ISCTE Business School
Instituto Universitário de Lisboa

FROM THE ROOTS OF SHARING TO SHARED E-SCOOTERS PLATFORMS

FACTORS INFLUENCING USERS' ADOPTION

Diogo Brito Infante

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Supervisor:
Prof. António da Silva Robalo, Prof. Catedrático, ISCTE Business School,
Departamento de Marketing, Operações e Gestão Geral

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Resumo

O aumento do volume de tráfego urbano, o aquecimento global e as mudanças nos valores da sociedade, exigem uma reestruturação do desenvolvimento urbano. A partilha surgiu então como uma solução para a necessidade de uma evolução sustentável. As plataformas de mobilidade partilhada, alimentadas pelas tecnologias de comunicação e informação, têm vindo a transformar a maneira como nos deslocamos em meios urbanos. No entanto, a literatura referente a este tema é ainda limitada, e está fragmentada em estudos que exploram diferentes aspetos da mobilidade partilhada. Posto isto, esta tese de mestrado visa preencher a lacuna existente na literatura, explorando os fatores que influenciam a adoção de plataformas de trotinetes elétricas partilhadas pelo consumidor.

Assente em estudos passados, contruiu-se um modelo de investigação baseado nos princípios estabelecidos pelos modelos teóricos de *Technology Acceptance Model e Theory of Planned Behavior*. Com vista à recolha de dados, realizou-se um questionário online, do qual se recolheram 201 respostas. Consequentemente, as diferentes correlações entre as variáveis estabelecidas no modelo de investigação foram testadas, aplicando o modelo de equações estruturais.

Em suma, os resultados deste estudo indicam que *Subjective Norm* foi a variável que mais contribuiu para a intenção de adotar trotinetes elétricas partilhadas, seguida pela variável *Attitude*, que mostrou uma correlação similar. A variável *Perceived Behavioral Control*, por sua vez também mostrou influenciar, com menor intensidade a intenção dos usuários em adotar os sistemas partilhados. Por outro lado, e em contraste com o modelo de pesquisa, a variável *Perceived Usefulness* não contribui significantemente para a intenção em adotar a plataforma.

Palavras chave: Micromobilidade; Economia Partilhada; Comportamento do Consumidor; Technology Acceptance Model; Theory of Planned Behavior

JEL Classificação: C12 - Hypothesis testing; M20 - General

Abstract

The continuous increasing traffic volume, global warming challenges, and shift in urban society values, demand to rethink and forge a new framework of urban development. Sharing has emerged as one of the most proponent solutions for a principle of sustainable development to be embraced by the contemporary society. Fueled by information communication technologies, shared mobility transport platforms are drastically reshaping the urban landscape. Nonetheless, the literature on this topic is still limited to a few numbers of fragmented studies exploring distinct aspects of micromobility. Therefore, this research aims to fulfill this knowledge gap by exploring what factors are influencing the consumer adoption of shared e-scooter platforms.

Drawn from a theoretical established and relevant literature, a research model was built upon the frameworks of Technology Acceptance Model and Theory of Planned Behavior. Subsequently, empirical data was gathered from 201 contributors through a questionnaire and, the hypothesized relationships between the variables were tested employing Structural Equation Modeling (SEM). The results of this study indicate that Subjective Norm was the strongest predictor regarding intention to adopt shared e-scooters, followed by Attitude that revealed similar correlation toward intention, and Perceived Behavioral Control. In contrast to the designed research model, Perceived Usefulness does not contribute significantly to Behavioral Intention. Additionally, the results demonstrate that Perceived Usefulness and Perceived Ease of Use positively influence Attitude, as well as Perceived Ease of Use influences Perceived Usefulness.

Keywords: Micromobility; Sharing economy; Consumer behavior; Technology Acceptance Model; Theory of Planned Behavior.

