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User Behavioral Intentions toward a Scooter-Sharing Service: An Empirical Study

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Abstract: This paper proposes an innovative shared scooter service whereby scooter owners can authorize the rental of their scooters to others through a mobile service platform. It constitutes a public short-distance mobility service for travelers and increases the efficient utilization of each private scooter. The study examines the adoption of scooter-sharing services by travelers and adapts the unified theory of acceptance and use of technology, attitude, and user experience (UX) to investigate the factors that may influence traveler acceptance of scooter-sharing services. The data were collected from Taiwanese travelers who used the shared scooters provided in this study and completed pre- and post-use subjective ratings of the scooter-sharing service ($n = 99$), analyzed using a hierarchical multiple regression analysis. The results indicate that the model constructs of habit, social influence, and environmental protections may positively affect users' behavioral intentions toward shared scooters, while performance expectancy and effort expectancy may negatively affect intention to use. Attitudes and UX had no direct effect on intention to use. In light of the findings, recommendations for improving the design of scooter-sharing services, implications for service providers, and a reference basis for the development of future shared micro-mobility services are provided.

Keywords: vehicle-sharing service; technology adoption; user experience; attitude; environmental protection

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1. Introduction

In the effort to tackle problems arising from urban transport, such as air and noise pollution, congestion, a lack of urban space, and parking costs, shared micro-mobility constitutes a new mobility pattern and a sustainable form of transportation. Such problems may have negative consequences for air quality, sustainability, and the livability of cities [1,2], and shared micro-mobility provides travelers with short-term access to various modes of transportation, such as bicycles, electric bikes (e-bikes), scooters, electric scooters (e-scooters), and standing scooters. Moreover, shared micro-mobility systems are rapidly becoming essential components of urban transit infrastructure, including bike sharing (e.g., Limebike and Citi Bike in NYC, Vélib in Paris, and YouBike in Taiwan), car sharing (e.g., iRent and Smart2go in Taiwan, car2go, Zipcar, and Lime), and scootersharing (e.g., Bird and emmy in Europe, CityScoot in Paris, Skip, Spin, Zapp, and Scoot in the US, and WeMo, GoShare, and iRent in Taiwan). The effects of shared micro-mobility include increased mobility, decreased automobile use, economic development, health benefits [3], and reduced greenhouse gas emissions [4]. Shared micro-mobility also avoids the costs and burdens of private scooter ownership, such as large fixed costs of maintenance, fueling, and ongoing insurance payments [5].

This paper concerns scooter-sharing services in the context of Taiwan. Taiwan is an island country with the highest density of scooter commuters worldwide. The Taiwanese government has proposed many policies and strategies to tackle the problems arising from scooter transit and has promoted e-scooters as one of the solutions. A battery swapping service based on a vehicle and battery separation model is one useful strategy for promoting e-scooters. This service makes the recharging of e-scooters as convenient as using a gas station for fuel-powered scooters and increases commuter acceptance of e-scooters [6]. However, previous research has indicated that e-scooters may be an effective solution to urban congestion and the last-mile problem, and they do not necessarily reduce environmental impacts from the transportation system. In order to reduce adverse environmental impacts from e-scooter products, it has been suggested to increase e-scooter lifetimes, reduce collection and distribution distance, use more efficient vehicles, and have less frequent charging strategies [7]. In addition, promoting e-scooters has also led to an increase in the total number of two-wheeled vehicles in Taiwan. Taking the sales volume of 2020 as an example, a total of 1.03 million scooters were sold, a 25-year high in Taiwan [8]. This sales volume does not include e-scooters (98,986 units) or e-bikes (about 30,000 units). Moreover, the latest survey report on the use of scooters by the Statistics Department of Taiwan's Ministry of Transportation and Communications indicates that the average scooter lifetimes is 13.3 years and average scooter use is 5.2 days per week; of these days, the average riding time is 51.1 min [9]. Scooters/e-scooters can hold up to two passengers. This means that private scooter/e-scooter efficiency is very low. The low daily usage of the scooter/e-scooters and a small number of passenger miles traveled over the scooter/e-scooter's lifetime show a very high global warming impact driven by the manufacturing and materials burdens [7].

From the perspective of sustainable transport development, the best services rely on electric vehicles (EVs) or encourage travelers to transition from owning a vehicle to using a shared vehicle [10]. Station-based bike-sharing service YouBike has been in the Taiwanese market since 2009. YouBike operates under a government program and private enterprise management. At present, YouBike has successfully provided services throughout Taiwan and has been upgraded to YouBike 2.0. With the development of information and communications technology (ICT), dockless bike-sharing services, such as oBike and VBike, have been in the market since 2017. Since these services did not receive the cooperation of the Taiwanese government, they eventually failed. Shared scooter/e-scooter services and dockless shared e-bike services have been on the Taiwanese market since 2018 and 2020, respectively. Among them, the scooter-sharing system is based on the idea that vehicle owners can authorize the rental of their vehicles to others through a mobile service platform. Such services allow owners to lease their vehicle to different users and give users instant access, the capacity to search for vehicles, and open-ended reservations. Most shared vehicle systems consist of a fleet of vehicles that are used by one or more travelers each day. Shared vehicles offer the convenience of private vehicles and are more flexible than public transportation alone. Sharing concepts provide cost-effective and efficient utilization of vehicles and reduce parking requirements [11]. More specifically, the shared scooter model applies ICT, such as wireless technologies and mobile devices, to enable accessibility for all travelers who have a driver's license to complete scooter rental, usage, and payment via mobile applications (apps), replacing the original scooter-rental procedure involving, for example, paper-based work and scooter keys. App-based services create a new Mobile-as-a-Service (MaaS) market model and an opportunity for travelers to have a scooter or e-scooter ride and use a battery-swapping system. The Taiwanese scooter-sharing service provides e-scooter models dedicated to sharing services for the short-term goal of travelers' commuting needs. However, the higher the number of shared e-scooters provided by these services, the higher the density of vehicles on the road. Further, a sharp increase in the number of injuries from e-scooters has been observed ever since shared schemes were introduced [12–14]. This means that road safety for scooter and e-scooter riders is an emerging public health challenge in countries that provide services of shared two-wheeled vehicles. In the future, private scooters/e-scooters will be gradually introduced into the service for the long-term goal of reducing the total number of scooters on the market. The purpose of shared scooter services is to replace the demand for travelers' private scooter commuting, not walking or public transportation.

On the user side, the mobile app provides all the services needed to use shared scooters. This means that travelers have to establish a new behavioral pattern to use shared scooters; such behavioral patterns are different when using private scooters. The effective implementation of any information system depends on user acceptance [15]. Thus, traveler acceptance is a critical factor for scooter-sharing services. Current research on shared micro-mobility services provides information on new and dedicated vehicle models; however, this study focuses on existing private vehicles in the market. This study focuses on how travelers achieve behavioral changes through interaction with the scooter-sharing system to complete shared scooter usage. The study considers the influences of travelers' attitudes, user experience (UX), acceptance, and satisfaction on behavioral intention toward shared scooters. In the context of this study, attitude is considered a central concept of social psychology and determines the instrumental behavior of each individual. Hence, individual self-reporting was used to observe traveler attitudes toward private scooters, shared scooters, and the introduction of their private scooters into shared services. In addition, the extended unified theory of acceptance and use of technology (UTAUT2) [16] was adapted to investigate performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, habits, and price value on the behavioral intention to use shared scooters. The core of UX evaluation is to understand the experiences evoked by use of a product [6]. Aesthetic, pragmatic, and hedonic qualities were used to elicit travelers' subjective responses to shared scooter usage. The purpose of this study is to empirically explore user attitudes toward either private or shared scooters and opinions on user acceptance and UXs after shared scooter usage. It is necessary to further understand the factors that influence the acceptance of shared scooters.

