

# Motivating Factors to Use Electric Vehicles Based on Behavioral Intention Model in South Korea

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**Abstract**—The global warming crisis forced humans to consider their place in the world and the earth's future. In this regard, Electric Vehicles (EVs) are a significant step towards protecting the environment. By identifying factors that influence people's behavior intentions toward using EVs, we proposed a theoretical model by extending the Technology Acceptance Model (TAM), including three more concepts, Subjective Norm (SN), Self-Efficacy (SE), and Perceived Behavior Control (PBC). The study was conducted in South Korea, and a random sample was taken at a specific time. In order to collect data, a questionnaire was created in a Google Form and sent via Kakao Talk, a popular social media application used in Korea. There were about 220 participants in this survey. However, 201 surveys were completely done. The findings revealed that all factors in the TAM model and the other added concepts such as SNs, SE and PBC significantly affect the behavioral intention of using EVs.

**Keywords**—Electric vehicles, behavioral intention, subjective norm, self-efficacy, perceived behavior control.

## I. INTRODUCTION

IN recent years, environmental protection has gained more attention due to humans' behaviors in releasing hazardous pollutants and subsequent climate change. Several factors contribute to environmental pollution, such as the high number of private vehicles [1], the demand for fossil fuels by industries, and transportation systems [2], [3]. Therefore, several research projects have been undertaken in order to examine how vehicular pollution affects the environment. The outcomes revealed that increasing vehicle numbers lead to higher energy consumption [4], which results in numerous challenges in energy security and sustainability [5], [6].

The International Energy Agency (IEA) reports that the world is home to approximately 1 billion vehicles, which use roughly 60 million oil barrels each day while releasing 14 million tons of greenhouse gases into the atmosphere [7]. Thus, reducing the environmental impact can be achieved by replacing traditional vehicles with new energy vehicles [8]. In this sense, EVs minimize negative environmental impacts due to their ecological benefits [9]. EVs are viewed as environmentally friendly options for urban transportation since they reduce dependency on oil and emissions [10], [11]. Research demonstrates that EVs reduce the emission of CO<sub>2</sub> by 30-50% and 40%-60% improvement in fuel efficiency over traditional engines [9].

Energy-saving [12] and environmental protection will push EVs into the leading industry development trend. In terms of the environmental sustainability of vehicles, eco-friendly,

energy-efficient, and innovative EVs models are vital. In order to use EVs, understanding user acceptance is the most crucial concept. The study of EVs acceptance in South Korea remains insufficient, despite many studies being conducted. In addition, studies that investigate the effects of SNs, SE and PBC on acceptance of EVs still lack data, and some studies have inconsistent results, compelling us to carry out more research. We used the TAM [13] as a theoretical foundation in this study and extended it by establishing influential factors. Expansion of the TAM can increase the explanatory power of the model [14]. In order to understand and develop EVs, it is helpful to discuss the acceptance and adoption of EVs by people in the community.

By applying a model that combines the TAM with the SN, SE, and PBC the paper intends to investigate consumers' opinions of EVs in South Korea and analyze factors that influence consumer acceptance. Furthermore, the objective is to increase penetration into the EV market and provide references to potential researchers.

The remainder of the paper is devoted to describing the research hypotheses in Part II and research methodology in Part III. Part IV of this article explains the results of our proposed model. Part V presents our discussion, while Section VI summarizes the paper.

## II. RESEARCH HYPOTHESES

### A. Technology Acceptance Model

In information technology systems, the model of TAM proposed by Davis [13] is considered one of the most widely used models. This model, shown in Fig. 1, predicts and explains the acceptance of technology by users. Many studies [13], [14] revealed that technology users' acceptance of technology systems could be indicated and explained by the theory of perceived usefulness and perceived ease of use. Perceived ease of use is also positively correlated with perceived usefulness, and these two factors increase willingness to use technology. This study measures users' desire to use EVs as an outcome variable and hypothesized:

- H1. Perceived ease of use significantly affects perceived usefulness.
- H2. Perceived ease of use significantly affects people's intention to use EVs.
- H3. Perceived usefulness significantly affects people's intention to use EVs.

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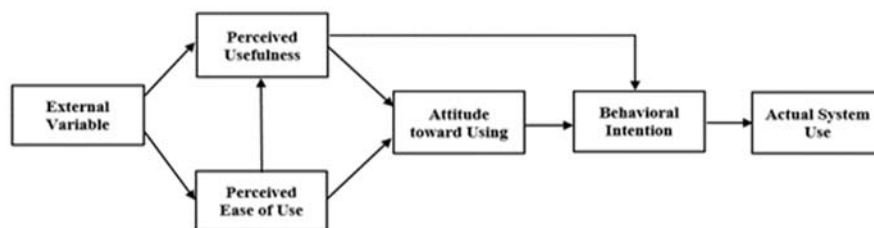


Fig. 1 Technology Acceptance Model (TAM)

### B. Subjective Norms

SNs are based on the factors of society and perceived pressures of the members of the community to comply or not comply with a norm. According to [15], behavioral intentions to use EVs are influenced by social factors. Accordingly, we hypothesized:

H4. SN significantly affects people's intention to use EVs.

