vietnam, we are making the assumption that the characteristics of the motorcyclist population closely resemble those of the adult population in Vietnam. Table A3 gives information about the survey sample comprised 329 males (49.7%) and 333 females (50.3%). The highest proportion (61.6%) of respondents were 25–54 year olds, followed by 16–24 year olds (25.4%). A chi-squared test was conducted to compare the gender and age distribution between the sample and Vietnamese adult population in 2019. The results of the chi-square test showed that the sample was representative of the broader population.

4.2. Analytical strategies

Research assistants distributed 800 questionnaires; however, a total of 769 were returned. Several participants decided to stop midway through a survey due to some reasons. After removing responses with missing values and outliers, 751 questionnaires were retained. Given the research objective is to explore users' switching intention from conventional motorcycles to electric motorcycles, only respondents who owned a conventional motorcycle and use it for daily travel were targeted and selected in this study. Finally, 662 responses were used for further analysis.

The normality of all the items was examined by calculating skewness and kurtosis. As Kline (2016) recommended, the absolute values of the

skewness and kurtosis coefficients should be below the threshold values of 3 and 8, respectively. The results of descriptive statistics revealed that skewness and kurtosis of all variables were within the acceptable spectrum (see Appendix A2). The highest absolute value of the skewness and kurtosis statistics were 1.614 and 4.019, demonstrating that the collected data were normally distributed.

Primary data analysis was proceeded after the examination of data normality. To address objective 1, observable items of two reason categories (i.e., 'reasons for' and 'reasons against') was first empirically examined with exploratory factor analysis (EFA) approach with SPSS employed. The study's objectives 2 and 3 concerning interrelationships among latent factors were implemented by SmartPLS, a prominent software program for partial least squares structural equation modeling (PLS-SEM). Not covariance-based SEM (CB-SEM), PLS-SEM was chosen since the research framework of this study strives to explore theoretical extensions of an established theory (i.e., Behavioural Reasoning Theory) (Hair et al., 2021). With the assistance of SmartPLS, complicated cause-effect relationships in a latent variable path model are explored. There are two sub-models in PLS-SEM, which are measurement model and structural model. To validate measurement models, this study carried out Confirmatory Composite Analysis, whose purpose is to confirm the quality of a composite measurement of a theoretical concept (Hair et al., 2021). In structure model evaluation stage, path coefficients were examined to test associations existed among latent constructs. This is the evidence used to confirm or reject developed hypotheses. The details of analysis techniques and process are provided in Fig. 2.

5. Results

5.1. Respondent characteristics

The socio-demographic characteristics of the survey participants are presented in Table 1. Fair distribution of respondents regarding gender and marital status was observed, with 50.3% women and 50.5% single.

Table 1
Respondents' socio-demographic characteristics.

Characteristics	*n*	%		*n*	%
Gender			*Occupation*		
Female	333	50.3	Full-time employee	337	50.9
Male	329	49.7	Part-time employee	69	10.4
Age			Student	124	18.7
Mean (Standard Deviation)	34.37 (13.43)		Retired	30	4.5
Level of education			Housewife	66	10.0
Below secondary school	12	1.8	Other	36	5.4
Secondary school	53	8.0	*Monthly income (VND)*		
High school	89	13.4	No income	80	12.1
College	135	20.4	$\leq$ 5 million	108	16.3
University	328	49.5	5–10 million	263	39.7
Above university	45	6.8	10–15 million	148	22.4
Marital status			$\geq$ 15 million	63	9.5
Single	334	50.5			
Married	328	49.5			

Note: 1 USD = 23,000 VND.

Regarding educational qualifications and occupations, three-quarters of respondents acquired college/ university and post-graduate degrees, and nearly half of them were full-time employees (50.9%). Since most respondents were of working age (34.37 ± 13.43) and had a high educational background, their self-reported monthly earnings corroborated this sampling structure. >70% of survey participants reported a monthly salary from 5 million to above 15 million (VND), implying they belonged to the middle class or higher in Vietnam.

5.2. Exploratory factor analysis results

Since observed items measuring 'reasons for' and 'reasons against' were adopted from various prior studies, exploratory factor analysis (EFA) was used to confirm the underlying dimensions of the items

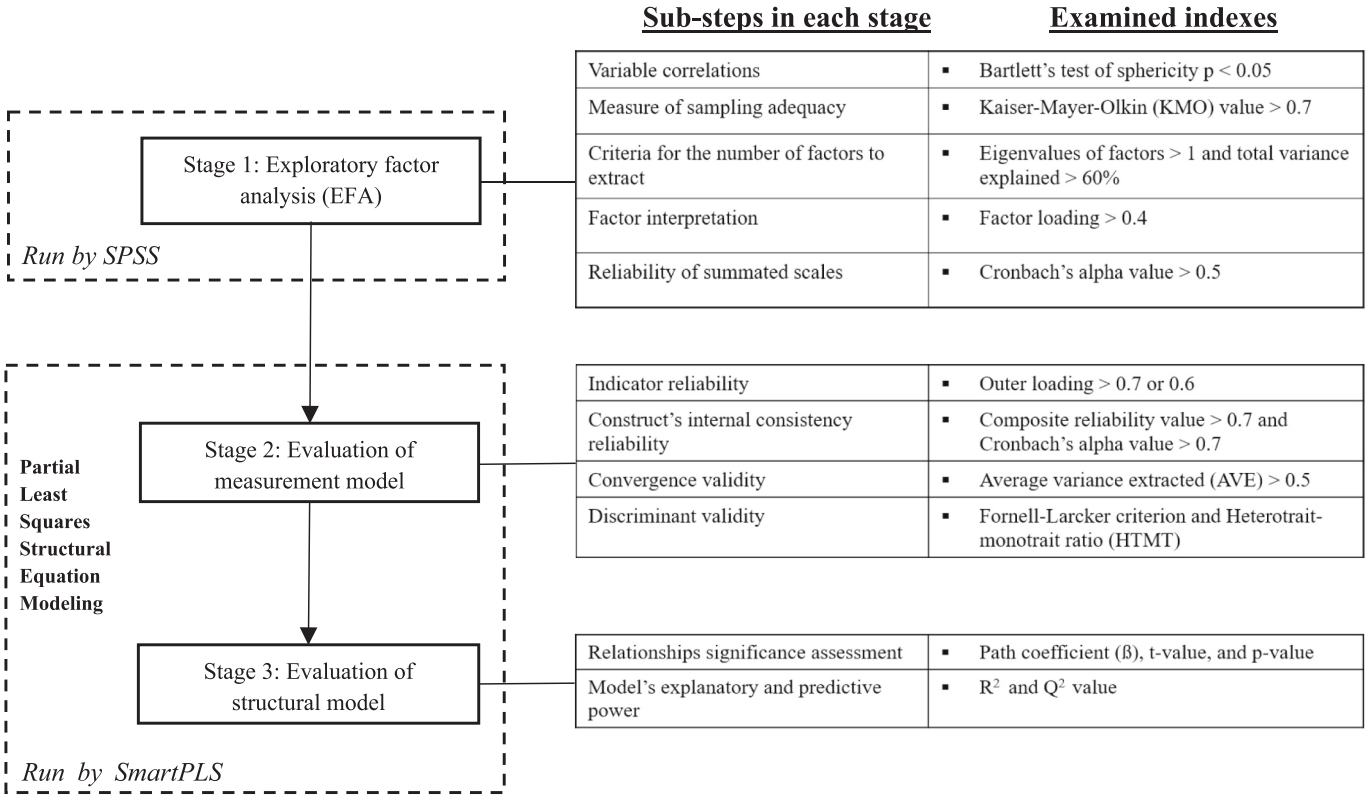


Fig. 2. Primary data analysis techniques and procedure.

measuring the users' reasons to switch to EMs. In this study, EFA, which employed principal component analysis with varimax rotation method, was performed based on eigenvalues of more than one. The Kaiser-Meyer-Olkin measure of sampling adequecy (KMO = 0.754) was greater than acceptable value of 0.6, and Bartlett's test of sphericity ($\chi 2 = 1609.336$, $p < 0.001$) indicated a significant correlation between the developed items (Hair et al., 2019a). These indexes denoted that the data was appropriate to be proceeded with factor analysis. Consequently, ten measurement items (i.e., REF1, REF2, REF3, REF4, REF5, REA1, REA2, REA3, REA4, REA5) were extracted into two factors (e,i., 'reasons for' and 'reasons against'), accounting for 72.658% of the total variance (see Table 2). Based on item loadings in each factor, the emerging factors were interpreted as representing (1) reasons for and (2) reasons against the switching intention to EMs. The reliability of the newly adapted scale was examined using Cronbach's alpha value. Kline (2005) suggested an acceptable value for Cronbach's α to be 0.7 to 0.8. Cronbach's α values of the two factors were 0.746 and 0.759, indicating adequate internal consistency of the newly adapted scale.

5.3. Construct reliability and validity

Prior to the significance testing of hypotheses, reliability and validity evaluation of the constructs was conducted. The flow of this measurement model evaluation stage is shown in Fig. 2. Correspondingly, the examination of outer loadings is the first step validating indicator reliability. As shown in Table 3, two items (REA5 and ENV3), with outer loadings much smaller than 0.7, were omitted following Hulland (1999)'s guideline. However, the items of REF1, REF2, REF4, and REA3 with outer loadings between 0.60 and 0.70 were considered to be acceptable because their associated constructs ('reasons for' and 'reasons against') adopted newly developed scales (Hulland, 1999).

Cronbach's alpha values fluctuated in a range of 0.706–0.930, and composite reliability parameters ranged from 0.815 to 0.956. All of the values were >0.7, demonstrating the internal consistency reliability of the construct measurements (Hair et al., 2019b). In the convergent validity examination, the average variance extracted is required to be above 0.5 (Hair et al., 2019b). Accordingly, AVE scores for all constructs satisfied the threshold value (Table 3), validating the convergence of measurement models.