The literature review describes shared micro-mobility in the urban transport context and the three device characteristics (i.e., attitude, UX, and behavioral intention) for predicting traveler acceptance of scooter-sharing services. Section 3 explains the methodology used to conduct this study. The empirical study and two subjective ratings for pre-use and post-use scooter sharing, developed on the basis of attitude, UX, and a modified version of UTAUT2 to predict the acceptance of using shared scooters, are described in detail. The results of analyzing the data are presented in Section 4, followed by a discussion and conclusions.

2. Literature Review

2.1. Two-Wheeler Sharing Service

With developments in ICT such as online social networks, GPS-enabled mobile devices, the Internet of Things (IoT), mobile payments, and cloud computing, economic models have emerged that are based on sharing or collaborative consumption of resources, called the sharing economy. This new form of resource sharing allows users to access goods without the burden of fixed ownership costs and the greater environmental impact of personal ownership [17]. The sharing economy has penetrated the markets of lodging, labor, equipment, food, and transportation and generated USD 15 billion in global revenue in 2014; this is poised to grow to USD 335 billion by 2025 [18]. With regard to transportation, the shared vehicle market provides various service models and transportation modes that meet the diverse needs of travelers. Such shared vehicle services may ensure sustainable access to mobility in increasingly urbanized regions as transport demands continually rise. Shared service providers offer users access to services or goods through a mobile device with a community-based online platform and allow them to operate the vehicle themselves. Such an MaaS enables users to receive information, plan a trip, make reservations, and operate and pay for multiple types of mobility services.

This study focuses on shared micro-mobility, which is an innovative and sustainable transportation strategy. Shared micro-mobility provides station-based bike-sharing (a bicycle picked up from and returned to any station) and dockless bike, scooter, or e-scooter sharing (a two-wheeler picked up and returned to any location). Such services enable travelers to have access to a collection of personal transportation vehicles, which can be accessed at any time (subject to vehicle availability) and between a large number of source and destination locations [19]. The important factors in the operation of shared vehicle services include prices, condition of the fleet, replacement of vehicles, rental/operation area, legal requirements, location of parking spaces, operational/serviceability safety, cost, types of systems, and electric vehicle power supply. Among them, price has the greatest impact. Recently, the COVID-19 pandemic had a negative impact on the operation of shared vehicle services. During the pandemic, sanitary and safety concerns inhibited travelers from using shared vehicles. The pandemic not only changed the needs of society, but also destroyed practices in the field of sustainable urban mobility built over the years. Shared vehicle service providers were forced to adapt their business practices to the new market situation and to new or improved services, such as disinfecting strategic places in vehicles. Additionally, operators were compelled to develop new pricing schemes to maintain the operation of shared vehicle services during the pandemic [10]. From the consumer's perspective, the reasons affecting the acceptance of shared micro-mobility services include cost savings, convenience, enjoyment [20,21], consumer innovativeness [22], socio-demographic attributes, and motivations [23]. Consumer innovativeness, an inherent trait of an individual that drives the use of innovation [24], affects EV preferences [25] and purchase intentions [26]. Moreover, shared micro-mobility is presented as a green innovation, as it is promoted as an innovative and green transport mode [24,26]. However, many travelers opt against shared micro-mobility services because the service mainly caters to a rather select group of travelers [21]. Shared micro-mobility users are more likely to perceive the environmental benefits of shared micro-vehicles than non-users. Consumers' environmental knowledge is related to their transport mode choices [27] and perceptions [28]. Simply put, consumer innovativeness and green perceptions are significantly related to the use of shared micro-mobility [23]. With regard to socio-demographic attributes, age, education, income, gender, and possession of a driver's license are relevant in the decision to use shared micro-vehicles. Individuals who are young, educated, male, who have a higher income and are not in possession of a driver's license are most likely to use shared vehicles [29–31]. Among these, age is an important predictor of shared-vehicle adoption. With regard to motivation, the reasons for using shared e-bikes and shared e-scooters are different among travelers. Travelers use shared e-bikes to supplement their commute along with conventional shared bikes, while shared e-scooters are used for recreational purposes and enjoyment [21,32]. In addition, many travelers use shared e-bikes as alternatives to shared bikes and public transport, whereas they use shared e-scooters as a substitute for commuting by taxi, carpools, walking, and public transport [32–35]. This presents a new challenge, namely, how to guide travelers to use shared vehicles to replace cars. Thus, shared micro-mobility services may achieve their purpose as an environmentally friendly alternative.

Users' travel demands may not be satisfied due to inefficiencies in vehicle-sharing systems, such as limited vehicles, a shortage of battery swap stations (BSSs), and unsolved issues in asymmetric demand across time and space. In addition, the majority of shared vehicles do not have permanent rack/dock parking spaces. Dockless sharing systems have faced many challenges, such as oversized fleets [36–38], vandalism, vehicles cluttering sidewalks, curb-space management issues [39], and traffic safety [40]; they also require extra manpower to maintain, recycle, or park these vehicles at a considerably high cost. More specifically, the services provided by the shared fleet will bring a large number of vehicles and related hardware equipment to the city. A large number of vehicles in city traffic has led to numerous safety and chaos problems. Regarding road safety, for example, non-compliance with safety rules when moving with vehicles or vehicles cluttering sidewalks may cause communication barrier with other road users and affect the safety of vulnerable road users, especially pedestrians and people with disabilities. Regarding service management, for example, the vehicles are maliciously destroyed or thrown into rivers and the equipment of the vehicle is stolen [41]. Fleets that are poorly managed and out of service may yield lots of abandoned equipment and vehicles. These may cause problems related to the ecological issue of users/sharing service operators dropping vehicles or equipment and the issue of waste poisoning the natural environment. In addition, city curbs are becoming increasingly crowded as shared vehicles, for-hire services, and delivery services compete for parking space and pick-up and drop-off locations. Attempts to add parking spaces and expand roadways raise environmental concerns and threaten the livability of cities. The provision of curb space reserved for shared vehicles is an important policy issue confronting public agencies. The key elements of shared vehicle curb space policies often include policy processes, device caps, service area limitations, designated parking areas, fees, and equipment and operational requirements. These are intended to facilitate walking as a safe, attractive, and viable travel mode and allow pedestrians to access their destinations [3]. This highlights the importance of the development of special types of policies and regulations dedicated to people using shared vehicles or related devices and the education for shared micro-mobility to shape users' appropriate transport behavior.

