

# The Influence of Environmental Awareness on Intent to Use Electric Scooters: Perspectives Based on the Theory of Planned Behavior

Cheng Mei Tung<sup>1,\*</sup>, Shu-Hsun Ho<sup>2</sup>

<sup>1</sup>Department of International Business, Feng Chia University, Taichung City, Taiwan

<sup>2</sup>Department of Business Administration, Providence University, Taichung City, Taiwan

\*Corresponding author: [justineatfc@gmail.com](mailto:justineatfc@gmail.com)

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**Abstract** Consumers' concerns about the protection of the environment affect their consumption. People in Asian countries generally choose two-wheels scooters for commuting, because they are relatively inexpensive and convenient. Although electric scooters have entered the market with an emphasis on environmental responsibility, their market penetration is still low, and there has been little research on this topic. This study attempts to explore university students' intent to use electric scooters by using the theory of planned behavior and supplemented with environmental awareness variable in Taiwan. Overall, 500 questionnaires were collected and analyzed using the structure equation model. The results show that environmental awareness has a significant effect on students' attitudes, subjective norms, and perceived behavioral control. Attitude is the strongest predictor of the intent to use electric scooters. The results provide guidance for companies and policy makers to refine further strategy on the marketing of electric scooters.

**Keywords:** *environmental awareness, intent to use, Theory of Planned Behavior, electric scooters, attitude*

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## 1. Introduction

In the last few decades, a rapid increase in the consumption of goods and services has led to continued growth in resource use and severely harmed the environment [1]. Environmental damage leads to problems such as global warming, water pollution, and air pollution [2]. Governments have paid attention to the threat of environmental pollution and encouraged the implementation of actions to reduce the environmental damage caused by commercial activities [3]. When consumers have a high awareness of environmental issues and implement green consumption behaviors in their daily lives, they also have a positive attitude toward consumption that protects the environment [4,5,6,7].

Daily commute by two-wheels scooter is common in Asia [8], as it provides a relatively convenient point-to-point travel. Taiwan has the greatest scooter concentration in Asia [9] and scooters are widely used for peoples' daily transportation [10]. The legal age for scooter uses in Taiwan is 18. According to a report by the Ministry of Transportation and Communications [11], by the end of August 2021, the total number of scooters was 14.2 million, an average of 378 per square meter in Taiwan. Furthermore, 71.1% of scooter users say that no matter

how the government implements scooter management measures, they will not switch to public transportation [12]. Scooters emit volatile compounds, and the noise they make causes discomfort. Electric vehicles are considered an environmentally friendly option [13,14,15], but electric scooters have not fully gained a foothold in the market [15]. An electric scooter in this research is a two wheelers vehicle that uses electricity as a source of power, and looks like a gasoline-powered motorcycle [16].

Many studies have examined the relationship between environmental awareness among consumers and a willingness to use eco-friendly products [1,17,18,19]. However, there are few studies on consumer willingness to use electric scooters, particularly on how consumers' environmental awareness and attitudes affect their intent to use electric vehicles. Researches on environmental issues and the use of green transportation in Taiwan has also gradually emerged [10,20,21,22]. Research has found that economic incentives provided by the government have a significant impact on the use of electric vehicles [23]. In the past, the Taiwanese government also adopted a strategy of subsidizing the use of electric scooters. The question of how to encourage growth in the market share of electric vehicles when subsidies gradually decrease merits further discussion.

Research on the younger generations' awareness of environmental impacts is still evolving [24]. Young

people's transportation choices will affect the environment, and they are a significant segment of consumers of the future that will affect both society and the environment [25]. They are more knowledgeable about environmental issues [26] and pay closer attention to the environment [25]. Therefore, this study focused on university students and explored their intent to use electric scooters. The results can be of interest to managers and policymakers.

In response to the research questions, this study used the theory of planned behavior (TPB), supplemented with an environmental awareness variable, to explore the relationship on the intent to use electric scooters. The TPB has been utilized to study green consumer behavior in the past [1,20,27,28,29] but with little emphasis on specific green commodities. This study will identify factors that can explain and predict consumers' intent to use electric scooters.