JEL Classification: C12 - Hypothesis testing; M20 - General

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Glossary

BI- Behavioral Intention

CFA- Confirmatory Factor Analysis

E-Scooter – Electronic Scooter

ICT- Information Communication Technology

PBC – Perceived Behavioral Control

PEOU – Perceived Ease of Use

PU – Perceived Usefulness

SEM- Structural Equation Modeling

SN - Subjective Norm

TAM - Technology Acceptance Model

TPB – Theory of Planned Behavior

1. Introduction

1.1 Relevance of the topic

"The world of mobility is undergoing a tremendous transition. Traditional combustion engines are gradually being replaced by new electric drive concepts. Vehicle ownership is becoming less important and shared mobility services are on the rise. Micromobility shapes the future of urban transportation." (Krummel, Gernant, Stolt, Stolze, & Moschner, 2019).

According to the United Nation, two-thirds of the world population is projected to live in urban areas by 2050. Continuous increasing traffic volume, fossil fuels finiteness, climate change challenges, and shift in urban society values demand rethinking and forge a new framework of urban development. Understanding key trends in urbanization is crucial to implement a sustainable development.

In a world of limited resources and growing challenges, sharing has emerged as one of the most proponent solution for a principle of sustainable development to be embraced by the contemporary society. On the one hand, unsustainable resource consumption's problems are emerging, on the other hand new business opportunities are arising to promote and organize the sharing services (Matzner, Chasin, & Todenhöfer, 2015a). Internet technology establishes a basis for effective matchmaking between providers who own resources, and users who need them but do not want to own them (Matzner et al., 2015a).

In this context, the promotion of sustainable urban mobility concepts may play a key role for a moving toward a more sustainable future. The advances of internet platforms, smartphones and tablet applications, and the rise of social media platforms are becoming increasingly relevant in transport contexts, as they facilitate travelling and allow for co presence in the sharing of distant lives (Gössling, 2017).

The interrelationships of transport and Information Communication Technologies (ICT) have evolved over the last decades. This new mode of transportation has evolved from shared mobility systems such as car sharing, which can be accessed sequentially by multiple users on a pay per use basis to shared micromobility transportation systems. Shared systems are expected to promote environmentally friendly and efficient mobility.

Over the last two years micromobility services have drastically re-shaped the urban landscape of countless cities across the globe. The main concept behind micromobility is the unbundling of the car, instead of using one´s own automobile for every trip, users are encouraged to select a vehicle according to their needs (Krummel et al., 2019). The grow of micromobility market is astounding. It theoretically encompass all passenger trips of less than 8 kilometers, which account for as much as 50 to 60 percent of today's total trips in Europe, that are used to be accomplished by using car transportation (Heineke, Kloss, Scurtu, & Weig, 2019). The micromobility potential lies on connecting people to the existent transportation network, thus solving the widespread problem of first and last mile (Krummel et al., 2019). Nowadays in Portugal, global coverage companies, such as Lime, Bird and Jump, are looking forward to thriving efficiently by implementing their devices in the streets of major cities. Lime, a Californian platform was the first one stepping in Portugal, two months after starting operations, 53000 riders were already using the service (Lime, 2018). One year after, in October 2019, Lime has accomplished the number of 1.8 million rides only in Portugal (Peixoto, 2019), which leave us thinking about the immediate impact of this type platforms.

Micromobility platform providers are still a very young phenomenon, which leads to inconclusive effects between social, economic and environmental issues. The literature on this topic is limited to a few numbers of fragmented studies, exploring distinct aspects of this phenomenon. Some studies have investigated the impact of shared e-scooters on parking etiquette (Fang, Steele, Hunter, & Hooper, 2018), others explore the health impacts derived from the usage of such devices, with focus on riders injuries (Mitchell, Tsao, Randell, Marks, & Mackay, 2019), some focus on vehicle distribution optimization (Y. Chen, Cheng, Li, & Yu, 2018) and others on shared mobility patterns (Mckenzie, 2019). We are in position to conclude that the literature on micromobility topic is limited and lacks a framework for categorization and analysis of factors influencing users' adoption of shared e-scooter platforms. This research aims at filling this knowledge gap by exploring what factors are influencing consumer adoption of shared e-scooter platforms.