Shared vehicles introduce significant flexibility for users, but also for management complexities [42]. To tackle these problems, electronic fence and geofence technologies have been applied to the sharing of dockless two-wheelers. These services may connect to walking or public transportation, encouraging travelers to plan longer or more flexible journeys, thereby reducing their transportation costs and potentially increasing their willingness to spend the saved funds on other forms of consumption during the journey. More specifically, the electronic fence system is part of a smart quarantine system. Such a system uses a convenient and simple mobile signal on the telecom base station instead of GPS information to locate the rough position of mobile devices. Dockless two-wheeler sharing with electronic fence technology enables users to pick up and drop off two-wheelers anywhere within a geographic area by locking the two-wheeler to a two-wheeler sharing station, existing two-wheeler parking, street furniture, a designated bike-sharing rack [43], or lively hotels, attractions, and restaurants. Geofencing is a location-based technique that establishes a virtual boundary in an actual geographic area [44]. A geofence app service uses GPS or Wi-Fi to trigger a pre-programmed action when a mobile device enters or exits a virtual boundary set up around a geographical location. Dockless two-wheeler sharing with geofencing may satisfy over 90% of total parking demand, reduce inappropriate parking behaviors [45], preserve transportation flexibility, avoid potential conflicts, and allow electric two-wheelers to de-activate on sidewalks but turn on when they are in two-wheeler lanes. In summary, dockless two-wheeler sharing involves high vehicle maintenance, logistics, and system construction and management costs. Both the system maturity of shared two-wheeler services and recovery of costs must wait until the consumption and usage frequency of consumers reach a certain value, which generally takes several years.

E-scooters are the main product in the Taiwanese shared scooter market, which is mainly based on 24 h dockless services. The charging infrastructure throughout Taiwan, including gostation, ionex, and e-moving, accelerated the introduction and widespread adoption of e-scooters. For example, Gogoro had provided more than 2145 BSSs as of July 2021. Ionex is expected to provide 4000 BSSs in 2022. Ionex also provides an innovative service through dispatched personnel to deliver and swap batteries for e-scooter owners at night. These charging infrastructures can be regarded as stable, growing, and continuously innovative service items. With the impact of the COVID-19 pandemic, personal mobility has become more popular than public mobility. Alongside outright sales, an increasing number of manufacturers are willing to shift the sales model of two-wheelers to subscription-based and/or lease-based models [41]. Sharing-service providers offer specific and new e-scooters to the market. Each provider offers an intermediary app service to travelers to locate nearby available shared e-scooters or BSSs, to reserve and pick up an e-scooter, to unlock keyless e-scooters after scanning a QR code, to return e-scooters when a trip is completed, and to pay the usage fee. The e-scooter pick-up and drop-off locations need not be the same. The app on mobile devices plays a central role in the realization of connected mobility, such as e-scooter sharing. In other words, Taiwanese shared e-scooters are more likely to be used in a rental economy. Rental economies are focused on business between customers, while sharing economies are primarily focused on services that connect consumers. A recent report by the Taiwanese National Police Agency, Ministry of the Interior [46], indicated that there were 362,393 road traffic accidents in 2020. Among them, scooters and e-scooters (55.08%) had the highest rate of accidents, followed by cars (29.28%), trucks (5.58%), and other vehicles. The main reason for scooter accidents was failure to yield the road appropriately (16.99%), followed by improper turning (10.63%), failure to maintain distance (9.35%), and other reasons. Scooter-related injuries are common and of varying severity, given the low rates of adherence to rider age requirements and low rates of helmet use [14]. The scooter accident rate decreases with age. In addition, more than half of road traffic deaths occur among vulnerable road users, especially motorcyclists, cyclists, and pedestrians [47]. Compared with the policies of shared bikes and shared e-bikes, the related policies of shared e-scooters recently introduced to the market are not yet mature. In addition, the lack of shared e-scooter regulations has resulted in issues relating to road users' safety, relevance for transport, and environmental impact [23]. To ensure that shared e-scooters can be operated legally and that related hazards of traffic safety can be reduced, Taiwanese traffic laws regulate age restrictions and requirements for use. Therefore, app registration must include an applicant's ID card and driver's license. Applicants can open an e-scooter- or scooter-sharing service if they are over 18 years of age and can open an e-bike service if they are 14 years old; scooters and e-scooters can take two passengers, while e-bikes hold one. Both riders and passengers must wear a helmet to drive on the road. For user convenience, two-wheeler sharing providers offer one or two helmets that are placed in the storage space of the scooter. A survey report on the analysis of shared e-scooter behavior among Taiwanese people indicated that 80% of the respondents knew about the sharing services but that only 22% had used it. The respondents further stated that convenience (65% of the respondents) and meeting travel demands (61%) were core motivators for using the e-scooter sharing service [48]. This means that there is still much room for growth in the e-scooter sharing market.

2.2. Attitude, User Experience, and Behavioral Intention

This initial study explores the factors that may influence travelers' acceptance of shared scooters. Here, acceptance is examined on the basis of the behavioral intention and UX with regard to using shared scooters and attitudes from the perspective of human–system interaction.

The impacts of shared micro-mobility can be grouped into four categories: travel behavior, environmental, land use, and social [49]. The UTAUT model, which focuses on workplace technology acceptance [50], has been extended into the UTAUT2, a conceptual model that explains the acceptance and use of technologies in a consumer use context [16]. The UTAUT combines eight well-known theories, including the technology acceptance model (TAM) [15], in relation to technology adoption. In the TAM, perceived usefulness and perceived ease of use are postulated as key constructs influencing the intention of a person to accept a technology. This study uses the UTAUT2 evaluation method to examine Taiwanese travelers' adoption of and intentions toward the proposed scooter-sharing service. All the constructs for UTAUT2 are utilized to investigate the influence of performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, habits, and price value on behavioral intention on shared scooter acceptance. Furthermore, personalization constructs—gender and scooter-usage experience—are assumed to moderate the effects of constructs on behavioral intention.

Taiwanese people live in a scooter-dominant environment and are accustomed to using a private scooter as one of the main forms of transport for short-distance mobility. Their long-term cognitive and cultural habits of private-scooter usage differ from those of shared scooter usage. Attitudes, considered to be a central concept of social psychology [51], are multidimensional constructs [52] and defined as "an enduring organization of motivational, emotional, perceptual, and cognitive processes with respect to some aspect of the individual's world" [53]. An attitude is a disposition toward or against a specified phenomenon, person, or thing [54], as well as a response to a stimulus. In other words, an attitude has cognitive, affective, and behavioral components. Attitudes can be inferred from individuals' self-reports and behaviors. Strongly held attitudes may be more stable over time and better predictors of behavior than weak attitudes [51,55]. Generally, "people who hold positive attitudes should engage in behaviors that approach, support, or enhance the attitude object, and people who hold negative attitudes should engage in behaviors that avoid, oppose, or hinder the object" [56]. In the field of marketing, attitude is crucial for predicting consumer intention and purchasing behavior [57]. Attitudes may explain customers' individual motives and purchasing habits over time [58]. Consumer attitude is defined as "human beings' learned predisposition for consistent responses in a favorable and unfavorable manner to a given object" [59]. Consumer attitudes are based on the functional motives of the consumer, the amount of pleasure and pain they receive from the product, and the consumer's perception that products and services affect their social identity [58]. The functional motive is determined by consumers' motives to satisfy various functions, such as the utilitarian function, value-expressive function, ego-defensive function, and knowledge function [60]. In this study, individual self-reporting was used to observe travelers' attitudes toward private and shared scooters.