In terms of discriminant validity, two common criteria were rigorously examined. Compared to the traditional Fornell–Larcker criterion (Fornell and Larcker, 1981), Heterotrait-monotrait (HTMT) ratio of correlations (Henseler et al., 2016) offers a superior assessment (Henseler et al., 2016). When the AVE of a construct exceeds its squared correlations with all other constructs (Fornell-Larcker criterion) and HTMT ratios are under 0.85, good discriminant validity is obtained. As depicted in Table 4 and Table 5, all indexes met the conditions for discriminant validity. In conclusion, it is evidenced that the reliability and validity of all constructs are adequate.

Table 2
EFA results.

Factors and Items	Items' factor loading	Eigen-value	Explained variance	Cronbach's alpha
Factor 1: Reasons for switching to EMs (REF)		2.284	22.838	0.746
REF1	0.700			
REF2	0.704			
REF3	0.735			
REF4	0.632			
REF5	0.767			
Factor 2: Reasons against switching to EMs (REA)		2.853	28.525	0.759
REA1	0.509			
REA2	0.755			
REA3	0.772			
REA4	0.740			
REA5	0.750			

KMO = 0.754 > 0.5, $\chi^2 = 1609.336$, p < 0.001.
Total variance explained = 72.658.
Note: EFA = Exploratory factor analysis, KMO = Kaiser-Meyer-Olkin value, $\chi 2$ = Bartlett's test of sphericity.

5.4. Testing hypothesis

First, in order to evaluate the fitness of the research model employing PLS-SEM, the bootstrapped Standardized Root Mean Square Residual (SRMR) is the most popular measure (Benitez et al., 2020), with a rule of thumb of below 0.08 (Hu and Bentler, 1998). In this study, SRMR value equals 0.065, denoting a good fit. Furthermore, the other model fit indices also passed the model fit criteria suggested by Henseler et al. (2016): $\chi 2 = 1652.630$, d-ULS (squared Euclidean distance) = 1.274, d-G (geodesic distance) = 0.411, NFI (Normed Fit Index) = 0.808. Therefore, all statistics consolidate that the research model obtained an acceptable fit.

Having the model fitness established, we subsequently test the hypothesized relationships by employing bootstrapping procedure with 5000 subsamples. According to Hair et al. (2021), a path coefficient is significant when the empirical t-value achieves a theoretical t-value of 1.96 with 5% error probability. Regarding direct effects, subjective norms, attitudes, and perceived behavioural control had positive influences on customer intention towards switching to EMs with a confidence level of 99% (p-value <0.01), confirming the role of global motives for switching intention ($\beta_{SNO \rightarrow SWI} = 0.415$, $\beta_{ATT \rightarrow SWI} = 0.303$, $\beta_{PBC \rightarrow SWI} = 0.165$, respectively). Thus, H1, H2, and H3 were supported. Furthermore, there was a difference between two reason tendencies in the mechanism of EMs adoption. Particularly, while reasons against were verified to negatively affect switching intention ($\beta_{REA \rightarrow SWI} = -0.129$, $t = 4.254$, $p < 0.001$) (H11 was supported), reasons for had no effect on the investigated dependent variable ($\beta_{REF \rightarrow SWI} = -0.026$, $t = 0.704$, $p > 0.05$) (H7 was not supported) (see Fig. 3).

On the other hand, three global motives, subjective norms, attitudes, and perceived behavioural control of using EMs, positively impacted reasons for but did not impact customers' reasons against switching to EMs. Path coefficients, t-values, and p-values were displayed in Table 6, showing the support of H4, H5, and H6, yet the opposition of H8, H9, and H10.

In addition, environmental concerns were a good predictor of EMs advocates' reasons ($\beta_{ENV \rightarrow REF} = 0.433$, $t = 8.862$, p < 0.001). Regarding reasons against EMs, it was found to be strengthened by environmental concerns ($\beta_{ENV \rightarrow REA} = 0.272$, $t = 6.025$, p < 0.001). This demonstrated that when environmental concerns are greater, drivers' agreement with both reasons for and reasons against switching to EMs is stronger, supporting H12 and H13. Additionally, the impact of environmental concerns on attitude was not statistically significant ($\beta_{ENV \rightarrow ATT} = -0.072$, $t = 1.768$, $p < 0.05$). In conclusion, the data evidenced that nine out of 14 examined direct relationships were statistically verified.

The indirect effects among constructs were also explored in this study (Table 7). The results performed that the causal link from reasons for EMs adoption to switching intention was fully mediated by global motives, including subjective norms ($\beta_{REF \rightarrow SNO \rightarrow SWI} = 0.155$, p < 0.001), attitudes($\beta_{REF \rightarrow ATT \rightarrow SWI} = 0.165$, p < 0.001), and perceived behavioural control ($\beta_{REF \rightarrow PBC \rightarrow SWI} = 0.058$, p < 0.001). Meanwhile, the indirect effect of reasons against using EMs on their actual switching intention was not significant ($\beta'_{REA \rightarrow SWI} = -0.010$, p > 0.05). In addition, environmental concerns indirectly affected the endogenous constructs in the structural model, including subjective norms, attitudes, perceived behavioural control, and switching intention.

The total effects of the predictors on customer intention to switch from traditional gasoline motorbikes to EMs were also depicted in

Table 3
Estimation of measurement model.

Constructs	Indicators	Mean	SD	Loadings	CA	CR	AVE
Switching Intention	SWI				0.910	0.944	0.848
	SWI1	4.669	1.503	0.917			
	SWI2	4.630	1.552	0.942			
	SWI3	4.861	1.496	0.903			
Subjective Norms	SNO				0.930	0.956	0.878
	SNO1	4.595	1.441	0.941			
	SNO2	4.601	1.496	0.946			
	SNO3	4.417	1.520	0.923			
Perceived Behavioural Control	PBC				0.834	0.900	0.751
	PBC1	5.441	1.150	0.870			
	PBC2	5.417	1.205	0.884			
	PBC3	5.196	1.490	0.845			
Attitude	ATT				0.853	0.911	0.773
	ATT1	5.455	1.187	0.858			
	ATT2	5.391	1.07	0.907			
	ATT3	5.199	1.151	0.871			
Reasons for	REF				0.754	0.834	0.502
	REF1	6.082	0.919	0.688			
	REF2	5.775	0.977	0.693			
	REF3	5.858	1.017	0.701			
	REF4	5.264	1.256	0.688			
	REF5	6.074	1.012	0.770			
Reasons against	REA				0.706	0.815	0.524
	REA1	5.840	1.057	0.752			
	REA2	4.740	1.533	0.737			
	REA3	4.597	1.551	0.696			
	REA4	5.036	1.499	0.708			
	REA5	4.083	1.766	–			
Environmental concerns	ENV				0.792	0.878	0.706
	ENV1	6.128	0.966	0.797			
	ENV2	6.140	0.958	0.883			
	ENV3	5.799	1.197	–			
	ENV4	6.329	0.841	0.839			

Note: AVE: Average Variance Extracted; CA: Cronbach Alpha; CR: Composite Reliability.

Table 4
Fornell-Larcker criterion of the first-order factor model.

Constructs	AVE	ATT	ENV	PBC	REA	REF	SNO	SWI
ATT	0.773	0.879						
ENV	0.706	0.156	0.840					
PBC	0.751	0.531	0.121	0.866				
REA	0.524	0.018	0.272	0.021	0.724			
REF	0.502	0.510	0.433	0.348	0.125	0.709		
SNO	0.878	0.577	−0.002	0.388	0.055	0.374	0.937	
SWI	0.848	0.615	−0.055	0.476	−0.100	0.325	0.637	0.921

Note: ATT = Attitude, ENV = Environmental concerns, PBC = Perceived behavioural control, REA = Reasons against, REF = Reasons for, SNO = Subjective norms, SWI = Switching intention.

Table 5
Heterotrait-monotrait ratio results.

Constructs	ATT	ENV	PBC	REA	REF	SNO	SWI
ATT							
ENV	0.194						
PBC	0.630	0.169					
REA	0.073	0.341	0.108				
REF	0.626	0.556	0.435	0.217			
SNO	0.647	0.031	0.440	0.115	0.432		
SWI	0.697	0.076	0.543	0.127	0.383	0.692	

Note: ATT = Attitude, ENV = Environmental concerns, PBC = Perceived behavioural control, REA = Reasons against, REF = Reasons for, SNO = Subjective norms, SWI = Switching intention.

Table 8. Subjective norms were identified as the strongest determinant of switching intention ($\beta = 0.415$, $p < 0.001$), followed by drivers' perception of reasons for ($\beta = 0.352$, $p < 0.001$), attitudes towards EMs adoption ($\beta = 0.303$, $p < 0.001$) and perceived behavioural control ($\beta = 0.165$, $p < 0.001$). Environment concerns showed the smallest impact on the switching intention ($\beta = 0.093$, $p < 0.001$). 'Reasons against' negatively impacted the intention with $\beta = -0.139$, $p < 0.001$.

5.5. Predictive capability of the model

The coefficient of determination (R^2 value) and Stone-value Geisser's Q^2 value were used to assess the structural model's in-sample and out-of-sample predictive potential. As shown in Table 9, the R^2 value of switching intention was 53.4%, describing the moderate explanatory power of the tested model, as the value exceeds the 50% benchmark for moderate predictive accuracy (Hair et al., 2011). In addition, to ensure the generalisability for data not used in the model estimation, predictive relevance or Q^2 value should also be examined through the blindfolding procedure (Hair et al., 2021). Accordingly, Q^2 of switching intention to EMs was 42.6% which satisfied the rule of thumb of being greater than zero (Hair et al., 2021), indicating sufficient predictive relevance in explaining drivers' switching intention.