Mckinsey Center for Future Mobility have forecasted shared micromobility market for 2030, which revealed a market potential of $300 billion in the United Stated and $150 billion in Europe (Heineke et al., 2019). This trend brings a gigantic potential business market for platform providers. By understanding users' behavior, shared e-scooter

platforms can better address user needs, improving their mobility experience and attracting potential users to use the service. Hence, it is essential to learn how individuals accept the shared e-scooters systems.

This master thesis has the ultimate goal of answering the question: *What are the influencing factors on consumer Behavioral Intention when adopting shared e-scooters in Portugal?*

To answer the previous question, the authors pictured a theoretical research framework inspired by the association of Technology Acceptance Model (TAM), from Davis (1989) jointly with the Theory of Planned Behavior (TPB), from Ajzen (1991).

The study is consequently divided in an introductory part, followed by three main parts and a conclusion part. The introductory chapter presents the general developments in the scope of micromobility concepts and its drivers, and glimpses from sharing as new phenomenon. The second part of this chapter focus on understanding what is behind the research theoretical framework employed in this research, and which are the variables incorporated into the models. Chapter two describes the research methodology and data collection. Chapter three focus on data analysis and results, in this chapter the data collected (recurring to questionnaire), is analyzed by employing Structural Equation Modeling technique and hypothesized variables correlation are analyzed. Chapter four aims to interpret in a detailed way, the variables that have shown to be relevant for this study. Chapter five, the final chapter, exposes theoretical and practical implication emerged from this research, as well as limitation and future directions.

2. Literature Review

2.1 Domain definition and categorization of sharing

2.1.1 The evolution of micromobility

The early days of micromobility have already gone, since it was originated by 1960 in Europe. The first era of on demand micromobility started with bicycle sharing in Europe, when the Provo, a countercultural movement in Amsterdam launched the first community bicycle program. In 1995, the advent of rack locking technology brought new ways of business, namely in Copenhagen where a coin-based system was set up. This business model was the first large scale urban bike sharing with 1000 units to be implemented. Since then, a growing number of bikes sharing system have been developed and implemented all around the world (Krummel et al., 2019).

The second era of micromobility brought new innovations to the growing business, by introducing the free-floating cycle sharing or dockless systems. It was only possible with the advent of smartphone and GPS system. This new system became a gigantic phenomenon in China, where companies, such as Off and Mobike, spread thousands of bikes all over the main cities (Krummel et al., 2019).

The third era was originated with the addition of electrically powered vehicles as free-floating mobility devices. The novel shared e-scooters were introduced firstly in Santa Monica by Bird, a local start up. This new business model gained an enormous attention on a global scale, and it is seen as a solution to solve traffic problems around the main urban areas, while has shown its convenience for traveling users' in their first and last miles from home when compared to the existent transportation network (Krummel et al., 2019).

BCG consulting group estimated that the global market for shared e-scooters could potentially reach $40 billion to $50 billion by 2025 (Schellong, Sadek, Schaetzberger, & Barrack, 2019).

2.1.2 Drivers of Micromobility

According to Mckinsey Center for Future Mobility, shared micromobility has gained a tremendous momentum in the recent years. Since 2015, stakeholders have invested more than $5.7 billion in micromobility startups (Heineke et al., 2019). Micromobility was expanded from pedal and e-bikes to electric scooters, and cities around the world have begun to adapt and embrace this new approach to personal transportation. Three main micromobility drivers can be drawn: shared mobility momentum, technological innovation and millennials.