The content is organized in several sections. Section 2 includes a literature review and the discussion of the research hypotheses. The third section describes the research framework and methodology. Section 4 covers the results of the research, and Section 5 contains the conclusion and implications.

## 2. Conceptual Framework and Hypothesis Development

### 2.1. The Theory of Planned Behavior (TPB)

The TPB derives from the Theory of Reasoned Action (TRA) [30]. Ajzen (1985) extended the TRA by incorporating perceived behavioral control (PBC), attitude towards behavior, and subjective norm (SN) to predict intentions and behavior. The TPB has been used to explore consumer behavior in a variety of disciplines [3,4,26,32,33,34] and is seen as a powerful model for explaining environmentally friendly behavior [35,36]. The consumption behavior of young people will influence by their beliefs and values [7]. A study of Malaysian college students used the TPB to explore the factors that influenced their recycling behavior, and found that the most accurate predictor of their behavior was PBC [5].

Purchase intention is defined as motivation factors that influence customers intention that has been considered the best predictor of behavior [33]. [37] found that young Indian consumers' green products purchasing intentions could be predicted by attitude, SN, and PBC. [38] used TPB to explore green furniture purchase intention. The results found environmental awareness had an indirect effect on intention but attitude had no significant impact on intention. The results also indicated that PBC was the strongest predictor of intention, followed by SN.

### 2.2. Attitude

Attitude pertains to an individual's favorable or unfavorable perception of a problem or event [39]. It is the strongest predictor of behavioral intention [36,40]. The TPB has used attitude to explain an individual's intent to consume particular products [4,41] as well as green purchasing behavior [3]. [26] explore Iranian students' intent to choose organic foods and indicate that attitude is

a strong predictor of behavioral intention. Based on the literature review, this study proposed the following hypothesis:

H1: Attitude toward electric scooters has a positive influence on the intent to use them.

### 2.3. Subjective Norm (SN)

SN indicates the social pressure individuals feel to perform or not to perform a particular behavior [31,40]. SN is influenced by peers and superiors [43], such as families, close friends, relatives, colleagues, or business partners [33]. Studies have found a positive correlation between SN and such intentions as using a particular technology [44] or staying at green hotels [27,40,45]. Consumers feel supported from significant groups influence their behavior intentions [46]. [32] study students' intentions concerning environmental protection activities and find that when individuals have a higher SN of supporting participation in environmental protection activities, they have a stronger intent to follow prescribed practices. Another study showed that consumers perceived the ethical and social standards that affected their recycling behavior and SN can predict the intended actions [47]. The perceptions of green behavior of their significant others can affect the consumer's green purchasing behavior [48]. Therefore, the following hypothesis was proposed:

H2: SN has a positive influence on intent to use electric scooters.

### 2.4. Perceived Behavioral Control (PBC)

PBC is the perceived ease or difficulty of engaging in a behavior [49] and is related to prior experience and expected difficulties [33]. [40] found that PBC was the most significant factor affecting consumers' choice of green hotels. The more resources and opportunities individuals had, the smaller the expected obstacles were; smaller expected obstacles then led individuals to perceive stronger control of behavior [3,26,32,41,47]. Ajzen (1989) believed that if a person who wanted to engage in a behavior found no relevant resource, opportunity, or ability to engage in it would in fact not engage in it. [50] noted that affordability was a perceptual cue that consumers considered before buying a product [50]. Related research indicates that PBC influences intent to do recycle resources [5], select organic food [26], and purchase green products [1]. Thus, this research proposed following hypotheses:

H3: PBC has a positive influence on the intent to use an electric scooter.

### 2.5. The Extended Theory of Planned Behavior

New variables were included in the TPB to enhance its ability to predict behavior [19,25,27,29]. [31] also noted that models can be extended to include further variables, so that the description of the intended behavior can be more precise. In order to better understand the intent to use electric scooters, this research added environmental awareness to the model.