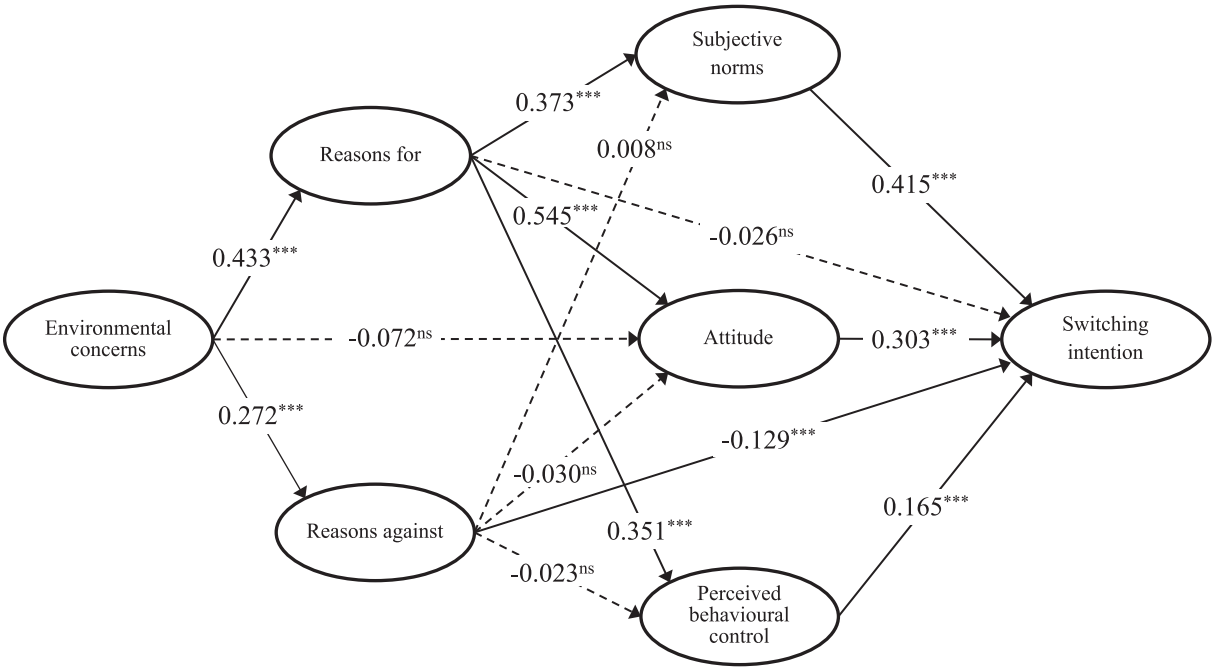


Fig. 3. Structural model estimation results.

Table 6
Direct effects in the proposed structural model.

Hypothesis	Hypothesized relationship	Coefficient (ß)	SD	*t-value*	*p*-value	Supported
H1	SNO → SWI	0.415***	0.039	10.565	<0.001	Yes
H2	ATT → SWI	0.303***	0.048	6.334	<0.001	Yes
H3	PBC → SWI	0.165***	0.039	4.252	<0.001	Yes
H4	REF → SNO	0.373***	0.037	10.220	<0.001	Yes
H5	REF → ATT	0.545***	0.044	12.334	<0.001	Yes
H6	REF → PBC	0.351***	0.044	8.045	<0.001	Yes
H7	REF → SWI	−0.026ns	0.037	0.704	0.482	No
H8	REA → SNO	0.008ns	0.042	0.191	0.849	No
H9	REA → ATT	−0.030ns	0.040	0.767	0.443	No
H10	REA → PBC	−0.023ns	0.041	0.555	0.579	No
H11	REA → SWI	−0.129***	0.030	4.254	<0.001	Yes
H12	ENV → REF	0.433***	0.049	8.862	<0.001	Yes
H13	ENV → REA	0.272***	0.045	6.025	<0.001	Yes
H14	ENV → ATT	−0.072ns	0.041	1.768	0.077	No

Note: SD = standard deviation, *** $p < 0.01$, ns non-significant.

Table 7
Indirect effects in the proposed structural model.

Indirect path	Coefficient (ß')	*SD*	*t*-value	*p*-value
ENV → ATT	0.228***	0.036	6.411	<0.001
ENV → PBC	0.146***	0.03	4.795	<0.001
ENV → SNO	0.164***	0.022	7.422	<0.001
ENV → SWI	0.093***	0.026	3.520	<0.001
REA → SWI	−0.010ns	0.029	0.332	0.740
REF → SWI	0.378***	0.034	11.117	<0.001

Note: *SD* = standard deviation, *** $p < 0.01$, ns non-significant.

Table 8
Total effects in the proposed structural model.

Paths	Effect types	Coefficient	*SD*	t-value	p-value
REF → SWI	Direct effect	−0.026ns	0.037	0.704	0.482
	Indirect effect	0.378***	0.034	11.117	<0.001
	Total effect	0.352***	0.039	9.106	<0.001
REA → SWI	Direct effect	−0.129***	0.030	4.254	<0.001
	Indirect effect	−0.010ns	0.029	0.332	0.740
	Total effect	−0.139***	0.040	3.467	<0.001
ENV → SWI	Direct effect	–	–	–	–
	Indirect effect	0.093***	0.026	3.520	<0.001
	Total effect	0.093***	0.026	3.520	<0.001
SNO → SWI	Total effect (Direct effect)	0.415***	0.039	10.565	<0.001
ATT → SWI	Total effect (Direct effect)	0.303***	0.048	6.334	<0.001
PBC → SWI	Total effect (Direct effect)	0.165***	0.039	4.252	<0.001

Note: *SD* = standard deviation, *** $p < 0.01$, ns non-significant.

5.6. Moderating effects evaluation

5.6.1. Moderating effect of trust

Moderated multiple regression was deployed to examine the moderation role of customer trust in switching intention towards using EMs, following Cohen et al. (2014)'s guidelines. As shown in Table 10, two out of five proposed hypotheses concerning the moderating role of trust were statistically significant. The interaction of subjective norms and trust was substantially related to switching intention (β= −0.057, *p*

Table 9
Evaluation of predictive accuracy and predictive relevance.

	R^2	SSO	SSE	Q^2 (=1-SSE/SSO)
Attitude	0.266	1986.00	1600.90	0.194
Perceived behavioural control	0.121	1986.00	1817.25	0.085
Reasons against	0.074	2648.00	2560.10	0.033
Reasons for	0.188	3310.00	3014.99	0.089
Subjective norms	0.140	1986.00	1759.31	0.114
Switching intention	0.534	1986.00	1140.86	0.426

Noted: SSO: sum of the square observations and SSE: sum of squared prediction errors.

Table 10
Results of moderating effects of trust.

Interaction effects	Coefficient (ß)	SD	*t*-value	*p*-value
H_{15a1}: REF * (TRU → SWI)	−0.008	0.028	0.282	0.778
H_{15a2}: REA * (TRU → SWI)	−0.014	0.018	0.798	0.425
H_{15b1}: SNO * (TRU → SWI)	-0.057**	0.023	2.498	0.013
H_{15b2}: ATT * (TRU → SWI)	0.080**	0.033	2.442	0.015
H_{15b3}: PBC * (TRU → SWI)	−0.019	0.027	0.714	0.475

< 0.05), corroborating hypothesis H_{14b1}. Particularly, the positive impact of subjective norms on switching intention was weaker in case consumers placed high trust in EMs (simple slope = 0.278) and vice versa (simple slope = 0.221) (Fig. 4).

Similarly, the interaction of attitude and trust was significantly positive in the association with switching intention (β= 0.080, p < 0.05), lending support for hypothesis H_{14b2}. The results also revealed that positive attitudes towards EMs more strongly foster switching intention when customer trust was high (simple slope = 0.326) rather than low (simple slope = 0.246) (Fig. 5).

5.6.2. *Moderating effect of knowledge*

Consumer knowledge of EMs was found to be the moderator in the negative relation between reasons against using EMs and switching intention (Table 11). The interaction of reasons against and knowledge demonstrated a significant association with switching intention (β = 0.082, $p < 0.001$), supporting hypothesis H_{15a2}. The plotted interaction

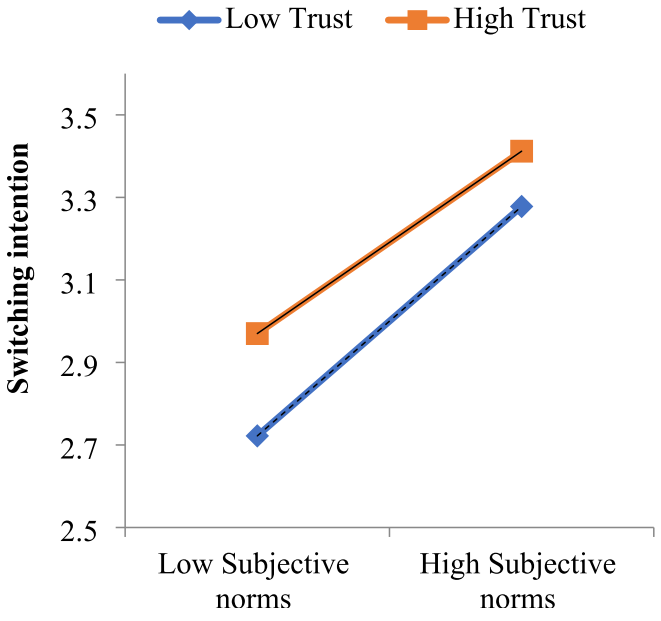


Fig. 4. Interaction effect of trust and subjective norms on switching intention.

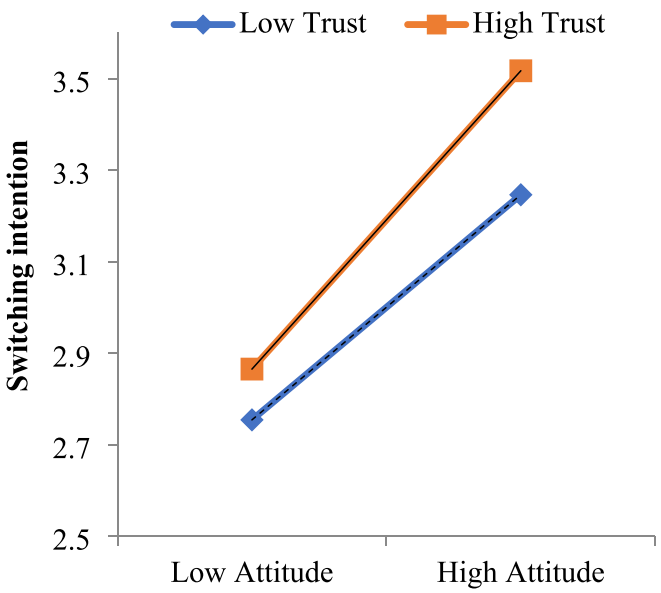


Fig. 5. Interaction effect of trust and attitude on switching intention.

