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The impact of driving experience on consumer adoption intentions of electric motorcycles: An analysis of perceived advantage, ease of use, and risk factors

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ABSTRACT

Background: his study investigates consumer attitudes and perceptions toward adopting electric motorcycles, focusing on the perceived relative advantage, ease of use, and risk associated with usage. The aim is to examine how driving experience influences these perceptions and ultimately impacts the intention to adopt electric motorcycles. Previous studies have highlighted the relevance of consumer perceptions in adoption decisions, yet few have examined the influence of direct driving experience on perceived advantages, ease of use, and risks associated with electric motorcycles. **Methods**: A quantitative approach was applied, involving survey-based data collection from a sample of respondents with varying levels of driving experience with electric motorcycles. Structural equation modeling was used to analyze the data. **Findings:** Findings indicate that driving experience significantly enhances the perceived relative advantage and ease of use, while reducing perceived risk. These factors, in turn, positively influence adoption intentions, demonstrating that driving experience indirectly impacts adoption by shaping perceptions of advantage, ease, and risk. However, direct effects of driving experience on adoption intention were not observed. Expanding on prior research, this study provides insights into how experience shapes consumer perspectives on electric motorcycles, thus contributing to understanding adoption behavior in this sector. **Conclusion**: driving trials appear essential in promoting adoption, as they cultivate positive perceptions that drive consumer intent. **Novelty/Originality of this article:** The novelty of this study lies in highlighting the role of experiential factors as indirect mediators of adoption intentions, providing a unique perspective in the context of electric motorcycle adoption.

KEYWORDS: electric motorcycle, consumer adoptions, driving experience.

1. Introduction

The advancement of vehicle technology has shifted engines from traditional internal combustion systems to electric powertrains (Barkenbus, 2020). An electric motorcycle is defined as a vehicle that derives its propulsion exclusively from a rechargeable battery pack, which can be charged via a plug connected to a power outlet (Egbue & Long, 2012; Jensen et al., 2013; She et al., 2017). Prior research has classified two-wheeled vehicles into three categories: electric two-wheelers, motorcycles, and bicycles in China. In Europe, two-wheeled vehicles are categorized according to speed and power according to legal regulations into e-mopeds, e-bikes, and e-vehicles or scooters (Weinert et al., 2007). That

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electric motorcycles differ from e-bikes in that they cannot be pedaled by humans. Electric motorcycles primarily consist of Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) (Xu, 2020). BEVs operate entirely on electric energy supplied through a connection to the electricity grid, with energy stored in batteries (Adhikari et al., 2020). They do not consume fossil fuel. In contrast, PHEVs utilize batteries to store electric energy from the grid and employ fossil fuels to power their combustion engines. Electric motorcycles can be viewed as a significant alternative to the widespread use of Internal Combustion Engine Vehicles (ICEVs), which burn traditional fuels and emit greenhouse gases (Egbue & Long, 2012). Unlike traditional fuel-based vehicles, electric motorcycles are powered by electric drivetrains and do not incorporate internal combustion engines. By reducing dependence on fossil fuels and carbon emissions, electric motorcycles play a crucial role in environmental protection and climate change mitigation (Egbue & Long, 2012; Yang, 2019).

Worldwide sales of electric motorcycles have surged dramatically, buoyed by supportive transportation policies (Song & Potoglou, 2020). In 2019, global electric motorcycle sales reached a record 2.1 million, surpassing previous sales figures (International Energy Agency, 2020). Numerous European countries, along with the United States, Japan, and China, have made significant efforts to develop electric motorcycles as a primary direction for future land transportation (Schuitema et al., 2013; Rauh et al., 2017; Nian et al., 2019). According to the International Energy Agency's Global EV Outlook 2020, several Asian countries, including Taiwan, China, Laos, Vietnam, and Indonesia, account for 80% of the global motorcycle fleet, indicating a high dependence on motorcycles in these regions for the adoption of electric motorcycles. However, in 2015, global sales surpassed 40 million, with over 90% in China, 5% in Europe, and 0.7% in the United States. In Indonesia, the number of electric motorcycle users surged 13-fold, representing 55% of the domestic electric motorcycle market share from 2020 to 2022 (Deloitte & Foundry, 2023).