### 2.5.1. Environmental Awareness

Environmental awareness represents individual's awareness that human behavior threatens the environment [52,53,54,55]; it is related to individuals' willingness to protect the natural environment from environmentally harmful behavior [32,56]. [54] pointed out that environmental awareness is an important factor in green behavior [55]. Consumers' decision to buy organic food is influenced by their environmental awareness. Increased environmental awareness affects personal consumption behavior and environmental sustainability [57].

Environmental awareness is an expression of environmental concern, environmental attitudes, and knowledge to predict green purchasing intentions on part of the customers [3,55,58]. It represents people's belief about the relationship between behavior and environment [59] and has a positive relationship with pro-environment behavior [60]. Consumers who have higher environmental awareness are more likely to engage in environmentally friendly behavior than consumers whose environmental awareness is lower [61]. Environmental awareness is a multi-dimension concept, so the research can be explored from different perspectives [59].

[52] used environmental awareness and environmental knowledge interchangeably. Environmental awareness and knowledge are very important factors in energy-saving behavior. Knowledge and awareness shape managers' green behavior attitude and intention [55]. [20] indicated that environment value and awareness had a significant impact on using electric scooter sharing intention. [62] mentioned that environmental awareness had a significant impact on consumer intention to purchase environmentally friendly cars. People who follow social norms in behavior may be more concerned about environmental information, and therefore build more environmental-related knowledge [1]. Environmental awareness will also increase personal

beliefs in environmental control [63]. Consumers' environmental awareness will make them have a positive attitude towards green products [53]. Therefore, the attitude of environmentally conscious consumers towards green products will further affect their purchase intention [64]. Based on the literature review, this study proposed following hypotheses:

H4: Environmental awareness has a positive influence on attitude toward electric scooters.

H5: Environmental awareness has a positive influence on SN.

H6: Environmental awareness has a positive influence on PBC.

H7: Environmental awareness has a positive influence on the intent to use electric scooters.

The research framework is diagrammed in Figure 1.

## 3. Method

This study used a survey to test research hypotheses. This section discusses the development of the questionnaire and collection of data.

### 3.1. Development of the Questionnaire

Given the aim and research framework, this study designed a two-part questionnaire to test the theoretical model. The first part of the questionnaire covered demographic data, while the questions in the second part covered the research constructs that are referenced in related research (Table 1). Each question was linked to a construct, and the responses were scored using a five-point Likert scale, in which a score of 1 meant "Strongly disagree," and 5 meant "Strongly agree." Two academic experts reviewed the content of a complete questionnaire draft and recommended revisions in the wording and sequence of the questions.