Table 11
Results of moderating effects of knowledge.

Path	Coefficient (ß)	SD	*t*-value	*p*-value
H_{16a1}: REF * (KNO → SWI)	−0.019	0.030	0.642	0.521
H_{16a2}: REA * (KNO → SWI)	0.082***	0.016	5.233	<0.001
H_{16b1}: SNO * (KNO → SWI)	−0.001	0.028	0.024	0.981
H_{16b2}: ATT * (KNO → SWI)	−0.040	0.036	1.124	0.261
H_{16b3}: PBC * (KNO → SWI)	0.001	0.022	0.036	0.971

of Fig. 6 exhibited that the negative influence of reasons against EMs on switching intention decreased when customers acquired a higher level (simple slope = −0.063) rather than a lower level (simple slope = −0.145) of knowledge. However, knowledge did not moderate the relationships between four independent variables (i.e., reasons for EMs adoption, subjective norms, attitudes, perceived behavioural control) and switching intention. Thus, hypotheses H_{15a1} and $H_{15b1–3}$ were not supported.

6. Discussion

6.1. *Theoretical implications*

The present investigation provides a clear understanding of the determinants of the switching intention to use electric motorcycles (EMs) in a low- and middle-income country where motorcycles dominate the traffic flow. These countries have been neglected in the main academic discourse on the electrification of transport systems, as most studies have focused on electric cars, which are not the dominant type of vehicle in the global south. Drawing on behavioural reasoning theory (BRT), this study developed and validated a conceptual framework to explore the underlying mechanism behind the intention to switch to EMs. A key contribution is that the research findings advanced our understanding of the facilitators or barriers when switching to EMs, as well as the moderating role of consumer trust and knowledge in forming the behavioural intention. Some of the major contributions from a theoretical perspective will be discussed in the following paragraphs.

As hypothesized, three global motives positively influenced consumer switching intention. Out of the three factors, subjective norms were the strongest predictor, implying that switching intention is significantly affected by the social context. This trend is more pronounced in a collectivism-dominant society such as Vietnam, which has

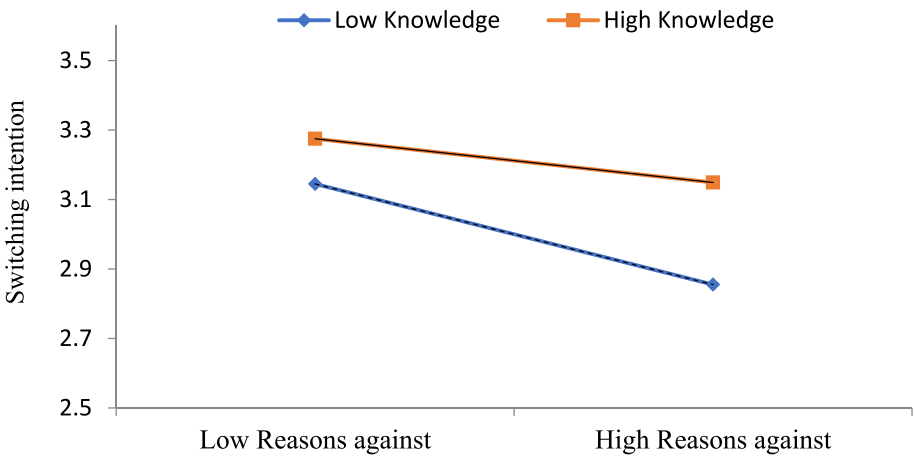


Fig. 6. Interaction effect of product knowledge and reasons against on switching intention.

been confirmed in previous studies on green and innovative behaviours (e.g., Wang et al., 2014; Asadi et al., 2021b; Nguyen-Phuoc et al., 2022b). Indeed, based on Hofstede's six-dimension model of national culture, Vietnam has been demonstrated to belong to one of the most collectivist cultures in the world (Načinović Braje et al., 2019). Similar to other East Asian countries (e.g., China, Japan), Vietnamese society originally leans towards Confucian culture (Thu et al., 2021), which often encourages individuals to associate themselves with external concerns and comply with organizational norms (Lee and Green, 1991). Consumers under the influence of such culture will be heavily affected by its population, including family members, friends, colleagues, and even the entire society (Ding et al., 2018). Therefore, the strong effect of subjective norms on switching intention towards EM in this study can be justified as a consequence of collectivistic culture. Particularly, when important people in an individual's life support EM use, they will be more willing to switch to EMs. Further, this result is in line with the findings electric cars literature. For example, Mohamed et al. (2018) found that potential buyers of sport utility cars mainly based their feelings on societal pressure to purchase an environmentally-friendly car, regardless of the relative importance of attitudes and perceived behavioural control. In addition, the current study also indicated that the effect of attitudes was larger than that of perceived behavioural control, corroborating the BRT (Westaby, 2005) and previous literature on electric vehicles/ cars adoption (Mohamed et al., 2018; Asadi et al., 2021; Huang and Ge, 2019).

We empirically demonstrated the relevance of 'reasons for' and 'reasons against' (driving and restricting factors) on EMs usage, as suggested by the BRT. To the best of our knowledge, this paper is the first investigation to establish a comprehensive set of measurable items for 'reasons for' and 'reasons against' switching to EMs in the context of a LMIC. Based on the total effects, the effect magnitude of 'reasons for' on switching intention was greater than that of 'reasons against.' While previous research found that reasons for EMs usage directly impact motorcyclists' intention (Liu and Lai, 2020), our results suggested an indirect association instead. Specifically, the perception of EM's benefits influenced global motives, which subsequently increased the propensity to switch to EMs. In other words, the association between customers' perception of EMs' benefits and switching intention was fully mediated by subjective norms, attitude towards using EMs, and perceived behavioural control. This finding is consistent with other research in the electric vehicle discipline (Degirmenci and Breitner, 2017; Sahoo et al., 2022). On the other hand, predicted challenges (i.e., reasons against) directly led drivers to object to switching to EMs, aligning with a prior study applying BRT in the context of reusable bag consumption (Yan et al., 2022). One potential explanation is that individuals prioritize behaviours that avoid negative outcomes rather than pursuing positive ones. This research finding reflects a common psychological phenomenon: bad impressions and stereotypes tend to have a quicker and stronger impact on human behaviour than good ones (Baumeister and Bushman, 2020). Therefore, the underlying scheme in which 'reasons for' affected motorcyclists' switching intention to EMs was more complicated than the direct effect of 'reasons against' on the behavioural intention. This helps to identify the best way to develop behaviour change interventions.

While recent studies investigated green product adoption by emphasising the role of symbols (e.g., status or innovation) and hedonic motives (Liu et al., 2021; Rezvani et al., 2015), this study observed EMs usage from a more altruistic perspective with the influence of environmental concerns and reasons related to macro or social benefits. Accordingly, this study found the indirect influence of environmental concerns among motorcyclists on their perceived behavioural control, subjective norms, and attitudes towards the switch to EMs. The full mediating role of 'reasons for' demonstrated that if customers had greater concerns towards the environment, they would be more acutely aware of the positive consequences of EMs usage, thereby adopting positive attitudes towards EMs. Furthermore, it is noteworthy that environmental concerns might foster consumers' perception of reasons against the consideration of EMs as a feasible alternative to gasoline motorcycles. This finding concedes our contention that environmentally conscious drivers tend to perform a more rigorous evaluation of potential impediments related to the battery (e.g., toxic materials, combustion possibility) prior to deciding to switch to EMs.

The total effect also indicated that environmental concern is key trigger on the change potential customers' choice of EMs over petrol-based motorcycles. Wu et al. (2019) also concluded a similar pattern concerning the adoption of autonomous electric vehicles. While numerous studies (Mohamed et al., 2018; Wang et al., 2014) scrutinised the direct effect of environmental concerns on customer behavioural intention towards electric vehicles, the current research offered a substantial theoretical contribution to the body of knowledge by empirically demonstrating the indirect association under the mediation of global motives and holistic reasoning approach. Consequently, the interrelationships of beliefs and values (i.e., environmental concerns) → reasons → global motives → intention originally proposed by Westaby (2005) were empirically validated in the context of EMs.

This study explicated reasons-motives-intention relationships in conjunction with the moderating role of customer trust and product knowledge. The results indicated divergencies in the moderating effects of such two variables. Particularly, customer trust only strengthened the influence of attitude on switching intention. The more drivers believe EMs possess promised attributes, the higher possibility that drivers adopt EMs by replacing petrol motorcycles, when having favourable attitudes towards EMs. This finding is consistent with Lavuri et al. (2022)'s proposition that trust dramatically modified the relationship

between attitudes and purchase intention towards sustainable goods. In a reverse pattern, customer trust was found to weaken the relationship between subjective norms and switching intention. The negative moderating effect provided a fresh insight: when increasing trust of prospective riders, the potential customers would be more self-aware of switching to EMs in lieu of asking for other people's opinions (e.g., families and friends). Meanwhile, trust had no moderation in the relationship between both types of reasons and vehicle shifting intention. This contradicted prior findings suggesting that trust was a vital element in enhancing the effect of perceived environment-related benefits on behavioural intention (Bonn et al., 2015). Unlike most prior studies investigating buying intention, the current study concentrated on switching intention. Switching behaviour could involve higher risks and barriers since customers have to terminate an existing relationship with a familiar product/ provider and substitute it for a new one (Jones et al., 2000). Arguably, trust was insignificant in modifying the effect of customers' subjective perceptions (i.e., reasons for and reasons against) on switching intention in this study's context.