### III. RESEARCH METHODOLOGY

An empirical analysis based on questionnaires was conducted to verify the hypothesis. Related research was used to establish the measurement items. The items were rated using a Likert scale of 1-5, from "strongly disagree" (1) to "strongly agree" (5). For the empirical analysis, we collected data from surveys conducted among drivers in South Korea. An anonymous survey questionnaire randomly was distributed to users of KakaoTalk, Korea's most used communication network, between 2021/10/1 and 2021/10/15. The data collected came from 220 individuals. In total, 201 valid responses were left for statistical analysis after removing missing or repetitive responses. The study used IBM SPSS 22.0 software for statistical analysis, including descriptive statistics and mediating effects analysis. The framework of proposed model is presented in Fig. 2.

### IV. RESULTS

#### A. Demographic Profiles of Respondents

A summary of the 201 respondents is provided in Table I. Male and female respondents share nearly the same percentages (58.1% and 41.9%, respectively). Those in their 30s represented the majority of respondents (27.1%), followed by those in their 40s (23.3%), 50s (16.2%), and 60s (12.5%). Employees accounted for (54.1%) of the respondents, followed by self-employed persons (24.4%), housewives (16.1%), and other respondents (5.4%). Graduates with a bachelor's degree hold the highest number of shares, at 43.7%, followed by those with a master's degree (29.7%). Among respondents, 31.4% had a driving history of 10 years or more, followed by those with five to ten years of experience (29.4%), three to five years (14.5%), two years (13.5%), and one year (11.2%).

#### B. Model Test Results

The correlation coefficients of each dimension are shown in Table II. This result indicates that there is an association between the predictors and outcome variables.

Fig. 2 depicts the results of the model test. Accordingly, the  $R^2$  value of the whole model is 0.418, which is between the Henseler and Ringle standards of the medium explanatory power of 0.33 and 0.67 [17]. It shows that the whole model accounts for 41% of the variance in the intention to use EVs. In addition, perceived ease of use, perceived usefulness, SN, SE, and perceived behavior control significantly influence willingness to use EVs.

TABLE I  
 DEMOGRAPHIC ANALYSIS (N: 201)

Items	Option	Percentage (%)
Gender	Male	58.1
	Female	41.9
Age Group	20-29	12.1
	30-39	27.1
	40-49	23.3
	50-59	16.2
	60-69	12.5
Occupation	70- more	8.8
	Employee	54.1
	Self-employed	24.4
	Housewife	16.1
Education level	Other	5.4
	High school	6.3
	Bachelor Degree	43.7
	Master Degree	29.7
Experience in driving	Ph.D. Degree	20.3
	1	11.2
	2	13.5
	3- 5	14.5
	5- 10	29.4
	More than 10	31.4

#### C. Self-Efficacy

Perceived SE refers to the extent to which a person believes she/he can handle future situations, that is, the degree of self-confidence an individual has in handling situations [16]. SE directly impacts and directs user behaviors. We, therefore, hypothesized that:

H5. SE significantly affects people's intention to use EVs.

#### D. Perceived Behavior Control

PBC is defined by [15] as the perception of ease and difficulty of using EVs. Individuals believe that they can predict obstacles by controlling their behavior based on previous experiences. In light of this, the last hypothesis is:

H6. PBC significantly affects people's intention to use EVs.