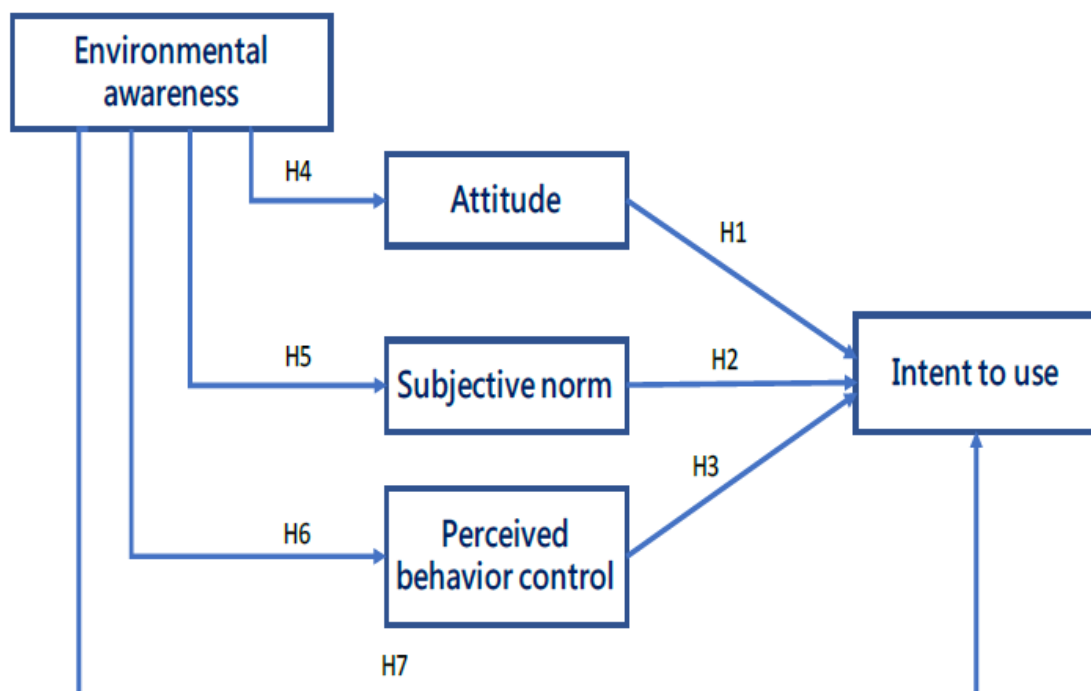


Figure 1. Proposed research framework

**Table 1. Study constructs and measurement items**

Survey Items	References
<b>Attitude</b> 1. I believe that using an electric scooter will help protect the environment. 2. I believe that using an electric scooter is a good idea. 3. I have a favorable attitude towards using an electric scooter.	[1]
<b>Subjective norm</b> 1. Most people who are important to me think I should use an electric scooter. 2. People whose opinions I value would prefer that I use an electric scooter. 3. Most people who are important to me would want me to purchase an electric scooter when I shop for one.	[1,33]
<b>PBC</b> 1. I am confident that if I want to, I can use an electric scooter. 2. I am confident that if I want to, I can buy an electric scooter. 3. I am confident that electric scooters are easy to use.	[33,65]
<b>Environmental awareness</b> 1. I want to have a deeper insight of the inputs, processes and impacts of products before purchase. 2. I am aware of how to protect the environment from pollution. 3. I think individuals have the responsibility to protect the environment. 4. I would be willing to reduce my consumption to help protect the environment.	[1,33,55]
<b>Intent to use</b> 1. If I wanted to buy a scooter, I would choose an electric one. 2. I will consider buying an electric scooter in the future. 3. I have the resources and willingness to use an electric scooter. 4. The next time I purchase a scooter, I will tend to choose an electric one, because it pollutes less. 5. I would like to use an environmentally friendly electric scooter. 6. I plan to use an electric scooter in the future. 7. I intend to use an electric scooter.	[1,58]

### 3.2. Data Collection

The questionnaire was administrated through an online survey and convenient sampling in Taiwan. A total of 500 responses collected in this research. [67] has mentioned the required samples for measuring latent variable of a research that are ten for each item. The sample size meets the requirement. The demographic characteristics of the participants are shown in Table 2; 51.5% were male, and 48.5% were female.

**Table 2. Demographic characteristics of samples (n=500)**

Characteristics	Category	Frequency	Percentage
Gender	Male	257	51.5
	Female	243	48.5
Age	18~24	488	97.6
	25~29	7	1.4
	30~34	5	1
Monthly disposable income (NTD\$)	Less than 5,000	298	59.5
	5,001~10,000	167	33.3
	10,001~15,000	22	4.4
	15,001~20,000	6	1.2
	20,001 or more	7	1.6

## 4. Data Analysis

This study adopted a two-stage procedure for data analysis [68]. First, using reliability, convergent validity, and discriminant validity examined construct validity. Second, this study used the AMOS 23.0 program to analyze the structural equation model (SEM). Before analyzing reliability and validity, the study examined skewness and kurtosis of the variables. The absolute value of the skewness of all the observed variables is between 0.06 and 1.55, and the absolute value of their kurtosis is

0.24 to 2.6. The variables fulfill the assumptions of the general linear model [66].

### 4.1. Construct Validity

The study used confirmatory factor analysis (CFA) to examine all the constructs in the model. The resulting model showed that the overall fit of the indices displayed an acceptable level of fit:  $X^2/df(123) = 2.91$ , goodness of fit index (GFI)=0.93, adjusted goodness of fit index (AGFI)=0.90, comparative fit index (CFI)=0.952, Tucker Lewis Index (TLI)=0.943, the root mean squared error approximation (RMSEA)=0.06, and standardized root mean squared residual (SRMR)=0.04.