Consumer intent to adopt electric motorcycles is often complex. The emergence of adoption intent is influenced by the interplay of internal and external factors (Li et al., 2017a; Wang et al., 2018b). Prior research has explored various factors affecting consumers' intention to adopt electric motorcycles. Ozaki & Sevastyanova (2011), Schuitema et al., (2013), Sierzchula et al. (2014), Bjerkan et al. (2016), Coffman et al. (2017), and Han et al. (2017) identified these factors as including product attributes (such as price, performance, range, charging time, and convenience) and external situational factors (such as subsidy policies, fuel prices, charging costs, and charging facilities) (Xu et al., 2020). Conversely, Rezvani et al.(2015); Li (2017a, 2017b), Lin & Wu (2018), Wang (2018b), and Liu et al. (2019) noted consumer psychological factors (such as perceived risk, emotions and attitudes, norms, and environmental awareness) (Xu et al., 2020). Several researchers, including Carley et al. (2013), Schuitema et al., (2013), Peters & Dutschke (2014), Helveston (2015), Lai et al. (2015), Schmalfub (2017), Jansson (2017), and White & Sintov (2017), have conducted studies based on behavioral model theory, norm activation theory, or integrated models to discuss the impact of psychological factors on consumers' adoption intentions regarding electric motorcycles (Xu et al., 2020). Recent research by Adnan et al. (2017), Chen et al. (2016), and Chu et al. (2019) indicates that environmental concern is increasingly significant in the adoption of electric motorcycles (Xu et al., 2020). Despite the environmental benefits of electric motorcycles and their growing trend, several barriers continue to hinder the transition from Internal Combustion Engine Vehicles (ICEVs) to electric motorcycles, particularly Battery Electric Vehicles (BEVs) (Murugan & Marisamynathan, 2022). The primary barrier is the unaffordable purchase price due to high battery costs (Egbue & Long, 2012; She et al., 2017). Although battery prices have decreased significantly over the past decade (International Energy Agency, 2020), the initial purchase price of available electric motorcycles is still 60% higher than that of comparable conventional vehicles (Ouyang et al., 2021). The lack of charging station availability and lengthy charging times further exacerbate range anxiety (Coffman et al., 2017; Sang & Bekhet, 2015). These factors affect the appeal of electric motorcycles when consumers consider vehicle purchases (Asadi et al., 2021; Sang & Bekhet, 2015). Users prioritize economic benefits when adopting electric motorcycles compared to other factors (Damayanti et al., 2020).

Policy analysis regarding electric motorcycle adoption has been conducted in leading electric motorcycle markets, including Norway, the Netherlands, and Sweden (World Economic Forum, 2019). A study in Norway found that purchase taxes, battery electric vehicle (BEV) technology, toll exemptions, and the density of charging stations were the most significant factors influencing BEV adoption (Bjerkan et al., 2016; Deuten et al., 2020; Zhang et al., 2016). Similar results were observed in Sweden and Denmark, where public charging infrastructure readiness positively impacted electric motorcycle adoption (Egnér & Trosvik, 2018; Haustein, 2021). In China, a major automotive market with low electric motorcycle penetration, the government has implemented subsidies for initial purchases, the development of charging stations, and exemptions from restrictions imposed on Internal Combustion Engine Vehicle (ICEV) users (Liu, 2021; Wu, 2021). It was also found that the establishment of charging stations and purchase exemption regulations are key factors in electric motorcycle adoption, while financial incentives have a less significant effect (Liu, Sun, Zheng, & Huang, 2021). In India, charging infrastructure, localized battery production to reduce electric motorcycle production costs, and the enhancement of the vehicles themselves are crucial for electric motorcycle adoption (Chhikara et al., 2021; Singh et al., 2021). Other studies by Griskevicius et al. (2010) and Helveston (2015) emphasize the importance of signaling status through ownership of electric and hybrid vehicles. However, in interviews with 17 pioneer users, the most frequently mentioned motivation for using electric motorcycles was cost minimization (Axsen et al., 2018). Other reasons for adopting electric motorcycles include environmental protection, innovation, and the social value of owning an electric motorcycle (Axsen et al., 2018). Furthermore, Wang, Cao, & Zhang (2021) found that environmental concern significantly impacts attitudes toward Battery Electric Vehicles (BEVs) and the intention to purchase.

This study investigates the relationships among variables that may influence consumers' intentions to adopt electric motorcycles. In this research, independent variables measure the extent to which consumers intend to adopt electric motorcycles. To indicate consumer intent to adopt, the study utilizes perceived relative advantage, perceived ease of use, and perceived risk as variables. It is important to emphasize that this research focuses on adoption intent rather than actual adoption behavior influenced by external and situational factors.

2. Methods

2.1 Research design: conclusive descriptive

Research design is a systematic plan that encompasses methods for data collection, processing, and analysis, aimed at achieving the research objectives effectively and efficiently (Pabundu, 2005). This study adopts a descriptive approach with quantitative methods to comprehensively describe the problem and reveal factual insights. Data collection employs a cross-sectional approach, where information is gathered from a sample at a single point in time, offering a clear snapshot of the current situation. Through this approach, the study aims to generate detailed insights into the factors influencing consumer behavior.