Finally, our findings show that customers' knowledge of EMs could substantially mitigate the negative relationship between reasons against EMs and switching intention. Anticipated obstacles to EMs usage would not make consumers resistant to switching motorcycles if those drivers had a deeper knowledge about the resources that can facilitate the adoption of EMs, for example, collaborative discharge capability or vehicle sharing. Product knowledge had a decisive effect when customers' negative cognitions affected their tendency to switch to using EMs. In the literature on electric cars, several studies solely verified the strong and direct impact of increased electric vehicle knowledge on consumer adoption intention (e.g., Brückmann, 2022; Simsekoglu and Nayum, 2019. However, the moderating role of product knowledge has not been considered. The present study offered a new perspective on understanding the knowledge-behaviour gap in the specific context of EMs.

Table 12 summarizes the comparisons of findings in this study with those in existing studies from multiple perspectives.

6.2. Practical implications

The present study has several practice implications. First, according to our findings, subjective norms was the most critical factor motivating drivers to switch from petrol to EMs. Motorcycle riders are more willing to change their current vehicle into EMs when their important people highly recommend EM usage. This suggests possible directions for marketing activities, e.g., new buyers should be encouraged to capture a photo with their EMs and share it on social media in exchange for vehicle insurance or free EM design accessories such as customized anti-scratch covers or helmets. Such action can be considered a product endorsement that potentially attracts familial and peer group members to acquire a similar motorcycle in the future. Moreover, industry firms can collaborate with brand influencers whose image is attached to

Table 12
Findings comparison between current study and previous studies.

No.	Author (Year)	Country	Investigated dependent variable	Similar findings	Different findings	
					The prior studies	The current study
1	Chiu and Tzeng (1999)	Taiwan/ Developed country	Acceptance of EMs		Perceived behavioural control (price) > Reasons for (emission level, operating cost)	Reasons for > Perceived behavioural control
2	Jones et al. (2013)	Vietnam/ Developing country	EM adoption		Perceived behavioural control (price) > Reasons for (operating cost)	Reasons for > Perceived behavioural control
3	Wu et al. (2015)	Taiwan/ Developed country	Purchase intention	Reasons against (usage risk > Reasons for (EM image)		
4	Chen et al. (2017)	Taiwan/ Developed country	Purchase intention		Product knowledge directly influences Purchase intention	Product knowledge: moderator of the relationship between Reasons against and Switching intention
5	Chen et al. (2018)	Taiwan/ Developed country	Innovation resistance	Reasons against (perception barriers) directly influences customer intention		
6	Guerra (2019)	Indonesia/ Developing country	Willingness to adopt	Attitude > Environmental concerns		
7	Chen et al. (2021)	Taiwan/ Developed country	Intentions for switching to EMs	Attitude > Reasons against	Reasons for directly influences switching intention	Reasons for indirectly influences switching intention
8	Jayasingh et al. (2021)	India/ Developing country	Purchase intention		Attitude > Reasons for (Perceived economic benefits) > Subjective norms (Social influence)	Subjective norms > Reasons for > Attitude
9	Murtiningrum et al. (2022)	Indonesia/ Developing country	EM adoption		Attitude > Perceived behavioural control > Subjective norms > Knowledge > Environmental concerns	Subjective norms > Attitude > Perceived behavioural control > Environmental concerns Knowledge: moderator of the relationship between Reasons against and Switching intention
10	Zhang and Chang (2023)	China/ Developed country	Behavioural intention	Attitude directly influences customer intention		
11	Chakraborty and Chakravarty (2023)	India/ Developing country	Purchase intention		Reasons against (EM risk - charging and performance) > Reasons for (EM benefit - cheap in long-run) > Environmental awareness	Reasons against > Reasons for > Environmental concerns

Notes: In the parentheses "()" are the constructs examined in prior studies that correspond with the ones examined in the current study.
The greater than signs ">" represent the comparison of effect size among influencing factors on the associated dependent variables.

environmental activism or green lifestyles to create information and sensitization campaigns on contemporary media (e.g., Youtube, Tiktok, microblogs). Businesses should carefully consider authenticity and relatability between influencer personas and EM products to conduct effective commercial sponsorships, exerting implicit pressure on followers who share the same value and aspire to the influencers' lifestyles. Customers' pro-environmental behaviours tend to be displayed more frequently when celebrities are the pioneers (Ho et al., 2022). The aim of such marketing campaigns is to position electric motorcycles or vehicles as a social norm activating spill over effect in society.

Based on the total effect, 'reasons for' was found to have the second highest effect on switching intention. Therefore, marketing managers should tailor their marketing mix strategies to help consumers gain a clearer perception of EMs' relative advantages. For instance, communication messages should consistently emphasize the benefits, including environmental preservation and reducing greenhouse gas emissions in consumption and production. EM manufacturers and retailers are also advised to jointly organize EM demo events in public where consumers can try driving EMs and talk about their experience. Offering first-hand experiences would be a practical approach to instruct the public on understanding plus points such as ease of control, rapid acceleration, and silent engine, enhancing two-wheelers' confidence in new vehicle manipulation.

Third, the findings showed that consumers with positive attitudes towards EMs and high behavioural control are more likely to switch from conventional motorcycles to EMs. Accordingly, promotional programs should target middle-class to upper-class individuals, who often have sufficient financial capacity. In Vietnam, this income category is anticipated to grow by an average of 17% per year and is expected to be achieved by nearly half of the population until 2030. Additionally, conducting a trade-in scheme to assist consumers in switching out outdated conventional motorcycles for electric motorcycles (tydep.gov.tw, 2021) would increase their perceived behavioural control over EM purchases. Besides economic incentives, moral education could also contribute to encouraging individuals to develop environmentally friendly lifestyles and subsequently perceive EM use as a necessary action.

Fourth, customer switching intention to EMs was directly linked with 'reasons against'. Since consumers are concerned about the unavailability of recharging facilities, EM manufacturers should develop a network of 24/7 outdoor battery stations to facilitate battery replacement in the middle of the trip, following the innovative system 'swap and go in seconds' in Taiwan. However, developing EMs with swappable batteries and constructing free battery-swapping stations require collective efforts from multiple stakeholders. EM manufacturers need to standardize batteries in terms of chemistries, form factors, and components. Such an operating model could also assist EM enterprises in controlling the number of batteries in circulation and adopting a rigorous treatment process for out-of-use batteries, ensuring that they do not end up in landfills. Implementing swappable battery systems could improve EM batteries' safety and environmental friendliness. In parallel, governments should offer incentives such as specific tax exemptions and reductions or waivers in land leases for the battery swap stations. Authorities can also provide financial and technical support for technological research and development, creating an avenue to propel battery-swappable EMs.

In terms of environmental concerns, it was evidenced to have a modest effect on customer switching intention towards EMs. Marketing activities should be stimulated towards connecting consumers' EM usage with a sense of duty towards ethical and green consumption. It is essential to disseminate detailed information on how environmental problems have worsened in recent years and how EM can be a sustainable solution.

Regarding moderating effects, the results showed that the negative impact of reasons against EM usage on switching intention can be diminished when customers are fully equipped with technical knowledge about EMs and their usefulness. Through various communication channels, EM brands should impart information about EM technological performance and battery swapping methods, as well as elaborate on how EMs are integrated with intelligent networking technologies to create a green transport ecosystem in the future. For example, EMs can be utilized in mobility sharing services and managed by all-in-one mobile applications on which riders can find, rent, and drop the motorcycle everywhere. Riders can also follow technical indicators of EMs (e.g., battery status, remaining range) on the synchronized mobile application, all of which would help customers gain clearer and better perceptions of EM applications in the scenario of sustainable cities. Furthermore, trust was found to be a significant moderator in the relationship between customer attitude towards EM and switching intention. Accordingly, public relations activities such as sponsoring environment-related events should be boosted to help EM manufacturers build brand reputation and trustworthiness. Also, business mission and product quality assurance should be exhibited on company websites and other official channels.

6.3. Limitations and directions for future research.

This study is subject to the following limitations: First, although the present study is one of the pioneering research laying foundations in EM research stream by formulating a set of reasons for and against EMs usage and incorporating them into switching intention, the developed measurement scale is still in the primitive stage. This calls for the investigation of more in-depth insights into two-wheelers' reasoning processes (e.g., multi-dimensional conceptualisation) due to the context-specific nature of these constructs. Second, the current research is limited to the geographic region of Vietnam. Future studies could focus on validating the findings with populations from other countries with different cultures or different government monetary policies for innovative transport modes. In this way, the current theoretical scope of knowledge will be extended. Third, the cross-sectional design may cause social desirability bias. Therefore, later studies should allay the probability of such bias by employing other methodologies, such as experimental, observational, and longitudinal research design. Finally, the authors also recommend other directions of future studies on the EM domain: for example, investigating the moderating effects of variables such as personal innovativeness and vital demographics (e.g., social status, income) that could result in divergent patterns in consumer behaviour towards EMs.

7. Conclusion

The present investigation provides a clear understanding of the determinants of the switching intention to use electric motorcycles (EMs) in a low- and middle-income country where motorcycles dominate the traffic flow. These countries have been neglected in the main academic discourse of electrification of the transport systems, as most studies have focused on electric cars, which are not the dominant type of vehicle in the global south. Drawing on behavioural reasoning theory (BRT), this study developed and validated a conceptual framework to explore the underlying mechanism behind the intention to switch to EMs. A key contribution is that the research findings advanced our understanding of the facilitators or barriers when switching to EMs and the moderating role of consumer trust and knowledge in forming the behavioural intention.

Author statement

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Data availability

Data will be made available on request.

Acknowledgements

This research is funded by Foreign Trade University under research program, namely "*Encouraging sustainable consumption for green economy development in Vietnam*".

Appendix

Table A1
Operational definition of constructs.

Variable	Operational definition
Switching intention	consumer's partial reduction or complete termination of traditional gasoline motorcycles and make a switch to electric motorcycles (EMs) as an alternative
Environmental concerns	consumer's awareness towards environmental problems and their support for the efforts needed or willingness to contribute to address them
Reasons for	consumer's subjective and specific cognitions of pros, benefits, and facilitators that motivate him/her to use EMs
Reasons against	consumer's subjective and specific cognitions of cons, costs, constraints that resist him/her to use EMs
Subjective norms	consumer's belief about whether people in society approve or disapprove of using EMs
Perceived behavioural control	consumer's perception of his/her capability of buying and using EMs
Attitude	the way a consumer thinks and evaluates EMs usage
Trust	the belief that consumer has in the reliability and credibility of EMs
Knowledge	consumer's understanding of technological innovations and advantages of EMs

Table A2
Measurement scales.