All designed products and services evoke a wide range of emotions. Emotions are multidimensional constructs that have a range of components: affective (e.g., subjectively experienced feeling), cognitive (e.g., thoughts, achievement goals, and expectations), expressive (e.g., mimics and gestics), motivational (e.g., actional tendencies), and physiological (e.g., heart rate) [61]. Consumers can hold positive or negative perceptions and feelings about products or services depending on the positive or negative emotions they have experienced previously. Products or services that evoke positive emotions are used more often and are more pleasurable than those that do not. Pleasure with products is defined as "the emotional, hedonic, and practical benefits associated with products" [62]. Emotions govern the quality of interaction with a product in the user's environment and relate directly to the appraisal of the UX. The UX is defined as "a person's perceptions and responses that result from the use or anticipated use of a product, system, or service" [63]. UX evaluation is used to understand users' experiences that a service or product evokes. In this study, UX evaluation focuses on short-term service usage, aesthetic quality, hedonic goals, pragmatic goals, and the overall quality of experience arising from the interaction with the shared scooter system.

3. Methods

This study was conducted to examine a dockless scooter-sharing service with electronic fence technology located around the campus of Asia Eastern University of Science and Technology in New Taipei City, Taiwan, and to elicit users' subjective responses to shared scooter usage in order to understand how the service affects behavioral intention. The scooter-sharing service used in this study allowed scooter owners to authorize the rental of their scooters by others at any time they were not using the scooter. Two private scooters were introduced into the sharing service. The study recruited people to ride on the shared scooters for short-distance mobility without payment. Selection criteria were no previous experience of a shared two-wheeler service, possession of a driver's license, and being over 20 years of age. All participants were invited to fill out online subjective ratings before and after their shared scooter usage. The samples for this study were shared scooter users who completed both pre-use and post-use subjective ratings.

3.1. Measurements

The subjective rating of pre-used shared scooters contained the following four sections: (1) personal information, comprising three items designed to collect socio-demographic data on sex, ownership of a private scooters, and main means of transportation; (2) attitude toward private scooters ($A_{\text{private scooter}}$), comprising seven items designed to measure attitudes toward having a private scooter, the scooter product, scooter information, scooter usage, and demand for scooters; (3) attitude toward shared scooters ($A_{\text{shared scooters}}$), comprising two items designed to measure attitudes toward using shared scooters; and (4) attitude toward sharing service ($A_{\text{sharing service}}$), comprising four items designed to measure attitudes toward introducing your own private scooters into sharing services. All attitude items used a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

The subjective ratings of post-use shared scooters contained three sections. The first was UTAUT2, utilizing 25 items that were designed to collect categorical data on performance expectancy (four items), effort expectancy (four items), social influence (three items), facilitating conditions (two items), hedonic motivation (three items), price value (two items), habits (three items), and behavioral intention (four items), assessed on a seven-point Likert scale. The second section focuses on UX. It utilized four items that were designed to gauge the satisfaction level of the participant on aesthetic quality, hedonic quality, pragmatic quality, and overall user satisfaction. The overall user satisfaction item was assessed on a seven-point Likert scale. The other three items were assessed on a ten-point Likert scale. The third section measured the choice of scooter service. It utilized three items that were designed to gauge the willingness level of the participant to have a private scooter, use shared scooters, and choose shared scooters to protect the environment, assessed on a seven-point Likert scale.

3.2. Participants

Ninety-nine individuals (44 males and 55 females) used the shared scooters provided by this research and completed both pre-use and post-use subject ratings. The median age of the participants was 20 years (min: 20, max: 55). Almost all the participants were university students. This conforms to the finding of Aguilera-García, Gomez, and Sobrino [31], who indicated that young and highly educated people are a segment of the population with a higher probability of using shared mobility alternatives. Of the 99 participants, 51.5% used scooters as their main means of transportation, followed by public transportation (45.5%), Ubike (2%), and cars (1%). In addition, 53.5% of participants owned a scooter, 45.5% had never owned a scooter, and 1% of participants had previously owned a scooter.

3.3. Data Analysis

Analyses were conducted using SPSS software, Version 22.0. Variables were assessed by factor analysis, reliability analysis, t-test, correlation analysis, and hierarchical multiple regression analysis. The two-tailed significance level was set at $p < 0.05$.

3.4. Ethical Approval

The Research Ethics Committee of National Tsing Hua University approved this study (IRB protocol number 10906EC065).

4. Results

4.1. Descriptive Statistics

The descriptive statistics of UX and the choice of scooter services are shown in Table 1. The results indicated that around 80 respondents were satisfied with shared scooters' aesthetic, pragmatic, and hedonic qualities, and 68 of them were satisfied with the overall shared scooter service. With regard to the choice of scooter services, 72 respondents would like to have a private scooter, and 56 respondents would like to use shared scooters. Among these respondents, 51 would like to have both private and shared scooters. In addition, 70 respondents tended to choose using shared scooters to protect the environment. Of these 70 respondents, 16 did not consider continuing to use shared scooters before mentioning environmental issues.

Table 1. Descriptive statistics of UX and the choice of scooter services.

Items	Minimum	Max	Mean	SD
UX				
Aesthetic quality	1	10	7.42	1.95
Pragmatic quality	1	10	7.52	1.70
Hedonic quality	1	10	7.43	1.80
Overall user satisfaction	1	7	5.33	1.30
Choice of scooter services				
I like to have a private scooter	1	7	5.38	1.33
I like to use shared scooters	1	7	4.83	1.60
I would like the choice of shared scooters for environmental protection	1	7	5.37	1.27

4.2. Factor Analysis and Reliability Analysis

In this study, the internal consistency of the UX scores (∝ = 0.938), attitude scores (∝ = 0.807~0.905), and UTAUT2 scores (∝ = 0.908~0.960) were high. The sampling for attitude (Kaiser–Meyer–Olkin (KMO) value = 0.816; $p = 0.000$) and constructs of UTAUT2 (KMO value = 0.934; $p = 0.000$) were adequate. The items on each variable were divided into two parts: agree and disagree.

To ensure that the three attitude dimensions were distinct, a factor analysis was conducted using principal component extraction and varimax rotation. Table 2 shows the factor loadings and scale reliabilities. Typically, factor loadings greater than 0.5 are considered acceptable, whereas those above 0.7 are considered good. All attitude items are loaded above 0.5, which confirms convergent validity [64]. In addition, a factor analysis was conducted using principal component extraction and varimax rotation to ensure that the eight UTAUT2 dimensions were distinct. Table 3 shows the factor loadings and scale reliabilities. All item loadings (above 0.7) were loaded appropriately.

Table 2. Factor loadings and scale reliabilities for attitude measures.

Construct	Item	M	SD	Factor Loading	∝
$A_{\text{private scooter}}$	A1. I think I should have my own scooter if I have frequent short-distance mobility demands.	4.78	1.45	0.540	0.904
	A2. I spend a lot of time riding a scooter every day.	3.78	2.07	0.803	
	A3. I think I understand scooters well.	3.61	1.94	0.791	
	A4. I think scooters can meet my transportation needs.	4.44	1.91	0.738	
	A5. I think scooters are a great means of transportation.	4.79	1.57	0.720	
	A6. I pay attention to information about scooters every day.	3.32	1.80	0.536	
	A7. Owning a private scooter can give me a lot of satisfaction.	4.60	1.74	0.736	
$A_{\text{shared scooters}}$	A8. I think the scooter-sharing service is great.	4.58	1.53	0.726	0.807
	A9. If I had frequent short-distance mobility demands, I would definitely choose shared scooters.	4.16	1.59	0.807	
$A_{\text{sharing service}}$	A10. I am willing to introduce my private scooter into sharing services to increase the efficient utilization of the scooter.	3.41	1.87	0.786	0.905
	A11. I am willing to introduce my private scooter into sharing services to earn rental fees.	3.48	1.95	0.886	
	A12. I am willing to introduce my private scooter into shared services to have a professional team managing my scooter.	3.59	1.78	0.812	
	A13. I think that shared scooters will gradually replace private scooters.	3.43	1.59	0.625	

Table 3. Factor loadings and reliabilities for UTAUT2 measures.