Shared mobility is known as the shared use of a vehicle, bicycle, or other mode. This innovative transportation strategy enables users to gain short term access to transportation, according to their demands (Susan, Nelson, Apaar, & Adam, 2015). New options for mobility have emerged, empowered by smartphone "apps" that aggregate several mobility options and optimize routes for travelers. Shared mobility has created a transformative impact on many global cities by enhancing transportation accessibility, while simultaneously reducing driving and personal vehicle ownership. Mckinsey Center for Future Mobility reported that urban consumers already value shared mobility, by incorporating it into their attitudes and transportation patterns. Car sharing, ride-hailing and bike sharing are examples of convenient and flexible ways to get around in increasing congested cities (Heineke et al., 2019). The climate of transportation innovation emphasized the shared systems and paved the way for micromobility sharing, by responding to the public's desire for cheap, efficient and convenient transportation systems (Schellong et al., 2019). Many travelers were already in touch with the innovative concepts emerged from the shared mobility, such as accessing and paying for shared mobility trips through a smartphone "app". It is argued that "this element has played a critical role accelerating the adoption of micro vehicles sharing" (Chang, Miranda-Moreno, Clewlow, & Sun, 2019).

Technological systems have revolutionized the transportation scenario. Advances in Information and Communication Technologies (ICT), alongside with hardware innovation, have change the landscape of cities' transportation systems (Gössling, 2017). Micromobility platforms, taking advantage of cutting-edge technologies and setting up a dockless system, have gained popularity as an alternative mode of travel. This device is characterized for having a long-range autonomy, light heavy and affordable manufacture

price, comparing with other sharing solution (e.g. car sharing). Additionally, by recurring to innovative technologies, such as internet of things (IoT), GPS, smartphone application, cloud storage and mobile payment technologies, shared e-scooters platforms are transforming how travelers' access to transportation systems. The ubiquity and affordability of these technologies are facilitating the access by matching effectively supply and demand (Chang et al., 2019).

The final driver of micromobility is the millennial factor. Millennials (those born between 1982 and 2000) are largely raised and educated in the internet era, and driven by the ubiquity availability of technology, which makes them the first generation of digital natives (Chang et al., 2019). Millennials' behavior is influencing prevalent changes in the consumer behavior in general. For instance, this generation has shown patterns related with lower purchases of cars, houses, and luxury goods, reflecting how lifestyle and mobility patterns have shift over time. Growing shared mobility awareness, coupled with increased accessibility of public transportation networks, are helping to draw a new demanding for travelling (Gössling, 2017). According to the world's leading shared e-scooter platform lime, the average age of lime's riders is 32 years, which set millennials as the main actors in the micromobility scenario (Lime, 2018).

2.1.3 The emergence of "sharing"

There is no "shared" consensus of what "sharing economy" is about (Codagnone & Martens, n.d.). Terms like "sharing economy", "peer economy", "collaborative economy" are often being interchangeable and overlapped, causing misunderstanding (Bardhi & Eckhardt, 2012; Botsman, 2015).

As the "sharing economy" sector expands, boosted by Information and Communication Technology (ICT), a fracturing understanding of what it actually is, and what it is not, emerged. Due to its novelty, "sharing economy" is an economic system that is constantly evolving and has been associated with other economic systems.

Nowadays, innumerous organizations have been eager to position themselves under the "umbrella" of the sharing economy, while on one hand, it would trigger a positive symbolic meaning of sharing in the consumer feelings, on the other hand, it has biased a truly and shared definition of what if sharing economy (Schor, 2017).

"Shifting values, a drive for innovation, and the realization that our resources are not unlimited have motivated changes in the economy" (Posen, 2015). "Sharing economy" is now encompassing everything from multi-billion dollar companies to a free durable good sharing sites (Schor & Attwood-Charles, 2017). It finds, over the last years, the possibility of collaboration offered by internet-based applications, and has become a buzzword thanks to a number of applications which, among other things, boosted the rise of consumption without necessary ownership (Arcidiacono, Gandini, & Pais, 2018; Botsman & Rogers, 2010).