Data collection in this study follows a single cross-sectional survey design, leveraging both primary and secondary data sources. Primary data is collected directly from respondents who represent the main focus of the research, ensuring accuracy and minimizing possible errors. Structured questionnaires, comprising both written and verbal statements, are used to capture essential information (Malhotra, 2020). The questionnaires target consumers who have test-driven Alvauto electric motorcycles, ensuring that respondents have relevant, firsthand experience with the product being examined.

In data collection, the methodology must be scrutinized to identify potential sources of bias, including sample size and characteristics, response rates, and questionnaire design and administration (Malhotra, 2020). A carefully chosen sample is critical to producing representative, reliable data. By ensuring diverse respondent characteristics in the sample, this research aims to reflect a broader societal context. This approach also aims to enhance the validity and reliability of the collected data.

2.2 Research model

This research model builds upon prior work by Xu et al. (2020), which identified a connection between the experience of riding an electric motorcycle and consumers' affective and cognitive responses. The present study seeks to validate Xu et al.'s findings in the Indonesian context, particularly in the Jabodetabek area, a region marked by high levels of pollution due to motor vehicles. Variables utilized in this study are extensions of those from previous research, applied within a distinct contextual framework. The research follows the Stimulus-Organism-Response (SOR) model, where stimuli include factors affecting consumer perception, such as product quality, information volume, and brand image.

2.5 Variable operationalization

The study incorporates five main variables: electric vehicle riding experience, perceived relative advantage, perceived ease of use, perceived risk, and adoption intention. Each variable is measured by several indicators, totaling 16 overall. Measurements employ a classic Likert scale, where 1 indicates strong disagreement and 6 indicates strong agreement. This scale aims to capture the nuanced attitudes of respondents toward each studied variable in greater detail.

2.6 Questionnaire structure

The questionnaire, serving as a structured data collection tool, consists of questions designed to gather relevant information from respondents (Malhotra, 2020). It begins with an introduction from the researcher regarding the study topic and respondent criteria, supplemented with contact information for further inquiries. Respondent profiles include personal data, such as name, gender, age, expenditures, and residence, which provide context for analysis. The main portion of the questionnaire includes questions related to the research variables, such as electric vehicle riding experience and adoption intention, integral for addressing the research objectives comprehensively.

2.7 Data analysis methods

This study employs Partial Least Squares-Structural Equation Modeling (PLS-SEM) using SmartPLS 4.0 due to its ability to explain complex causal relationships and empirically validate theoretical hypotheses through predictive steps. PLS-SEM effectively illustrates variable and indicator relationships, allowing for models with diverse scales (Henseller, Ringle, & Sinkovics, 2009; Hair, et al. 2017).

The analysis includes a wording test for questionnaire clarity, engaging three experienced electric motorcycle riders to provide feedback for improving language accuracy. Subsequently, validity and reliability tests were performed. Discriminant validity was assessed through Average Variance Extracted (AVE), with values above 0.5 indicating acceptable levels. Factor loadings were verified to be above 0.5, ideally 0.7 (Malhotra, 2020). Composite reliability and Cronbach’s alpha metrics validated reliability, requiring thresholds of 0.7 for composite reliability and 0.6 for Cronbach's alpha (Malhotra, 2020).

Descriptive analysis was used to provide an overview of data characteristics, useful for identifying patterns across both numerical and categorical data types. PLS-SEM was further applied to evaluate both manifest (measurement) variables and latent (abstract) variables in the model, examining internal consistency and discriminant validity to ensure they appropriately represent constructs. Structural model analysis then evaluated relationships among latent variables, confirming the significance of hypotheses through one-tailed testing, requiring t-values of 1.645 and p-values below 0.05 (Malhotra, 2020).

3. Results and Discussion

3.1 Descriptive data analysis

Descriptive analysis is a statistical method researchers use to describe and summarize data sets, enabling a general overview of the collected data. This analysis includes calculating minimum and maximum values, standard deviations, and mean values for indicators. Table 1 presents descriptive data on the driving experience variable, where the minimum and maximum scores are recorded as 1 and 6, with a range of 6. On average, respondents rated their driving experience between 3.46 and 3.76, while the standard deviation reveals a range in responses, with the highest deviation at 1.787 (DE4) and the lowest at 1.655 (DE1).

Table 1. Descriptive data analysis of the driving experience variable

Variable	Item	SD	Mean	Total Mean
driving experience	DE1	1.655	3.46	3.645
	DE2	1.682	3.63	
	DE3	1.750	3.73	
	DE4	1.787	3.76	
perceived relative advantage	RA1	1.631	3.93	3.73
	RA2	1.690	3.66	
	RA3	1.557	3.60	
perceived ease of use	PEU1	1.505	3.74	3.82
	PEU2	1.319	3.81	
	PEU3	1.399	3.91	
perceived risk	PR1	1.603	3.71	3.796
	PR2	1.773	3.87	
	PR3	1.574	3.81	
adoption intention	AI1	1.159	3.99	3.90
	AI2	1.332	3.81	
	AI3	1.280	3.90	

For the variable relative advantage, the minimum and maximum scores are also 1 and 6, respectively. Respondents rated their relative advantage between 3.93 and 3.60, with the highest standard deviation at 1.787 (RA2) and the lowest at 1.655 (RA3). Similarly, perceived ease of use ratings varied between 3.74 and 3.91, with the standard deviation ranging from a high of 1.505 (PEU1) to a low of 1.319 (PEU3). Lastly, adoption intention ratings averaged between 3.90 and 3.91, with standard deviation scores between 1.159 (AI2) and 1.280 (AI3).