Scales	Code	Skewness	Kurtorsis	Sources
Switching Intention	SWI			
I will switch to EMs in the future	SWI1	−0.526	−0.357	(Hsu, 2014)
I have the intention to switch to EMs in the future	SWI2	−0.511	−0.348	(Hsu, 2014)
I am likely to switch to EMs in the future	SWI3	−0.747	−0.012	(Hsu, 2014)
Attitude	ATT			
I think that using EMs is valuable	ATT1	−0.930	1.122	(Nguyen-Phuoc et al., 2022b)
I think that using EMs is right	ATT2	−0.658	0.677	(Nguyen-Phuoc et al., 2022b)
I think that using EMs is necessary	ATT3	−0.579	0.599	(Nguyen-Phuoc et al., 2022b)
Subjective Norms	SNO			
Most people who are important to me support that I should use EMs	SNO1	−0.312	−0.475	(Nguyen-Phuoc et al., 2022b)
Most people who are important to me agree that I should use EMs	SNO2	−0.293	−0.659	(Nguyen-Phuoc et al., 2022b)
Most people who are important to me recommend that I should use EMs	SNO3	−0.155	−0.791	(Nguyen-Phuoc et al., 2022b)
Perceived Behavioural Control	PBC			
I am capable of using EMs	PBC1	−1.128	1.543	(Nguyen-Phuoc et al., 2022a)
If I want, I can easily use EMs	PBC2	−1.17	1.454	(Nguyen-Phuoc et al., 2022a)
I have enough money to buy EMs	PBC3	−1.074	0.496	(Nguyen-Phuoc et al., 2022a)
Reason for	REF			
Using EMs would reduce greenhouse gas emissions and energy consumption	REF1	−1.506	4.275	(Wang et al., 2021b)
Using EMs would eliminate my fuel costs	REF2	−1.312	3.625	(Wang et al., 2021b)
It would be simple to control EMs	REF3	−1.267	2.512	(Wang et al., 2020)
Using EMs can make my driving easier	REF4	−0.843	0.817	(Xu et al., 2018)
Using EMs can protect the environment	REF5	−1.614	4.019	(Wang et al., 2020)
Reason against	REA			
EMs may run out of power and not be able to find a charging station on time to replenish the battery	REA1	−1.310	2.424	Authors developed
The batteries of EMs may combust when damaged, overcharged or subjected to high temperatures	REA2	−0.431	−0.685	Authors developed
The requirement of mining for manufacturing batteries and other related components in EMs is not environmentally friendly	REA3	−0.302	−0.760	(Krishna, 2021)
There is a negative environmental impact due to the toxicity of the materials used in making the battery	REA4	−0.780	−0.249	Authors developed
Using EMs may not protect my personal information (e.g., credit card number, phone number, address, etc.)	REA5	0.012	−1.154	(Featherman and Pavlou, 2003)
Knowledge	KNO			
I know the integration of EMs and information and communications technology to manage the vehicles	KNO1	−0.593	−0.102	(Huang et al., 2021)
I know the collaborative discharge capability of EMs batteries and its application scenarios	KNO2	−0.431	−0.262	(Huang et al., 2021)
I know the technological performance (such as charging time, acceleration, driving comfort and driving range) of EMs	KNO3	−0.705	0.210	(Huang et al., 2021)
I know the technological advantages of EMs over gasoline vehicles	KNO4	−0.503	−0.493	(Huang et al., 2021)
Trust	TRU			
I think that EMs would be reliable.	TRU1	−0.493	0.615	(Nordhoff et al., 2021)
I would trust this type of vehicle for my everyday travel	TRU2	−0.610	0.266	(Nordhoff et al., 2021)
EMs instill confidence in users	TRU3	−0.425	0.214	(Su et al., 2022)
Overall, I can trust EMs	TRU4	−0.788	0.771	(Nordhoff et al., 2021)
Environmental concerns	ENV			
I think environmental problems are becoming more and more serious in recent years	ENV1	−1.447	2.732	(Adnan et al., 2017)
I think human beings should live in harmony with nature in order to achieve sustainable development	ENV2	−1.533	3.753	(Adnan et al., 2017)
I think we are not doing enough to save scarce natural resources from being used up	ENV3	−1.383	2.186	(Adnan et al., 2017)
I think individuals have the responsibility to protect the environment	ENV4	−1.538	3.094	(Adnan et al., 2017)

Table A3
Comparison of gender and age ratios between sample and Vietnamese adult population.

Characteristic		Survey ($n = 662$)		Census*		Chi-squared χ^2
		Number of respondents (n)	Proportion (%)	Expected Value (n)	Proportion (%)	
Gender	Male	329	49.7	332	50.2	0.027
	Female	333	50.3	330	48.8	0.027
Age	16–24	168	25.4	138	20.8	6.696
	25–54	408	61.6	413	62.4	0.065
	55–64	60	9.1	86	13.0	8.044
	65–69	26	3.9	25	3.7	0.057
Total		662	100	662	100	

$\chi^2_{Gender}(0.054) < \chi^2_{Critical}(10.828)$, $\chi^2_{Age}(14.863) < \chi^2_{Critical}(18.467)$.
The level of significance for this test is $\alpha = 0.001$
* Vietnamese adults (16–69 years old) in 2019 (General Statistics Office, 2020).

References

Adnan, N., Nordin, S.M., Rahman, I., Rasli, A.M., 2017. A new era of sustainable transport: an experimental examination on forecasting adoption behavior of EVs among Malaysian consumer. Transp. Res. A Policy Pract. 103, 279–295.
Adnan, N., Md Nordin, S., Hadi Amini, M., Langove, N., 2018. What make consumer sign up to PHEVs? Predicting Malaysian consumer behavior in adoption of PHEVs. Transp. Res. A Policy Pract. 113, 259–278.
Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50, 179–211.
Asadi, S., Nilashi, M., Samad, S., Abdullah, R., Mahmoud, M., Alkinani, M.H., Yadegaridehkordi, E., 2021. Factors impacting consumers' intention toward adoption of electric vehicles in Malaysia. J. Clean. Prod. 282.
Bagozzi, R.P., Bergami, M., Leone, L., 2003. Hierarchical representation of motives in goal setting. J. Appl. Psychol. 88, 915.
Bang, H.K., Ellinger, A.E., Hadjimarcou, J., Traichal, P.A., 2000. Consumer concern, knowledge, belief, and attitude toward renewable energy: an application of the reasoned action theory. Psychol. Mark. 17, 449–468.
Batley, S.L., Fleming, P.D., Urwin, P., 2000. Willingness to pay for renewable energy: implications for UK green tariff offerings. Indoor Built Environ. 9, 157–170.
Baumeister, R.F., Bushman, B.J., 2020. *Social psychology and human nature*. Cengage Learning.
Benitez, J., Henseler, J., Castillo, A., Schuberth, F., 2020. How to perform and report an impactful analysis using partial least squares: guidelines for confirmatory and explanatory IS research. Inf. Manag. 57, 103168.
Berger, I.E., Ratchford, B.T., Haines Jr., G.H., 1994. Subjective product knowledge as a moderator of the relationship between attitudes and purchase intentions for a durable product. J. Econ. Psychol. 15, 301–314.
Berry, L.L., 1995. Relationship marketing of services—growing interest, emerging perspectives. J. Acad. Mark. Sci. 23, 236–245.
Bertea, E., Zaiţ, P., 2013. Scale validity in exploratory stages of research. Manag. Market. J. 11, 38–46.
Biswas, A., Roy, M., 2015. Green products: an exploratory study on the consumer behaviour in emerging economies of the east. J. Clean. Prod. 87, 463–468.
Bohn, S., Rogge, J.-C., 2022. The framing of green innovations—a comparative topic modeling study on the public frames of the electric vehicle in Germany and UK. J. Clean. Prod. 364, 132499.
Bonn, M.A., Cronin, J.J., Cho, M., 2015. Do environmental sustainable practices of organic wine suppliers affect Consumers' behavioral intentions? The moderating role of trust. Cornell Hosp. Q. 57, 21–37.
Bonn, M.A., Cronin Jr., J.J., Cho, M., 2016. Do environmental sustainable practices of organic wine suppliers affect consumers' behavioral intentions? The moderating role of trust. Cornell Hosp. Q. 57, 21–37.
Bradach, J.L., Eccles, R.G., 1989. Price, authority, and trust: from ideal types to plural forms. Annu. Rev. Sociol. 15, 97–118.
Brückmann, G., 2022. Test-drives & information might not boost actual battery electric vehicle uptake? Transp Res Part A Policy Pract 160, 204–218.
Buckley, L., Kaye, S.-A., Pradhan, A.K., 2018. Psychosocial factors associated with intended use of automated vehicles: a simulated driving study. Accid. Anal. Prev. 115, 202–208.
Chakraborty, R., Chakravarty, S., 2023. Factors affecting acceptance of electric two-wheelers in India: a discrete choice survey. Transp. Policy 132, 27–41.
Chang, C., 2004. The interplay of product class knowledge and trial experience in attitude formation. J. Advert. 33, 83–92.
Chen, Y.-S., 2010. The drivers of green brand equity: green brand image, green satisfaction, and green trust. J. Bus. Ethics 93, 307–319.
Chen, H.S., 2013. Applying technology acceptance model to explore the adoption of hydrogen-electric motorcycle in Taiwan. Appl. Mech. Mater. 459, 494–498.
Chen, H.-S., Tsai, B.-K., Hsieh, C.-M., 2017. Determinants of Consumers' purchasing intentions for the hydrogen-electric motorcycle. Sustainability 9.
Chen, H.-S., Tsai, B.-K., Hsieh, C.-M., 2018. The effects of perceived barriers on innovation resistance of hydrogen-electric motorcycles. Sustainability 10, 1933.
Chen, C.-F., Eccarius, T., Su, P.-C., 2021. The role of environmental concern in forming intentions for switching to electric scooters. Transp. Res. A Policy Pract. 154, 129–144.
Chiu, Y.-C., Tzeng, G.-H., 1999. The market acceptance of electric motorcycles in Taiwan experience through a stated preference analysis. Transp. Res. Part D: Transp. Environ. 4, 127–146.
Claudy, M.C., Peterson, M., O'driscoll, A., 2013. Understanding the attitude-behavior gap for renewable energy systems using behavioral reasoning theory. J. Macromark. 33, 273–287.
Claudy, M.C., Garcia, R., O'Driscoll, A., 2015. Consumer resistance to innovation—a behavioral reasoning perspective. J. Acad. Mark. Sci. 43, 528–544.
Cohen, P., West, S.G., Aiken, L.S., 2014. Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences. Psychology Press.
Cowley, E., Mitchell, A.A., 2003. The moderating effect of product knowledge on the learning and organization of product information. J. Consum. Res. 30, 443–454.
Davis, F.D., Bagozzi, R.P., Warshaw, P.R., 1989. User acceptance of computer technology: a comparison of two theoretical models. Manag. Sci. 35, 982–1003.
Degirmenci, K., Breitner, M.H., 2017. Consumer purchase intentions for electric vehicles: Is green more important than price and range? Transp. Res. D: Transp. Environ. 51, 250–260.
Dhir, A., Koshta, N., Goyal, R.K., Sakashita, M., Almotairi, M., 2021. Behavioral reasoning theory (BRT) perspectives on E-waste recycling and management. J. Clean. Prod. 280, 124260.
Ding, Z., Jiang, X., Liu, Z., Long, R., Xu, Z., Cao, Q., 2018. Factors affecting low-carbon consumption behavior of urban residents: A comprehensive review. Resour Conserv Recycl 132, 3–15.
Duann, L.-S., Chou, H., Wang, C., 2001. The factors affecting the demand for electric motorcycle. J. East. Asia Soc. Transp. Stud. 4, 209–220.
Dunlap, R.E., Van Liere, K.D., 1978. The "new environmental paradigm". J. Environ. Educ. 9, 10–19.
Eccarius, T., Lu, C.-C., 2020. Powered two-wheelers for sustainable mobility: a review of consumer adoption of electric motorcycles. Int. J. Sustain. Transp. 14, 215–231.
Fam, K.S., Foscht, T., Collins, R.D., 2004. Trust and the online relationship—an exploratory study from New Zealand. Tour. Manag. 25, 195–207.
Featherman, M.S., Pavlou, P.A., 2003. Predicting e-services adoption: a perceived risk facets perspective. Int. J. Human Comp Stud. 59, 451–474.
Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. J. Mark. Res. 18, 39–50.
Fu, F.Q., Elliott, M.T., 2013. The moderating effect of perceived product innovativeness and product knowledge on new product adoption: an integrated model. J. Mark. Theory Pract. 21, 257–272.
General Statistics Office, 2020. The 2019 Population and Housing Census Data Dashboard. General Statistics Office of Vietnam.
Guerra, E., 2019. Electric vehicles, air pollution, and the motorcycle city: a stated preference survey of consumers' willingness to adopt electric motorcycles in solo, Indonesia. Transp. Res. Part D: Transp. Environ. 68, 52–64.
Gupta, A., Arora, N., 2017. Understanding determinants and barriers of mobile shopping adoption using behavioral reasoning theory. J. Retail. Consum. Serv. 36, 1–7.
Hair, J.F., Ringle, C.M., Sarstedt, M., 2011. PLS-SEM: indeed a silver bullet. J. Mark. Theory Pract. 19, 139–152.
Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., Tatham, R.L., 2019a. Multivariate Data Analysis. Cengage Learning EMEA, United Kingdom.
Hair, J.F., Risher, J.J., Sarstedt, M., Ringle, C.M., 2019b. When to use and how to report the results of PLS-SEM. Eur. Bus. Rev. 31, 2–24.
Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., 2021. A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). SAGE publications, Thousand Oaks, California.
Handfield, R.B., Bechtel, C., 2002. The role of trust and relationship structure in improving supply chain responsiveness. Ind. Mark. Manag. 31, 367–382.
Hansla, A., Gamble, A., Juliusson, A., Gärling, T., 2008. Psychological determinants of attitude towards and willingness to pay for green electricity. Energy Policy 36, 768–774.
He, X., Zhan, W., Hu, Y., 2018. Consumer purchase intention of electric vehicles in China: the roles of perception and personality. J. Clean. Prod. 204, 1060–1069.