While, the popular arena has rapidly and enthusiastically embraced this idea as one with revolutionary potential, conflicting aspects have become evident and critical voices have emerged (Arcidiacono et al., 2018). Critics have pointed out to undesirable effects, such as platform monopolies, privacy violations (Frenken, Meelen, Arets, & Van de Glind, 2015). Over the intense debate and criticism, innovators, regulators and academics are trying to come up with solid and realistic definitions of what sharing economy is.

Cambridge Dictionary states, sharing economy consists in "an economic system that is based in people sharing possessions and services, either for free or for payment".

The advancement of Information and Communication Technology (ICTs), such as smartphones, Internet of things and big data, radically scale up the transportation network ecosystems, changing the spectrum and matching location of transportation systems. This platforms are characterized by diverging from traditional services, connecting users through two-sided platform-based marketplaces, providing exactly what customers want when they want through response, matching supply and demand in real time (Kim, Park, & Lee, 2019; Rayle, Dai, Chan, Cervero, & Shaheen, 2016).

Advocators of shared transportation networks look at it as providing fast, flexible and convenient mobility in metropolitan areas as well as an alternative to fill up gaps in the public transportation system, having important environmental benefits associated (Nugraha, n.d.; Rayle et al., 2016).

2.2 Theoretical Frameworks

2.2.1 Technology Acceptance Model (TAM)

Introduced by Davis (1986), TAM attempts to predict the likelihood of an individual or organization successfully adopting a new system of technology, by explaining the users' behavioral intention to use a given technological innovation. The model was grounded in the theory of reasoned action (TRA) developed by Fishbein & Ajzen, (1975).

While TAM has the capability to explore a system usage by an individuals' performance of a specified behavior, TRA is determined by users' behavioral intention to perform a given behavior, which is jointly influenced by people's attitude and subjective norm toward that behavior in question. Consequently, TAM is more suitable to be applied in technological contexts , where it aims to "describe the external factors affecting internal attitudes and use intentions of users and through these, to predict the acceptance and use of a system" (Salovaara & Tamminen, 2009), contrarily to TRA whose focus has a limited scope to Attitude and Subjective Norm.

TAM include and test two core beliefs influencing behavioral Attitude toward the usage of information systems: Perceived Usefulness and Perceived Ease of Use. Perceived Usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job" (Davis, 1989). On the other hand, Perceived Ease of Use refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). Consequently, the previous drivers respectively determine the users' subjective probability of using a specific technology application (Davis, Bagozzi, & Warshaw, 1989; Lai, 2017). Widely used in the information system area, TAM is characterized by its robustness, understandability and simplicity (Hu, Chau, Liu Sheng, & Tam, 1999; King & He, 2006).

In the earlier days, TAM was examined and investigated successfully regarding its validity, by testing the research theory on M.B.A student's acceptance of a word processor application, as well as testing the theory toward an e-mail system and word editor by employees at larger commercial organization (Davis, 1989; Davis et al., 1989). Recently, TAM has been successfully studied to predict/explain behavioral intention for IT acceptance studies (Min, Kam, So, & Jeong, 2018; Pavlou & Fygenson, 2006). Additionally, results from previous studies suggested that TAM is able to deliver

individually adequate explanation and/or prediction of user acceptance of IT systems (Hu et al., 1999). Nevertheless, various considerations need to be taken in account to emphasize limitations and weaknesses that have been pointed out by several researchers in the last years.