#### 4.1.1. Reliability and Convergent Validity

Cronbach's alpha was used to test reliability of the items of each construct; all multi-item constructs needed a value greater than 0.7 [69,70]. The Cronbach's alpha of each construct is between 0.70 and 0.94, indicating that all items are reliable indicators of the hypothesized constructs (Table 3).

Furthermore, this study used three indicators to measure convergent validity. First, the factor loadings of all are higher than 0.7; a significance level of 0.05 is required [71]. Second, validity for each construct, as measured by composite reliability (CR), should exceed 0.7 [72]. Third, the Average Variance Extracted (AVE) should be above the recommended level and exceed 0.5 [73]. The higher the AVE, the higher the convergent validity of the construct [74]. As Table 3 demonstrates, the factor loading of the observed variables, which ranges from 0.71 to 0.93, meets the cutoff value of 0.7 [71]. The CR is between 0.70 and 0.93, and the AVE value is between 0.53 and 0.80. These results show that the latent variable has good explanatory power for each observed variable.

**Table 3. Construct reliability and convergent validity**

Factors and items	Factor loading	AVE	CR	Cronbach's alpha
<b>Environ-mental awareness</b>				
Env1	0.71	0.53	0.70	0.70
Env2 <sup>a</sup>	0.62			
Env3 <sup>a</sup>	0.58			
Env4	0.75			
<b>Attitude</b>				
Att1	0.89	0.80	0.93	0.93
Att2	0.87			
Att3	0.91			
<b>PBC</b>				
PBC1	0.88	0.80	0.93	0.93
PBC2	0.90			
PBC3	0.83			
<b>SN</b>				
SN1	0.83	0.80	0.91	0.91
SN2	0.93			
SN3	0.92			
<b>Intent to use</b>				
Int1	0.75	0.70	0.93	0.94
Int2	0.73			
Int3	0.78			
Int4	0.9			
Int5	0.89			
Int6	0.88			
Int7	0.76			

<sup>a</sup> The factor loading of Env2 and Env3 are less than 0.7 and do not proceed further analysis.

**Table 4. Correlation, mean, standard deviation and square root of AVE**

	Environmental awareness	Attitude	SN	PBC	Intent to use
Environmental awareness	<b><i>0.728<sup>a</sup></i></b>				
Attitude	0.413**	<b><i>0.906<sup>a</sup></i></b>			
SN	0.170**	0.479**	<b><i>0.909<sup>a</sup></i></b>		
PBC	0.346**	0.149**	0.168**	<b><i>0.885<sup>a</sup></i></b>	
Intention	0.370**	0.665**	0.650**	0.149**	<b><i>0.814<sup>a</sup></i></b>
Mean	4.118	3.629	2.782	4.089	3.253
S.D.	0.765	1.004	1.022	0.869	0.919

\*\* p<0.01

<sup>a</sup> Square root of AVE for each construct.

#### 4.1.2. Discriminant Validity

Discriminant validity tests measured constructs that are not hypothesized to be related to each other. According to [69], the correlation coefficient between two different constructs should be less than the square root of the AVE, for each construct [73]. As shown in Table 4, the square roots of the AVE (the diagonal values in italic bold) are higher than the correlations between the constructs and other constructs. The constructs have met the criteria for discriminant validity.

#### 4.1.3. Common Method Variance

Since this study's data have a single source, common method variance may have an impact on outcomes [75]. The study uses a single-factor model to detect and evaluate such an impact. The results of the factor analysis show that five factors are extracted, and there is no excessive explanation for any one single factor. The problem of common method variance was thus ruled out.