Construct	Item	M	SD	Factor Loading	∝
Performance expectancy	PE1. I think shared scooters are very practical.	5.33	1.27	0.929	0.916
	PE2. I think using shared scooters enables me to experience the benefits of sharing easily.	5.38	1.19	0.910	
	PE3. I think using shared scooters enables me to decide quickly whether I want to continue to use the service.	5.02	1.38	0.940	
	PE4. I think offering shared scooters free of charge is a good way to promote the service	5.35	1.21	0.894	
Effort expectancy	EE1. It would not take me long to learn how to use shared scooters.	5.60	1.20	0.905	0.937
	EE2. I think it would be easy to understand how to use a scooter-sharing service and its app.	5.45	1.21	0.888	
	EE3. It would be easy for me to become skillful at using shared scooters.	5.42	1.23	0.930	
	EE4. I think the information provided by the scooter-sharing service provider is clear.	5.40	1.23	0.893	
Social influence	SI1. People who have influence on me think that I should use shared scooters.	5.06	1.43	0.928	0.933
	SI2. People who are important to me think that I should use shared scooters.	5.29	1.26	0.950	
	SI3. People whose opinions I value would like me to use shared scooters.	5.23	1.33	0.920	
Facilitating conditions	FC1. I have the knowledge necessary to use shared scooters.	5.46	1.23	0.927	0.942
	FC2. The mobile app of shared scooters is compatible with other forms of mobile devices that I use.	5.40	1.27	0.932	
Hedonic motivation	HM1. Using a shared scooter service is enjoyable.	5.33	1.32	0.928	0.922
	HM2. Using a shared scooter service is entertaining.	5.47	1.31	0.924	
	HM3. Using a shared scooter service is fun.	5.30	1.25	0.898	
Price value	PV1. Shared scooter services are really good value for money.	5.30	1.26	0.889	0.908
	PV2. The pricing of shared scooters is reasonable.	5.30	1.34	0.935	
Habits	HA1. I think I will develop the habit of using shared scooters.	5.16	1.39	0.949	0.919
	HA2. I think a scooter-sharing service will be addictive.	4.93	1.45	0.936	
Behavioral intention	BI1. I think it would be natural for me to use shared scooters as long as I have short-distance mobility demands.	5.05	1.55	0.926	0.960
	BI2. I intend to be a frequent user of shared scooters.	4.88	1.54	0.920	
	BI3. I intend to continue using shared scooters for commuting in future.	5.01	1.49	0.921	
	BI4. I intend to use shared scooters in my daily commuting.	5.00	1.56	0.906	

4.3. T-Test

The t-test results indicated that "whether to have a private scooter" ($t = 2.75$, $p < 0.01$), "I spend a lot of time riding a scooter every day" ($t = 2.38$, $p < 0.05$), "I think I understand scooters well" ($t = 2.16$, $p < 0.05$), and "I pay attention to information about scooters every day" ($t = 2.39$, $p < 0.05$) differed significantly by gender (see Table 4).

Table 4. Means and SDs of attitude factors by gender.

Items	Gender	Mean	SD	*t*-Value	Sig.
Whether to have a private scooter	Female Male	0.44 0.73	0.60 0.45	2.75	0.007
A2. I spend a lot of time riding a scooter every day	Female Male	4.84 4.32	1.50 1.84	2.38	0.019
A3. I think I understand scooters well	Female Male	3.35 4.07	2.15 1.80	2.16	0.033
A6. I pay attention to information about scooters every day	Female Male	4.82 3.80	1.59 1.86	2.39	0.019

4.4. Correlation Analysis

The correlation analysis showed positive correlations between all the constructs, i.e., performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, habits, price value, and behavioral intention, and the moderate variables, i.e., "I would like the choice of shared scooters for environmental protection", "overall user satisfaction" (satisfaction), and "I like to use shared scooters" (shared service) (see Table 5).

Table 5. Pearson's correlation coefficients for UTAUT2 among all the constructs and the moderate variables.

	PE	EE	SI	FC	HM	HA	PV	BI	EP	Shared Service	Satisfaction
PE	1										
EE	0.84 **	1									
SI	0.86 **	0.78 **	1								
FC	0.81 **	0.87 **	0.85 **	1							
HM	0.83 **	0.86 **	0.86 **	0.89 **	1						
HA	0.83 **	0.80 **	0.78 **	0.83 **	0.83 **	1					
PV	0.80 **	0.67 **	0.84 **	0.71 **	0.77 **	0.80 **	1				
BI	0.72 **	0.58 **	0.86 **	0.68 **	0.72 **	0.75 **	0.91 **	1			
EP	0.77 **	0.76 **	0.79 **	0.76 **	0.74 **	0.80 **	0.73 **	0.77 **	1		
Shared service	0.63 **	0.54 **	0.71 **	0.62 **	0.68 **	0.60 **	0.71 **	0.70 **	0.53 **	1	
Satisfaction	0.78 **	0.86 **	0.79 **	0.79 **	0.81 **	0.75 **	0.75 **	0.67 **	0.76 **	0.58 **	1

Notes: 1. PE = performance expectancy; EE = effort expectancy; SI = social influence; FC = facilitating conditions; HM = hedonic motivation; HA = habits; EP = environmental protection; BI = behavioral intention; PV = price value. 2. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4.5. Hierarchical Multiple Regression Analysis

Hierarchical multiple regressions (a stepwise regression analysis) were used to predict behavioral intention toward using a shared scooter (Y_{BI}). For the analysis, variables were entered in three steps: (1) the predictor variables (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, habits, and price value); (2) the moderator variables (gender, "whether I have a private scooter", "main means of transportation", $A_{private\ scooter}$, $A_{shared\ scooters}$, $A_{sharing\ service}$, choice of scooter services, "overall user satisfaction", and UX); and (3) the interaction terms for moderation analysis. Table 6 lists the main predictor variables (excluding interactions) for the Y_{BI} model. R^2 was significant in step 1 (F (7, 91) = 100.253, $p < 0.001$), accounting for 88.5% of the variance; in step 2, there was an improvement over the earlier model, with an R^2 change of 0.903. Therefore, the change in R^2 was significant (F (8, 90) = 104.812, $p < 0.001$), indicating that the second set of predictors ("I would like the choice of shared scooters for environmental protection") could predict behavioral intention. Of these, performance expectancy, effort expectancy, social influence, habits, and "I would like the choice of shared scooters for environmental protection" significantly influenced behavioral intention toward using shared scooters. Therefore, these variables were included in subsequent analyses.

Table 6. Hierarchical multiple regression results for Y_{BI}.