3.2 Measurement model analysis (outer model)

At this stage, the measurement model analysis includes presenting Cronbach's alpha, composite reliability, and internal consistency values for all variables, followed by AVE, cross-loading, and Fornell-Larcker criteria. The reliability of the measurement model was assessed using Cronbach's alpha, composite reliability, Rho_A, and average variance extracted (AVE) values. A variable is deemed reliable if Cronbach's Alpha (CA) is ≥ 0.6 and composite reliability ≥ 0.7 (Malhotra, 2020). AVE values above 0.5 indicate adequate reliability (Hair et al., 2010). The internal consistency test results are presented in Table 4.6.

3.3 Convergent validity testing & discriminant validity testing

Convergent validity assesses the degree to which a construct accurately represents its indicators. Researchers performed this test using cross-loading and average variance extracted (AVE) values. Outer loading values exceeding 0.60 indicate adequate convergent validity (Hair et al., 2010), while AVE values of 0.5 or higher (Malhotra, 2020) support convergent reliability, it's indicating 16 indicators above 0.6. Accordingly, the variables Driving Experience, Perceived Relative Advantage, Perceived Ease of Use, Perceived Risk, and Adoption Intention are considered valid.

Discriminant validity, used in structural equation modeling (SEM), was tested using the Fornell-Larcker criterion to assess the uniqueness and distinction of constructs. As shown in Table 4.8, the AVE values for each latent construct meet the ≥ 0.5 criteria (Hair et al., 2017). Additionally, in Table 4.9, the square roots of AVE for each construct are greater than the correlation with other latent constructs, meeting Fornell-Larcker's discriminant validity criteria.

3.4 Structural model analysis (inner model) & coefficient of determination (R^2) testing

In this stage, structural model testing was conducted by examining the coefficient of determination (R^2), goodness of fit, and path coefficient significance. The coefficient of determination (R^2) testing estimates the extent to which independent variables explain the dependent variables in the regression model (Hair et al., 2017), with values ranging from 0 to 1. The results are displayed in Table 4.10.

3.8 Significance of path coefficients testing

The significance of path coefficients, representing the hypothesized relationships between independent and dependent variables, was tested. Hypotheses are supported if p-values are < 0.05 and t-values exceed 1.645. Table 4.11 indicates significant relationships for five of the hypotheses, while two hypotheses show no significant relationship: driving experience and adoption intention, as well as perceived ease of use and adoption intention.

4. Conclusions

This study builds upon previous research that examined consumer attitudes and perceptions regarding the perceived relative advantage, ease of use, and perceived risk associated with adopting electric motorcycles. Based on the analysis of this study's findings, several key conclusions are drawn. First, driving experience with electric motorcycles positively enhances the perceived relative advantage, meaning that a higher level of experience leads consumers to perceive greater benefits in using electric motorcycles. Second, driving experience also has a positive impact on perceived ease of use, indicating that as consumers gain more experience riding electric motorcycles, they find them easier to use. Third, driving experience has a negative impact on perceived risk; as consumers become more familiar with electric motorcycles, they perceive a lower level of associated risk. Fourth, perceived relative advantage positively influences the intention to adopt electric motorcycles, meaning that as consumers recognize more benefits from electric motorcycles through driving trials, their adoption intentions strengthen. Fifth, perceived ease of use positively affects the adoption intention, suggesting that when consumers find electric motorcycles easier to use, their desire to adopt them increases. Sixth, perceived risk negatively impacts adoption intentions, implying that lower perceived risks encourage stronger consumer intentions to adopt electric motorcycles. Finally, while driving experience itself does not directly increase adoption intention, it indirectly influences adoption intentions through mediating factors such as perceived relative advantage, ease of use, and perceived risk.

Considering the limitations of this study, several recommendations are proposed for future research to enhance the study's quality and depth. Expanding the scope of the survey and increasing the sample size could provide a more comprehensive understanding of consumer perspectives. Moreover, future research could examine additional factors, such as external stimuli and specific characteristics of electric motorcycles, to explore their influence more thoroughly. Furthermore, focusing on concrete adoption behaviors in subsequent studies could yield insights into the practical aspects of consumer adoption of electric motorcycles.

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