## 4.2. Measurement Model

### 4.2.1. Model Fit Analysis

The structure model is tested to assess how consistent the empirical results are with the theory. As Table 5 shows, the overall theoretical structure exhibits a good fit with the data:  $X^2/df(125)=2.94$ , GFI=0.92, AGFI=0.90, CFI=0.97, TLI=0.96, RMSEA=0.06, SRMR=0.04). The chi-squared value is sensitive to sample size. When a sample size is large, the chi-squared value is more likely to be significant [66]. Therefore, the fit was measured by the model-matching index of chi-squared/degree of freedom ( $X^2/df$ ). The  $X^2/df$  for this study is 2.94 indicating good model fit [76]. Other fit indices, such as CFI and TLI, are both higher than 0.9, which also exceeds the recommended criteria [72]. The RMSEA is 0.06, also indicating a good model fit [69,77]. The comparison of the fitness index shows that the theoretical model proposed in this study is a good model to predict consumers' intent to use electric scooters.

**Table 5. Explanatory power and fit indices of models**

Model Fit Indices	Result Value	Recommend Value
X <sup>2</sup>	367.12	
X <sup>2</sup> /df	2.94	>1 and <3
GFI	0.92	>=0.90
AGFI	0.90	>=0.90
CFI	0.97	>=0.90
TLI	0.96	>=0.90
RMSEA	0.06	<=0.80
SRMR	0.04	<=0.1

References:[67,69,72,76,77].

### 4.3. Hypothesis Testing

Table 6 outline the hypothesis testing. The proposed model explains 71% ( $R^2=0.71$ ) of variance in intent to use electric scooters. Attitude significantly influences on intent to use electric scooters ( $B=0.47$ ,  $p<0.01$ ), supporting hypothesis H1. The SN and PBC also have significant impacts on intent to use electric scooters. These results support H2 ( $B=0.40$ ,  $p<0.01$ ) and H3 ( $B=0.12$ ,  $p<0.01$ ), respectively, indicating that intent to use electric scooters is affected both by the people who are important to university students and by PBC. These findings are similar to the results of [26] that students' attitudes, SN, and PBC affect their purchasing intentions. Environmental awareness also has a significant positive impact on attitudes ( $B=0.50$ ,  $p<0.01$ ) and has a significant positive influence on SN ( $B=0.23$ ,  $p<0.01$ ) as well as a significant positive impact on PBC ( $B=0.40$ ,  $p<0.01$ ). It was observed that environment awareness explains 25% ( $R^2=0.25$ ) of variance in attitude, 5% ( $R^2=0.05$ ) of variance in SN and 16% ( $R^2=0.16$ ) of variance in PBC. These results support hypotheses H4, H5, and H6. Furthermore, environmental awareness has not positive significant impact on intent to use electric scooters ( $B=0.10$ ,  $p>0.05$ ). The result does not support H7.

**Table 6. Summary of hypothesis testing**

Hypothesis	Relationship	B value	Support
H1	Attitude → Intent to use	0.47**	Yes
H2	SN → Intent to use	0.40**	Yes
H3	PBC → Intent to use	0.12**	Yes
H4	Environmental awareness → attitude	0.50**	Yes
H5	Environmental awareness → SN	0.23**	Yes
H6	Environmental awareness → PBC	0.40**	Yes
H7	Environmental awareness → Intent to use	0.10	No

\*\*  $p<0.01$ .

## 5. Conclusions

This study aimed to investigate the factors that influence university students' intent to use electric scooters in Taiwan. The variance explanation of the research model is 71%. The results indicate that attitude, SN, and PBC significantly influence consumers' intent, in this regard; they further support related researches on consumer green purchase intentions and actual consumption [25,36,40,45,78,79]. The environmental awareness does not impact on the scooter use intention. However, the attitude, SN, and PBC

increase the size of intent to use an electronic scooter. The result shows environmental awareness does not a single factor influence consumer intention, and have impact on through attitude, SN, and PBC. The empirical findings add to the understanding of environmental awareness and consumers' intent to use electric scooters.

The attitude of the university students in this study towards electric scooter use intention has more explanatory power than SN and PBC. Attitude significant and positively impact on young consumers' intentions concerning electric scooter use. These results support studies on intent to purchase environmentally friendly goods [27,38,62,80].