Model	Step		Step 1		Step 2		R^2	$\triangle R^2$
			β	VIF	β	VIF		
Y_{BI}	1	PE	−0.206	6.186	−0.221 *	6.187	0.885	0.876 ***
		EE	−0.338 **	6.103	−0.432 ***	6.393		
		SI	0.636 ***	7.568	0.531 ***	8.033		
		FC	−0.006	7.609	−0.022	7.62		
		HM	−0.017	7.248	0.061	7.48		
		PV	0.230 *	5.201	0.114	5.757		
		HA	0.634 ***	4.859	0.612 ***	4.884		
	2	EP			0.293 ***	3.702	0.903	0.894 ***

Notes: 1. PE = performance expectancy; EE = effort expectancy; SI = social influence; FC = facilitating conditions; HM = hedonic motivation; HA = habits; EP = environmental protection; PV = price value. 2. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. 3. VIF (variance inflation factor).

Hierarchical multiple regressions were used to predict five models: Y_{HA}, Y_{SI}, Y_{EE}, Y_{PE}, and Y_{EP}. Table 7 lists the main predictor variables (excluding interactions) for these models.

Table 7. Hierarchical multiple regression results for Y_{HA}, Y_{SI}, Y_{EE}, Y_{PE}, and Y_{EP}.

Model	Step		Step 1		Step 2		R^2	$\triangle R^2$
			β	VIF	β	VIF		
Y_{HA}	1	SI	0.792 ***	3.894	0.597 ***	5.179	0.784	0.777 **
		FC	−0.368 **	4.761	−0.422 ***	5.063		
		PV	0.546 ***	3.384	0.484 ***	3.543		
	2	Satisfaction			0.179 *	3.223	0.809	0.799 *
		Prefer shared			0.156 **	2.048		
Y_{SI}	1	PE	0.320 **	4.363	0.372 ***	4.69	0.862	0.856 *
		FC	0.486 ***	3.734	0.479 ***	3.741		
		PV	−0.192 *	4.763	−0.199 *	4.771		
		HA	0.403 ***	3.323	0.383 ***	3.391		
	2	$A_{private\ scooter}$			−0.075 *	1.091	0.868	0.861 *
Y_{EE}	1	PE	0.420 ***	4.381	0.336 ***	4.558	0.831	0.824 *
		FC	0.406 ***	5.637	0.345 ***	5.746		
		SI	−0.204 *	5.459	−0.265 **	5.579		
		HM	0.289 **	6.304	0.181 *	6.642		
	2	Satisfaction			0.322 ***	3.504	0.871	0.865 ***
Y_{PE}	1	SI	0.274 **	4.806	0.263 **	5.035	0.83	0.825 **
		EE	0.451 ***	2.519	0.314 ***	3.558		
		HA	0.199 **	3.461	0.152 *	3.687		
	2	UX			0.133 *	4.007	0.855	0.847 *
		$A_{private\ scooter}$			0.078 *	1.083		
Y_{EP}	1	SI	0.412 ***	2.57	0.286 **	3.452	0.709	0.703 ***
		PV	0.495 ***	2.57	0.418 ***	2.89		
	2	Satisfaction			0.226 *	3.031	0.726	0.718 *

Notes: 1. PE = performance expectancy; EE = effort expectancy; SI = social influence; FC = facilitating conditions; HM = hedonic motivation; HA = habits; EP = environmental protection; PV = price value. 2. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. 3. VIF (variance inflation factor).

In model Y_{HA}, R^2 was significant in step 1 (F (3, 95) = 115.008, $p < 0.001$), accounting for 78.4% of the variance, while in step 2, there was an improvement over the earlier model, with an R^2 change of 0.809. Therefore, the change in R^2 was significant (F (5, 93) = 78.968, $p < 0.001$), indicating that the second set of predictors ("overall user satisfaction" and "I like to use shared scooters") could predict habits.

In model Y_{SI}, R^2 was significant in step 1 (F (4, 94) = 146.624, $p < 0.001$), accounting for 86.2% of the variance, while in step 2, there was an improvement over the earlier model, with an R^2 change of 0.868. Therefore, the change in R^2 was significant (F (5, 93) = 122.833, $p < 0.001$), indicating that the second set of predictors ($A_{private\ scooter}$) could predict social influence.

In model Y_{EE}, R^2 was significant in step 1 (F (4, 94) = 115.852, $p < 0.001$), accounting for 83.1% of the variance, while in step 2, there was an improvement over the earlier model, with an R^2 change of 0.871. Therefore, the change in R^2 was significant (F (5, 93) = 126.129, $p < 0.001$), indicating that the second set of predictors (overall user satisfaction) could predict effort expectancy.

In model Y_{PE}, R^2 was significant in step 1 ($F (3, 95) = 155.0$, $p < 0.001$), accounting for 83% of the variance, while in step 2, there was an improvement over the earlier model, with an R^2 change of 0.855. Therefore, the change in R^2 was significant ($F (5, 93) = 109.292$, $p < 0.001$), indicating that the second set of predictors (UX and $A_{private\ scooter}$) could predict performance expectancy.

In the Y_{EP} model, R^2 was significant in step 1 ($F (2, 96) = 116.838$, $p < 0.001$), accounting for 70.9% of the variance, while in step 2, there was an improvement over the earlier model, with an R^2 change of 0.726. Therefore, the change in R^2 was significant ($F (3, 95) = 84.095$, $p < 0.001$), indicating that the second set of predictors (overall user satisfaction) could predict consumer perception of "I would like the choice of shared scooters for environmental protection".

5. Discussion

5.1. Attitudes toward Scooters and UX of Shared Scooters

The influence of travelers' attitudes toward private scooters, shared scooters, and the UX of using shared scooters on users' acceptance of a scooter-sharing services was investigated. The results revealed that the provision of shared scooters in a specific small area may create opportunities for travelers to use them for short-distance trips, with 66.7% of travelers willing to accept the service and continue using it. Before using the shared scooters, the respondents tended to have a slightly positive attitude toward private scooters and shared scooters and had a slightly negative attitude toward introducing their own private scooter into the scooter-sharing service. Gender differences were found in the "whether I have a private scooter" item and attitude toward private scooters. Male respondents tended to have a private scooter and higher agreement with the item "I think I understand scooters well" than females. However, female respondents tended to have higher agreement with the items of "I spend a lot of time riding a scooter every day" and "I pay attention to information about scooters every day" than males. In addition, the analytical results from the UX of using shared scooters showed that 80% of the respondents agreed with its aesthetic, pragmatic, and hedonic qualities. Moreover, 68% of the respondents were satisfied with overall scooter-sharing services, and significant support was found for the Y_{BI} model, with goodness of fit. The model was successful in predicting behavioral intention toward using shared scooters. Five of Y_{BI}'s predicted relationships were supported, with habits, social influence, and "I would like the choice of shared scooters for environmental protection" contributing uniquely and positively to users' behavioral intention, and performance expectancy and effort expectancy contributing uniquely and negatively to behavioral intention. These results showed that attitudes and UX had no direct effect on behavioral intention toward using shared scooters. This study offers several suggestions based on the factors of habits, social influence, performance expectancy, effort expectancy, and "I would like the choice of shared scooters for environmental protection".