Henseler, J., Hubona, G., Ray, P.A., 2016. Using PLS path modeling in new technology research: updated guidelines. Ind. Manag. Data Syst. 116, 2–22.
Ho, T.Q., Nie, Z., Alpizar, F., Carlsson, F., Nam, P.K., 2022. Celebrity endorsement in promoting pro-environmental behavior. J. Econ. Behav. Organ. 198, 68–86.
Hoffmann, S., Schlicht, J., 2013. The impact of different types of concernment on the consumption of organic food. Int. J. Consum. Stud. 37, 625–633.
Hsee, C.K., 1996. Elastic justification: how unjustifiable factors influence judgments. Organ. Behav. Hum. Decis. Process. 66, 122–129.
Hsieh, I.-Y.L., Pan, M.S., Green, W.H., 2020. Transition to electric vehicles in China: Implications for private motorization rate and battery market. Energy Policy 144, 111654.
Hsu, J.S.-C., 2014. Understanding the role of satisfaction in the formation of perceived switching value. Decis. Support. Syst. 59, 152–162.
Hu, L.-T., Bentler, P.M., 1998. Fit indices in covariance structure modeling: sensitivity to underparameterized model misspecification. Psychol. Methods 3, 424.
Huang, X., Ge, J., 2019. Electric vehicle development in Beijing: an analysis of consumer purchase intention. J. Clean. Prod. 216, 361–372.
Huang, X., Lin, Y., Lim, M.K., Tseng, M.-L., Zhou, F., 2021. The influence of knowledge management on adoption intention of electric vehicles: perspective on technological knowledge. Ind. Manag. Data 121, 1481–1495.
Hulland, J., 1999. Use of partial least squares (PLS) in strategic management research: a review of four recent studies. Strateg. Manag. J. 20, 195–204.
Ingeborgrud, L., Ryghaug, M., 2019. The role of practical, cognitive and symbolic factors in the successful implementation of battery electric vehicles in Norway. Transp. Res. A Policy Pract. 130, 507–516.
Jayasingh, S., Girija, T., Arunkumar, S., 2021. Factors influencing Consumers' purchase intention towards electric two-wheelers. Sustainability 13.
Jones, M.A., Mothersbaugh, D.L., Beatty, S.E., 2000. Switching barriers and repurchase intentions in services. J. Retail. 76, 259–274.
Jones, L.R., Cherry, C.R., Vu, T.A., Nguyen, Q.N., 2013. The effect of incentives and technology on the adoption of electric motorcycles: a stated choice experiment in Vietnam. Transp. Res. A Policy Pract. 57, 1–11.
Keaveney, S.M., Parthasarathy, M., 2001. Customer switching behavior in online services: An exploratory study of the role of selected attitudinal, behavioral, and demographic factors. J. Acad. Mark. Sci. 29, 374–390.
Kelly, S., Kaye, S.-A., Oviedo-Trespalacios, O., 2022. What factors contribute to acceptance of artificial intelligence? A systematic review. Telematics Inform. 101925.
King, M.F., Balasubramanian, S.K., 1994. The effects of expertise, end goal, and product type on adoption of preference formation strategy. J. Acad. Mark. Sci. 22, 146–159.
Kline, T., 2005. Psychological Testing: A Practical Approach to Design and Evaluation. CA, Sage Publications, Inc., Thousand Oaks.
Krishna, G., 2021. Understanding and identifying barriers to electric vehicle adoption through thematic analysis. Transport. Res. Interdiscipl. Perspect. 10, 100364.
Kunda, Z., 1990. The case for motivated reasoning. Psychol. Bull. 108, 480.
Lavuri, R., Jindal, A., Akram, U., Naik, B.K.R., Halibas, A.S., 2022. Exploring the antecedents of sustainable consumers' purchase intentions: evidence from emerging countries. Sustain. Dev. 31, 280–291.
Le, A.T., Nguyen, T.Y.L., Do, D.T., 2021. Study of Electric Mobility Development in Vietnam. Germany.
Liu, Y., Lai, I.K.W., 2020. The effects of environmental policy and the perception of electric motorcycles on the acceptance of electric motorcycles: an empirical study in Macau. SAGE Open 10, 1–14.
Lee, C., Green, R.T., 1991. Cross-cultural examination of the Fishbein behavioral intentions model. J Int Bus Stud 22, 289–305.
Liu, R., Ding, Z., Wang, Y., Jiang, X., Jiang, X., Sun, W., Wang, D., Mou, Y., Liu, M., 2021. The relationship between symbolic meanings and adoption intention of electric vehicles in China: the moderating effects of consumer self-identity and face consciousness. J. Clean. Prod. 288.
Lu, Y., Zhao, L., Wang, B., 2010. From virtual community members to C2C e-commerce buyers: trust in virtual communities and its effect on consumers' purchase intention. Electron. Commer. Res. Appl. 9, 346–360.
Malaviya, P., Sivakumar, K., 1998. The moderating effect of product category knowledge and attribute importance on the attraction effect. Mark. Lett. 9, 93–106.
Milfont, T.L., Gouveia, V.V., 2006. Time perspective and values: an exploratory study of their relations to environmental attitudes. J. Environ. Psychol. 26, 72–82.
Minton, A.P., Rose, R.L., 1997. The effects of environmental concern on environmentally friendly consumer behavior: an exploratory study. J. Bus. Res. 40, 37–48.
Mohamed, M., Higgins, C.D., Ferguson, M., Réquia, W.J., 2018. The influence of vehicle body type in shaping behavioural intention to acquire electric vehicles: a multi-group structural equation approach. Transp. Res. A Policy Pract. 116, 54–72.
Moorman, C., Deshpande, R., Zaltman, G., 1993. Factors affecting trust in market research relationships. J. Mark. 57, 81–101.
Moreau, C.P., Lehmann, D.R., Markman, A.B., 2001. Entrenched knowledge structures and consumer response to new products. J. Mark. Res. 38, 14–29.
Munkácsy, A., Monzón, A., 2018. Diffusion of bike sharing as an innovation vector in the city: the case of BiciMAD (Madrid). J. Urban Technol. 25, 1–26.
Murtiningrum, A.D., Darmawan, A., Wong, H., 2022. The adoption of electric motorcycles: a survey of public perception in Indonesia. J. Clean. Prod. 379, 134737.
Načinović Braje, I., Klindžić, M., Galetić, L., 2019. The role of individual variable pay in a collectivistic culture society: An evaluation. Econ. Res. -Ekon. 32, 1352–1372.
Newman, T.P., Fernandes, R., 2016. A re-assessment of factors associated with environmental concern and behavior using the 2010 general social survey. Environ. Educ. Res. 22, 153–175.
Ng, M., Law, M., Zhang, S., 2018. Predicting purchase intention of electric vehicles in Hong Kong. Australas. Mark. J. 26, 272–280.
Nguyen, M.H., Nguyen-Phuoc, D.Q., Johnson, L.W., 2023. Why do parents intend to permit their children to ride e-bikes? Empirical evidence from Vietnam.Travel Behav. Soc 32, 100586.
Nguyen-Phuoc, D.Q., Oviedo-Trespalacios, O., Nguyen, M.H., Dinh, M.T.T., Su, D.N., 2022a. Intentions to use ride-sourcing services in Vietnam: what happens after three months without COVID-19 infections? Cities 126, 103691.
Nguyen-Phuoc, D.Q., Su, D.N., Nguyen, M.H., Vo, N.S., Oviedo-Trespalacios, O., 2022b. Factors influencing intention to use on-demand shared ride-hailing services in Vietnam: risk, cost or sustainability? J. Transp. Geogr. 99, 103302.
Nordhoff, S., Kyriakidis, M., Van Arem, B., Happee, R., 2019. A multi-level model on automated vehicle acceptance (MAVA): a review-based study. Theor. Issues Ergon. Sci. 20, 682–710.
Nordhoff, S., Malmsten, V., van Arem, B., Liu, P., Happee, R., 2021. A structural equation modeling approach for the acceptance of driverless automated shuttles based on constructs from the unified theory of acceptance and use of technology and the diffusion of innovation theory. Transport. Res. F: Traffic Psychol. Behav. 78, 58–73.
Nuttavuthisit, K., Thøgersen, J., 2017. The importance of consumer trust for the emergence of a market for green products: the case of organic food. J. Bus. Ethics 140, 323–337.
Pagiaslis, A., Krontalis, A.K., 2014. Green consumption behavior antecedents: Environmental concern, knowledge, and beliefs. Psychol. Mark. 31, 335–348.
Peine, A., van Cooten, V., Neven, L., 2017. Rejuvenating design: bikes, batteries, and older adopters in the diffusion of e-bikes. Sci. Technol. Hum. Values 42, 429–459.
Peng, X., Zhao, Y.C., Zhu, Q., 2016. Investigating user switching intention for mobile instant messaging application: Taking WeChat as an example. Comput. Hum. Behav. 64, 206–216.
Rao, A.R., Sieben, W.A., 1992. The effect of prior knowledge on price acceptability and the type of information examined. J. Consum. Res. 19, 256–270.
Rezvani, Z., Jansson, J., Bodin, J., 2015. Advances in consumer electric vehicle adoption research: a review and research agenda. Transp. Res. Part D: Transp. Environ. 34, 122–136.
Ricci, E.C., Banterle, A., Stranieri, S., 2018. Trust to go green: an exploration of consumer intentions for eco-friendly convenience food. Ecol. Econ. 148, 54–65.
Ryan, J., Casidy, R., 2018. The role of brand reputation in organic food consumption: a behavioral reasoning perspective. J. Retail. Consum. Serv. 41, 239–247.
Sahay, B., 2003. Understanding trust in supply chain relationships. Ind. Manag. Data Syst. 103, 553–563.
Sahoo, D., Harichandan, S., Kar, S.K., Sreejesh, S., 2022. An empirical study on consumer motives and attitude towards adoption of electric vehicles in India: Policy implications for stakeholders. Energy Policy 165, 112941.
Sahu, A.K., Padhy, R., Dhir, A., 2020. Envisioning the future of behavioral decision-making: a systematic literature review of behavioral reasoning theory. Australas. Mark. J. AMJ 28, 145–159.
Seebauer, S., 2015. Why early adopters engage in interpersonal diffusion of technological innovations: an empirical study on electric bicycles and electric scooters. Transp. Res. A Policy Pract. 78, 146–160.
Simsekoglu, Ö., Nayum, A., 2019. Predictors of intention to buy a battery electric vehicle among conventional car drivers. Transp. Res. F: Traffic Psychol 60, 1–10.
Sirdeshmukh, D., Singh, J., Sabol, B., 2002. Consumer trust, value, and loyalty in relational exchanges. J. Mark. 66, 15–37.
Song, H.J., Lee, C.-K., Kang, S.K., Boo, S.-j., 2012. The effect of environmentally friendly perceptions on festival visitors' decision-making process using an extended model of goal-directed behavior. Tour. Manag. 33, 1417–1428.
Su, D.N., Nguyen, N.A.N., Nguyen, L.N.T., Luu, T.T., Nguyen-Phuoc, D.Q., 2022. Modeling consumers' trust in mobile food delivery apps: perspectives of technology acceptance model, mobile service quality and personalization-privacy theory. J. Hosp. Mark. Manag. 31, 535–569.
Su, D.N., Nguyen-Phuoc, D.Q., Tran, P.T.K., Van Nguyen, T., Luu, T.T., Pham, H.-G., 2023. Identifying must-have factors and should-have factors affecting the adoption of electric motorcycles–a combined use of PLS-SEM and NCA approach. Travel Behav. Soc. 33, 100633.
Sun, L., Zhang, J., 2013. Stated responses to policy interventions and technological innovation of electric motorcycles in Laos. J. East. Asia Soc. Transp. Stud. 10, 482–498.
Sung, Y.-C., 2010. Consumer learning behavior in choosing electric motorcycles. Transp. Plan. Technol. 33, 139–155.
Tandon, A., Dhir, A., Kaur, P., Kushwah, S., Salo, J., 2020a. Behavioral reasoning perspectives on organic food purchase. Appetite 154, 104786.
Tandon, A., Dhir, A., Kaur, P., Kushwah, S., Salo, J., 2020b. Why do people buy organic food? The moderating role of environmental concerns and trust. J. Retail. Consum. Serv. 57, 102247.
Thu, T.N.M., Huy, D.T.N., Thi, T.D.V., 2021. Effects of western and chinese culture and ideology on vietnam society. Ilkogretim Online 20 (2), 10–50.
Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D., 2003. User acceptance of information technology: toward a unified view. MIS Q. 425–478.
Wang, S., Fan, J., Zhao, D., Yang, S., Fu, Y., 2014. Predicting consumers' intention to adopt hybrid electric vehicles: using an extended version of the theory of planned behavior model. Transportation 43, 123–143.
Wang, Y., Wang, S., Wang, J., Wei, J., Wang, C., 2020. An empirical study of consumers' intention to use ride-sharing services: using an extended technology acceptance model. Transportation 47, 397–415.
Wang, H., Ma, B., Bai, R., 2019. How does green product knowledge effectively promote green purchase intention? Sustainability 11, 1193.
Wang, J., Shen, M., Chu, M., 2021a. Why is green consumption easier said than done? Exploring the green consumption attitude-intention gap in China with behavioral reasoning theory. Cleaner Respons. Consumpt. 2, 100015.