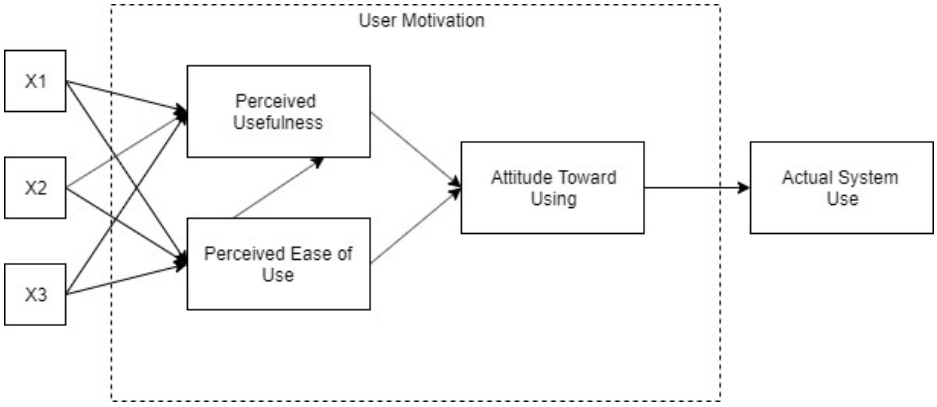

Figure 1: Original TAM proposed by Davis (1986)

- **Extension of the Technology Acceptance Model**

The original TAM aimed to access the effects of external variables on intention to use Information Technology systems, mediated by Perceived Usefulness and Perceive Ease of Use (Davis, 1986).

Davis et al. (1989), later, redefined the original model with the aim of adding a new variable, Behavioral Intention. Additionally, it was hypothesized a new line of correlation between variable Perceived Usefulness and variable Behavioral Intention, meaning if the system is meant to be useful to the user, he/she will develop a solid intention to use it. The new construct arose with the aim of mediating the relationship between attitude and the actual behavior.

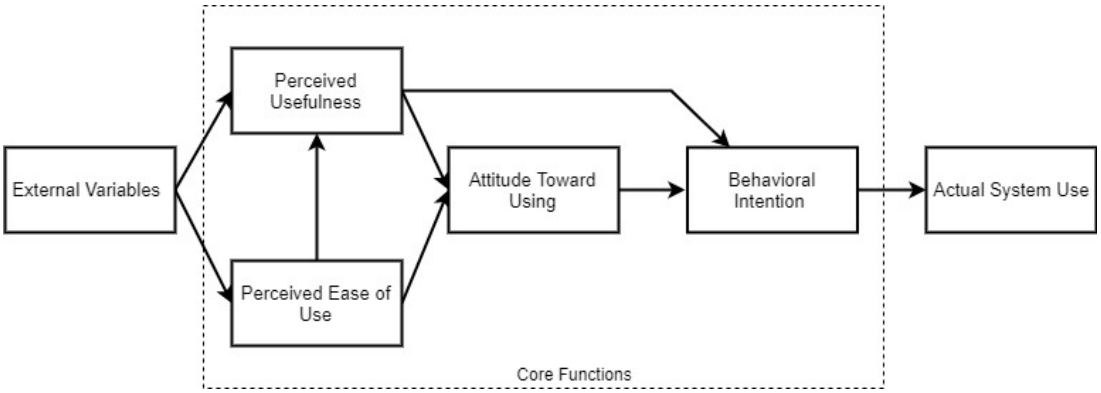

Figure 2: Modified TAM Davis et al. (1989)

A further development was made by Davis & Venkatesh (1996). The authors worked toward modifying the previous TAM, by removing the variable Attitude since they reach the conclusion that this variable has a minor role in the system usage behavior. It was named as the final version of TAM.

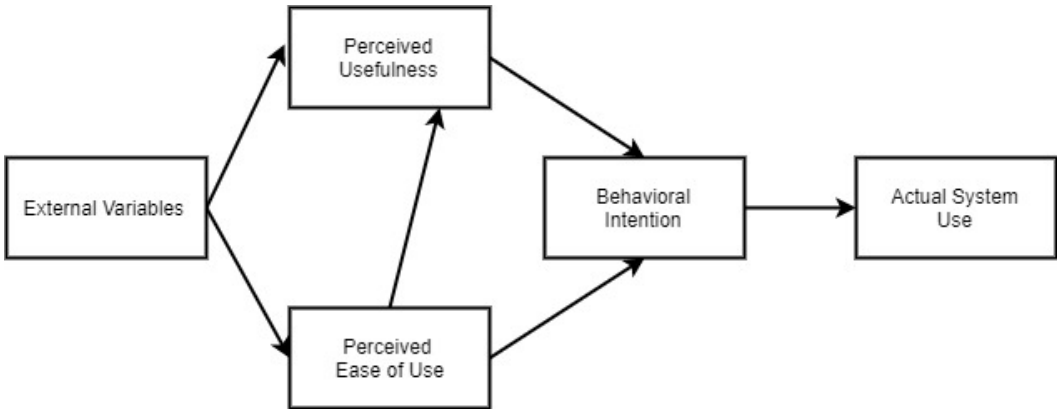

Figure 3: Final version of TAM Davis & Venkatesh (1996)