5.2. Behavioral Intentions toward Scooter-Sharing Services

Habit was the strongest predictor, suggesting that user-perceived habits regarding the use of a scooter-sharing service is the most important factor influencing behavioral intention to use shared scooters. This is consistent with the result found by Venkatesh et al. [16] that habits have significant relationships with intention to use. A habit is defined as the extent to which people tend to perform behaviors automatically because of learning [45]. Habit is measured as the extent to which an individual believes that the behavior is automatic [65]. Change in mobility behavior among the majority of people occurs gradually, especially because of the habitual nature of the everyday mobility decisions [66]. In this study, significant support was found for the Y_{HA} model, with goodness of fit. The Y_{HA} model successfully predicted habits toward shared scooters. Five of Y_{HA}'s predicted relationships were supported, with social influence, price value, "Overall user satisfaction", and "I like to use shared scooters" contributing uniquely and positively to habits toward shared scooters, and facilitating conditions contributing uniquely and negatively; social influence, price value, and facilitating conditions were classified as external environmental factors. The formation of a habit implies the delegation of control over behavior to the environment [67]. This means that the traveler's feelings of connection with the people who are important to them, awareness of the value between the perceived benefits of the service and the monetary costs of using them, and perceptions of the resources and support available to use the service all appear to be important factors in travelers' automatic responses to shared scooter usage. Although shared scooters apply IoT technology to the mobile app to replace the traditional scooter key and the behavioral mode of starting a shared scooter is very different from a private scooter, these factors do not negatively affect the formation of the habit of using shared scooters. The results indicated that the scooter usage experience of most respondents, comprising mainly university students, was not long (approximately 1–5 years). Moreover, it was found that potential users of shared mobility include young, educated, and wealthy individuals [30]. Further, young people have great potential to form mobility behaviors and habits in shared scooter usage. Several participants in this study identified some of the reasons for their unwillingness to form the habit of using shared scooters. Six respondents indicated that the Bluetooth connection quality between mobile devices and shared scooters is poor, which could negatively affect their willingness to use it. In addition, four other respondents stated that the location where the shared scooters were parked was far away from them. This could affect the possibility of long-term usage of the service. In other words, the Bluetooth connection quality and the location of vehicle placement for the sharing service play an important role. Placing a moderate number of shared scooters in the right place, for example, at a scooter-sharing station, by existing scooter parking, or near street furniture, lively hotels, attractions, and restaurants, may facilitate the sharing service, providing travelers with the best option for their journey. Once travelers have availed of the option to their satisfaction, meeting their requirement for short-distance travel will automatically trigger the behavior of shared scooter usage without conscious decision making. In such cases, the habit of using shared scooters has been generated. In addition, the rental fee of shared scooters also plays an important role in forming habits. Taking the promotion performance of Taipei's rental program of YouBike as an example, convenient service and low pricing were instrumental in forming the travelers' habit of riding bicycles in Taipei city. YouBike offered users a rental fee of USD 0.15 per half hour and free use for the first 30 min. Further, its bicycle rental program logged more than 20 million trips a year after the introduction of the bike-sharing service. Although YouBike breaks even on the program so far, the program gives the bike-sharing provider an opportunity to introduce potential customers to the benefits of cycling while building public goodwill toward its brand [68]. In contrast, the goal of a scooter-sharing service is to build a habit of shared scooter usage among travelers to replace private scooters. It is suggested that the rental fee of shared scooters must be lower than the price of buying a scooter and taking a taxi, and higher than the fee for boarding public transportation and using shared bikes/e-bikes. In addition, under the fluctuating gas price market, the relatively stable rental fee of shared vehicles may also become one of the factors influencing travelers to choose shared scooters. Younes et al. [69] indicated that a 1% increase in gas price increased shared e-scooter trips by 3.12%. As scooters are gradually eliminated in the future, travelers will naturally choose more convenient shared e-scooters. Consequently, e-scooters will replace scooters and the number of two-wheeled vehicles on the road will decrease as well. However, "Overall user satisfaction" and "I like to use shared scooters" are important moderator variables in predicting habit. This result is consistent with the finding of Verplanken and Orbell [70] that a habit is created by satisfactory repetition and automatic behavior. This means that once the scooter-sharing service satisfies the user, the habit of using the service may be generated by repeated usage.

Social influence's strong and direct impact on behavioral intention highlights that travelers' behavior is influenced by the way in which they believe others (e.g., family and friends) will view them as a result of having used the shared scooters. Social influence is similar to a subjective norm. Fishbein and Ajzen [71] asserted that both the attitude toward an action and subjective norm have an impact on behavioral intention, which in turn affects how people perform an action. Here, social influence is the degree to which a traveler perceives that people whose opinions they value can influence their overall behavioral intention to use shared scooters. Significant support was found for the Y_{SI} model, with goodness of fit. The Y_{SI} model was successful in predicting social influence for shared scooter usage. Five of Y_{SI}'s predicted relationships were supported, with facilitating conditions, habits, and environmental protection contributing uniquely and positively to social influence, and price value and "attitude toward private scooter" contributing uniquely and negatively. This means that travelers' expected benefits obtained from using shared scooters, perceptions of the resources and support available to use the services, and perceived habit of using shared scooters are important factors that positively and directly influence social influence. This study verified the positive and strong influence of social influence and habit factors on behavioral intention to use shared scooters. It is imperative for scooter-sharing service providers to strengthen the levels of habits and social influence to affect the subsequent levels of behavioral intention. Furthermore, social influence and habits have been found to have direct and positive influences on each other. The travelers perceived their image or status in their social group to be enhanced when using a scooter-sharing service, which can positively influence their habits toward using shared scooters. Allowing people who have an influence on the social community to promote two-wheeler sharing services, such as word-of-mouth or social networking, is suggested as a strategy to increase consumer acceptance of the services.

Travelers perceived "I would like the choice of shared scooters for environmental protection" to have a positive impact on behavioral intention, which suggests that awareness of the environmental benefit of scooter-sharing services may influence travelers' intention to use shared scooters. This is consistent with the result found by Flores and Jansson [23] that indicated that micro-mobility users have positive environmental attitudes toward shared vehicles and positive perceptions toward the environmental benefits of shared vehicles. In this study, significant support was found for the Y_{EP} model, with goodness of fit. The Y_{EP} model was successful in predicting travelers' agreement levels with "I would like the choice of shared scooters for environmental protection". Three of Y_{EP}'s predicted relationships were supported, with price value, social influence, and "Overall user satisfaction" contributing uniquely and positively to perceptions of "I would like the choice of shared scooters for environmental protection". This means that travelers' feelings of connection with people who are important to them, awareness of the value between the perceived benefits of the service and the monetary costs of using them, and perceptions of satisfaction with the scooter-sharing service appear to be important factors in travelers' decision making about using shared scooters in order to protect the environment. Previous studies have pointed out that increasing people's awareness of environmental protection, such as the dangers of pollution and the environmental conditions where they live, may alter their public behavior and lead them to behave more sustainably [72,73], motivating pro-environment behavior [74], efforts to reduce pollution [75], and green consumption [76], for example. With regard to motivating pro-environment behavior, when individuals perceive environmental problems as a societal issue and not as an individual responsibility, their environmental motivation increases. Since achieving sustainable behavior outcomes requires a large number of people to take collective action, applying collective intentionality to drive people to behave pro-environmentally is suggested [23]. With regard to green consumption, consumers who are aware of environmental protection will consider buying products or services with environmental benefits and will be willing to pay more for such products [77]. This study further verified that increasing travelers' awareness of the contribution of vehicle-sharing services to environmental protection may positively increase their behavioral intention toward using shared scooters. Further, it is suggested that the related promoting information should convey to travelers details about scooter reduction and environmental protection that is based on social responsibility to further increase their motivation to choose shared vehicles when they need mobility. This study further verified that increasing traveler awareness of the contribution of vehicle-sharing services to environmental protection may positively increase their behavioral intention toward using shared scooters.