Environmental awareness affects university students' SN in addition to their intent to use electric scooters. The university students make choices according to their preferences; SN therefore has a lower impact on purchase intentions than does attitude. This finding supports earlier research by [79], who note that SN is mainly derived from linked bonds within groups and influenced by opinions of people who are important to the students. Significant people's opinion influences university students' buying intentions. Another reason may be related to scooters' price because around 60% of the respondents' monthly disposable income is NTD\$5,000. The PBC of university students is influenced by their understanding and knowledge of the environment; it too affects their intentions. However, the impact of PBC on intentions is low. The reason may be that university students' disposable income limits their purchasing power. The affordability is one of the factors that influence intention to use [50]. Because of electric scooters' high price, students need support from their families to purchase one; for this reason, the opinions of family members influence their intentions higher than PBC. Students' SN therefore has a higher effect on intention to use than PBC.

The impact of environmental awareness on attitudes towards electric scooters shows that university students' concern for and understanding of environmental issues should cause their attitude toward them to improve. However, the environmental awareness has no direct influence on intent to use electric scooters. The finding is consistent with [1]. Although, the impact of environmental awareness on intended behavior has significance that has been pointed out in previous studies [58,82]. However, there are still limitations of interpretation. An individual who cares about environmental issues still finds it difficult to purchase an electric scooter directly without a positive attitude towards such a purchase, SN, and PBC. It is in part for this reason that this research proposes a possible influence of environmental awareness on intent to use electric scooters and use TPB to explain university students' intentions.

### 5.1. Practical Implications

The research identified the factors influencing university students to use electric scooters in Taiwan, and the findings could be for companies and government to consider. First, marketing strategy should address ways of increasing customers' environmental awareness. The environmental awareness is significant to attitude towards electric scooters, SN, and PBC, and in turn affect the

intention of use. Young customers are willing to respond to and practice environmental protection behavior [37]. Marketing strategy must choose proper communication channels to share the knowledge about environmental issues such as global warming, energy efficiency, pollution prevention, and environmentally friendly activities. Environmental awareness can strengthen intent to use electric scooters and increase the attention paid to university students' pro-environmental behavior [81]. This awareness can also motivate consumers to take intuitive actions that lessen negative impact on the environment [83].

A second implication is that since attitude is an essential predictor of environmental awareness and intent to use, companies need to cultivate a better understanding of attitude in university students. This research indicates that SN and PBC must also be considered. Companies need to use appropriate strategies to improve customers' attitude, SN, and PBC where electric scooters are concerned. Influencing the beliefs of potential customers, such as parents, can enhance responsibility for environmental protection and also predict intent to use electric scooters. Environmental policymakers, for their part, need to understand the factors that influence university students' intent to use electric scooters; when this has been done, specific practices can be developed. In order to strengthen use intentions, policies can first increase consumers' knowledge and awareness about carbon dioxide emissions, air pollution, and other issues. This, in turn, helps influence consumer attitude and increase the SN and PBC from environmental awareness. In addition, the affordability of consumers also needs to be taken into consideration. The necessary subsidy measures can be planned and implemented jointly by the government and enterprises.

## 5.2. Limitations and Future Research

The limitations of this study include that the results are based on the views of university students in Taiwan. This research suggests that consumers' environmental awareness will stimulate intent to purchase electric scooters. Because this study was conducted in Taiwan and the electric scooter market is still small, the respondents may have self-selection bias [84]. University students who responded to the questionnaire may tend to demonstrate only the behavior expected by the larger society [85]. The generalizability of the results is limited.

With an increase in the popularity of electric scooters, coupled with an increased number of users, future research can explore purchasing intent using environmental awareness and the TPB to investigate other demographic groups. Exploring the characteristics of different groups can deepen our understanding of marketing opportunities for electric scooters.

This research has only discussed intent to use an electric scooter and does not explore actual purchasing. Future research can use longitudinal studies to explore purchasing, and this will allow for a better understanding of the relationships among consumers' environmental awareness, intent to use an electric scooter, and actual behavior, as well as the variables in the TPB. It should also be borne in mind that purchasing intentions are also affected by such factors as price, trust and quality.

## Statement of Competing Interests

The authors have no competing interests.

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