Vu, V.H., Le, X.Q., Pham, N.H., Luc, H., 2013. Health risk assessment of mobility-related air pollution in Ha Noi. Vietnam. J. Environ. Prot. 4, 38678.
Wang, Y., Douglas, M., Hazen, B., 2021b. Diffusion of public bicycle systems: investigating influences of users' perceived risk and switching intention. Transp. Res. A Policy Pract. 143, 1–13.
Westaby, J.D., 2005. Behavioral reasoning theory: identifying new linkages underlying intentions and behavior. Organ. Behav. Hum. Decis. Process. 98, 97–120.
Wiser, R.H., 2007. Using contingent valuation to explore willingness to pay for renewable energy: a comparison of collective and voluntary payment vehicles. Ecol. Econ. 62, 419–432.
Wong-Parodi, G., Berlin Rubin, N., 2022. Exploring how climate change subjective attribution, personal experience with extremes, concern, and subjective knowledge relate to pro-environmental attitudes and behavioral intentions in the United States. J. Environ. Psychol. 79, 101728.
Wu, J.-H., Wu, C.-W., Lee, C.-T., Lee, H.-J., 2015. Green purchase intentions: an exploratory study of the Taiwanese electric motorcycle market. J. Bus. Res. 68, 829–833.
Wu, J., Liao, H., Wang, J.-W., Chen, T., 2019. The role of environmental concern in the public acceptance of autonomous electric vehicles: a survey from China. Transport. Res. F: Traffic Psychol. Behav. 60, 37–46.
Xu, Z., Zhang, K., Min, H., Wang, Z., Zhao, X., Liu, P., 2018. What drives people to accept automated vehicles? Findings from a field experiment. Transport. Res. Part C: Emerg. Technolog. 95, 320–334.
Yan, D., Cai, X., Xie, M., Javeed, S.A., Liu, F., Cao, Q., 2022. Why is reusable bag consumption easier to say than do? Front. Psychol. 13, 956998.
Ye, C., Potter, R., 2011. The role of habit in post-adoption switching of personal information technologies: An empirical investigation. Commun. Assoc. Inf. 28, 35.
Yeung, S.P.-M., 2004. Teaching approaches in geography and students' environmental attitudes. Environmentalist 24, 101–117.
Zhang, X., Chang, M., 2023. Applying the extended technology acceptance model to explore Taiwan's generation Z's behavioral intentions toward using electric motorcycles. Sustainability 15, 3787.