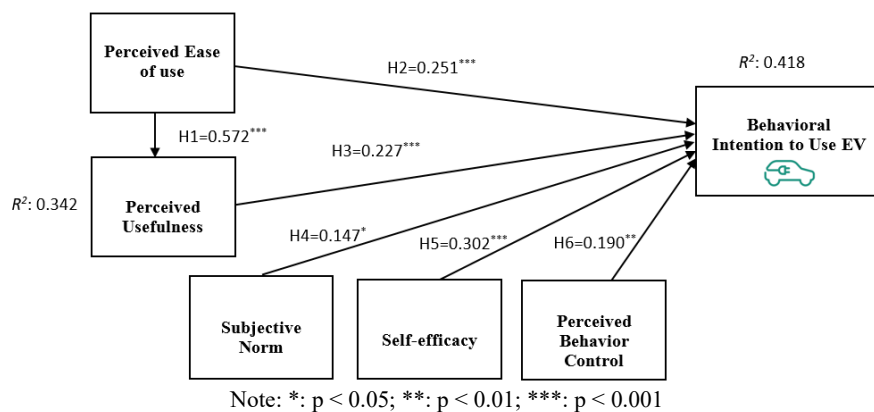


Fig. 2 Proposed Model verification results

TABLE II  
CORRELATION COEFFICIENT BETWEEN DIFFERENT DIMENSIONS

		SN	SE	PBC	PU	PEU
SE	Pearson Correlation	.240**	100			
	Sig.	.001				
	Number	201	201			
PBC	Pearson Correlation	.260**	.453**	100		
	Sig.	.000	.000			
	Number	201	201	201		
PU	Pearson Correlation	.104	.052	.191**	100	
	Sig.	.142	.460	.007		
	Number	201	201	201	201	
PEU	Pearson Correlation	.124	.313**	.332**	.140*	100
	Sig.	.079	.000	.000	.047	
	Number	201	201	201	201	201
BI	Pearson Correlation	.221**	.480**	.206**	.224**	.217**
	Sig.	.002	.000	.003	.001	.002
	Number	201	201	201	201	201

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

PU: Perceived Usefulness, PEU: Perceived Ease of Use, BI: Behavioral Intention.

The results indicate that perceived ease of use significantly affects perceived usefulness ( $\beta = 0.572$ ,  $p < 0.001$ ), as well as

TABLE III  
MEDIATION EFFECT TEST

Independent variable	Mediators	Dependent variable	Direct effect	Indirect effect	Total indirect effect	VAF
Perceived Ease of Use	Perceived Usefulness	Behavioral Intention	0.572***(4.520)	0.277***(3.101)	0.849	32%

Note: \*,  $p < 0.05$ ; \*\*,  $p < 0.01$ ; \*\*\*,  $p < 0.001$ ; the value inside is the t value; VAF, variance accounted for

## V. DISCUSSION

In this research, a TAM model was extended incorporating three additional factors: SN, SE, and PBC to demonstrate an acceptance model for using EVs. Based on the results, the SN, SE, PBC, perceived usefulness, and perceived ease of use are effective predictors of people's intention to use EVs. In this regard, the study's findings may offer guidance regarding the use of EVs and developing relevant policies.

The study has provided opportunities for examining the factors that influence EV use intention. Specifically, SE and other dimensions of EVs that are less discussed were

on intention to use EVs ( $\beta = 0.251$ ,  $p < 0.001$ ). Therefore, H1 and H2 are valid. H3 is supported by the finding that perceived usefulness significantly affects intention to use EVs ( $\beta = 0.227$ ,  $p < 0.001$ ). H4 is also verified because the SN significantly affects intention ( $\beta = 0.147$ ,  $p < 0.05$ ). SE also significantly influences use intention ( $\beta = 0.302$ ,  $p < 0.001$ ), so the H5 is verified. Finally, PBC significantly affects the intention to use EVs ( $\beta = 0.191$ ,  $p < 0.01$ ). H6 is therefore valid. Furthermore, the research considered that perceived usefulness indirectly influences intention to use. Table III shows the Bootstrap method's results to verify the multiple mediation effects since it is a stronger test than the Sobel method [18]. Then it is used the variance accounted for (VAF) rule of thumb (Full mediation, partial mediation, and no mediation), which is suggested by Hair et al. [18] to assess mediation. The rule indicated that  $VAF > 80\%$  shows complete mediation,  $VAF \leq 80\%$  displays partial mediation, and  $VAF < 20\%$  presents no mediation. From Table III, it is apparent that perceived usefulness is a mediator of perceived ease of use and intention to use EVs. Perceived Usefulness has an indirect effect of 0.277, t value of 3.101,  $p < 0.001$ , and a VAF value of 32%, which indicates that Perceived Usefulness is partially mediated.

incorporated into the TAM, thereby expanding the application potential of the TAM. We also have some limitations in our study. All of our study participants did not have driven experience with EVs, which may have affected the results in a certain way. By inviting users to drive EVs in the near future, we can help users better understand the EVs that can protect the environment. In addition, the research object is based in Korea, which limits its general applicability outside of Korea. Furthermore, the heterogeneity of the participants (e.g., gender, age) might affect the study's validity.

Lastly, we would like to point out that although convenience

sampling is popular, it may have some restrictions with regard to the results of the study. In the future, researchers may examine the role of SE, PBC, etc., that may change over time with experience, in determining technology use behaviors.

## VI. CONCLUSION

In order to reduce fossil fuel consumption, which is the leading cause of carbon dioxide emissions, EVs have an important role to play. Nonetheless, research on the intention to purchase EVs from the view of developing countries has been insufficient. People's intentions towards using EVs must be understood regarding the factors affecting them to develop EVs and their acceptance. To address this issue, in this paper, we presented a model that integrates the TAM with three more concepts to examine the opinions of consumers with respect to EVs in South Korea. According to our study, people's intention to use EVs is positively influenced by perceived ease of use, perceived usefulness, SN, SE, and PBC. The results of this study help people understand the short-term and long-term benefits of using EVs for themselves and the environment, which will lead to a better acceptance and development of EVs.

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