Effort expectancy and performance expectancy had negative impacts on behavioral intention. The results revealed that the respondents tended to agree with the benefits of using shared scooters and how easy it is to use their smartphones for shared scooter usage. Several respondents explained the reasons for their unwillingness to use shared scooters frequently, even if they were satisfied with the benefits and ease of use of the scooter-sharing service. The results indicated that they were unsatisfied with the scooter quality (64%), the storage space of the scooters (27%), and the quality of the scooter-sharing service management (9%). In this study, the scooters were privately owned and provided by the general public. Thus, they were neither new nor specially designed for sharing services, and the scooter models could not be standardized. The use and depreciation status of each scooter were also different. The quality and kind of shared scooter that the consumers rode on thus depended entirely on luck. To ensure the quality of shared scooters, service providers must establish standard conditions to assess private scooters that want to join the service. For all private scooters that are used in the sharing service, in order to increase the efficient utilization of each scooter, different scooter conditions should be classified, and according to the classification, suitable charging fees should be arranged. Future studies are therefore recommended to assess consumer preferences, acceptable standards of scooter quality, and the charging standards for sharing services. In addition, Taiwanese traffic laws stipulate that a scooter can carry up to two people, and each passenger must wear a helmet. In this study, two helmets were placed in the storage space of each scooter to increase consumer convenience. However, such services have the problem of insufficient storage space when there is only one passenger and their purpose of riding the shared scooter is to purchase daily necessities in the nearby market, because the unused helmet takes up storage space. Another problem arose when, for various reasons, users did not return the helmets after using the shared scooters, meaning that the next customer was unable to use the scooter. During the study period, several cases of missing helmets were observed. When consumers cannot find the helmets in the storage space of the scooter, most of them will blame the problem on the management quality of the sharing-service provider. This highlights that scooter-sharing service providers have to design a mechanism to ensure that two helmets have been placed in the storage space of the scooter when consumers return the scooter.

5.3. Issues in Scooter-Sharing Services

During the period of this empirical study, several problems were discovered in addition to the issues of scooter quality, helmet management, and establishing the habit of keyless scooter usage mentioned above.

In urban areas, insufficient parking space for vehicles, such as cars and scooters, has always been a problem for the relevant government agencies. This study discovered that several shared scooter users decided to park the scooters indiscriminately on the street when they could not find free parking spaces. They were not worried about the possibility of damage to the scooter if parked indiscriminately. Moreover, they had a gambling mentality, betting that the scooter would be taken by another consumer before the traffic police issued a ticket for parking violations. Once a scooter gets a ticket, the workload of the scooter-sharing service provider increases since they must pursue the consumer for the cost. It is recommended that the app be integrated into the traffic police system to provide user information. This may help the traffic police to send issued violation tickets directly to the consumer. In addition, several users chose to park the scooter in a paid parking area when they could not find a free parking space and then returned the scooter on the app. As a result, the issue of "who should pay for parking fees" arises. Another issue was that no consumers were willing to rent out scooters parked in a paid parking area. This highlights the importance of finding a clear solution to the problem of payment attribution for parking.

In addition, it is recommended that vehicle-sharing service providers cooperate with local governments to plan exclusive parking areas for shared vehicles.

Road safety is a major concern worldwide as socio-economic costs related to traffic crashes create a significant burden for society. The major factors contributing to traffic crashes are human error, vehicle malfunction, and defects in the road environment. Most traffic accidents are caused by human failure [78]. To maintain road safety, it is important to find methods and measures to prevent road users from getting injured or killed [79]. Taiwanese traffic laws stipulate that only those aged 18 years or above and who have a scooter driver's license can ride a scooter on the roads and can apply for registration of shared scooter app services. However, this study found that even if the shared vehicle usage recommendations and instructions appear on the app before the start of the journey, several users who did not meet these qualifications were able to start and ride the shared scooters because they used their relatives' or friends' accounts for the app. To overcome this problem, the service provider tried to lock the accounts of the app to specific smartphones. However, this would cause insufficient flexibility in mobile services for shared scooters. As long as the app users are willing to lend their smartphones to other users who do not meet the requirements or have not yet applied for the app, the problem will remain. Such illegal riding of shared scooters is undoubtedly a potential risk factor for traffic safety and must be eliminated. It is suggested that shared vehicle service providers develop database systems that register users who default when using shared vehicles, for example, damaging vehicles, exceeding speed limits, unpaid journeys [10], or illegal riding. This is to facilitate the provider to manage usage and penalize users who flout road safety by canceling their right to use the shared vehicle service. In addition, travelers who have long-term or regular commuting needs will choose to buy scooters. Such travelers may ride their own private scooters frequently or regularly and have an understanding of traffic laws and riding experiences. By contrast, some users of shared scooters may lack experience in riding scooters on the roads and lack knowledge of the traffic laws. There are no dedicated lanes for scooters in Taiwan. In this regard, it is recommended that before vehicle-sharing services are implemented, a complete traffic safety plan, related transportation infrastructure and services, and detailed legal guidelines for shared vehicles be established.

Young and educated people are more inclined to use shared vehicles than older individuals. Many young Taiwanese people who have previously never owned a scooter are potential customers of new scooters or e-scooters. In this study, 53.5% of participants owned a scooter and were willing to adopt the shared scooter service for their short-distance mobility. If these students who owned a scooter may be motivated by extrinsic or intrinsic motivations to introduce their private scooters into sharing services, a large number of shared scooters will be created in a short period of time. This will lead to convenient access and meet the short-distance mobility demand in and around campuses. In such an environment, it helps to establish the habit of shared scooter usage among consumers. Moreover, it is expected to reduce the demand for purchasing new scooters by satisfying the demand for short-distance mobility. This also indicates the need to explore the factors that favor sharing of a user's own scooter.

6. Conclusions

This empirical research has developed and tested a successful model for a scooter-sharing service through the UTAUT2 framework. Attitudes and UX have no direct effect on travelers' intentions to use shared scooters. The findings strongly support the suitability of the UTAUT2 as a means for guiding the understanding of the factors involved in travelers' acceptance of shared scooters. Habits, social influence, performance expectancy, effort expectancy, and "I would like the choice of shared scooters for environmental protection" perceptions were found to play a crucial role in behavioral intention toward shared scooters. No differences were found by gender, "whether I have private scooter", "main means of transportation", attitude, overall user satisfaction, or UX in the model. The results provided strong evidence that habits and social influence are the main factors in using shared scooters. The attitude expressed by "I would like the choice of shared scooters for environmental protection" is the dominant construct in shaping travelers' decisions to adopt scooter-sharing services. In addition, habits and social influence have a positive influence on each other, and social influence has a positive influence on perceptions of "I would like the choice of shared scooters for environmental protection". This highlights the importance of strengthening travelers' perception levels of habits, social influence, and the environmental protection of scooter-sharing services to affect the subsequent levels of their behavioral intention.

The results also yield recommendations for design improvements to engage users more effectively to use scooter-sharing services. It is hoped that, when implementing more permanent versions of public shared micro-mobility services, designers and developers of scooter-sharing services will consider issues such as scooter quality, helmet management, establishment of habits of keyless scooter usage, insufficient parking space for vehicles, illegal riding of shared scooters, and the factors that favor sharing of a user's own scooter in order to maximize service uptake. Finally, directions for future research could include a study of the standards of shared vehicle quality and charging fees and a study of the adoption of scooter-sharing services comparing urban and rural travelers.

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