Since then, other researchers followed the lead, by applying, revising, and extending TAM to different contexts within the technology system usage. Numerous studies have proposed extended models of TAM. Venkatesh & Davis (2000), worked together to come up with an extension of the final TAM, proposing what is called TAM2 as a new version of TAM, with emphasis on the incorporation of new determinants of Perceived Usefulness, such as image, job relevance, output quality and result demonstrability. Taylor & Todd (1995) proposed an integration between TAM and TPB, providing an hybrid model to study potential users of a computer resource center. Venkastesh et al.

(2003) suggested the Unified Theory of Acceptance and Use of technology (UTAUT). Chen et al. (2009), projected an integrated model designed to predict and explain an individuals' continuous use of self-service technologies based in the concepts of technology readiness (TR), TAM and Theory of Planned Behavior (TPB). Lin, Yu, & Sher, (2007), presented a study which integrates technology readiness into Technology Acceptance model to study the consumer adoption of e-commerce.

In a different fashion, several researchers sought to add new constructs into the Technology Acceptance model as proposed by Davis (1989) . Benbasat & Barki (2007), pointed out some additions that have made in their TAM extended model. They include constructs such as, trust, self-efficacy, job relevance, information quality, personal innovativeness, and so forth, aiming to overcome several limitations that TAM has shown, as well as to capture the increasing evolution of IT's environment.

Over the years, it is notorious the versatility of TAM, emphasized in dozens of different types of information systems, from communication systems (e.g. e-mail), general purpose system (e.g. computer, internet, e-commerce), office systems (e.g. database programs, word processor) to specialized business systems (e.g. hospital systems) among others (Y. Lee, Kozar, & Larsen, 2003).

- **Limitations and criticism of TAM**

TAM is qualified as a remarkable model within the field of Information systems. The model has been used by countless different researchers with focus on diverse research purpose. (Lee et al., 2003). Due to its widely appliance, dysfunctional outcomes were reported by researchers.

Theoretical concerns alongside with methodological doubts testing TAM were raised. Self-reported data usage is pointed out as one of the most commonly reported limitation, in which most of TAM research has been done by employing self-reported use of data. It is known that self-reported may raise biased outcomes, also distorting and overstating the casual relationship between independent and dependent variables (Y. Lee et al., 2003).

The second limitation contributing to the biased outcome is the tendency to predict or describe the behavior in an narrow manner, by examining only one information system with a homogeneous group of subjects on a single task at a single point of time (e.g. Davis

& Venkatesh, (1996)). Most studies focused on cross-sectional assessment, i.e. at a specific point of time, and since users' perception may change over time, it is advantageous applying the study at several points of time (Benbasat & Barki, 2007; Y. Lee et al., 2003).

The third limitation regards the short exposure to the technology before testing. When TAM is applied to a new technology, users may lack of knowledge about which components of the particular technology are indeed perceived to be more useful than others (Benbasat & Barki, 2007; Y. Lee et al., 2003).

The fourth limitation concerns the fact of TAM does not cover social influences and facilitating conditions of its development and implementation (Bagozzi, 2007; Benbasat & Barki, 2007).

Finally, the changing context of information technologies appliances "from a single system use in an organization context, to multiple users communicating via technologies through inter-organizational systems " (Benbasat & Barki, 2007) , exposed limitation of TAM's constructs of PU and PEOU as the cornerstone in capture individuals' perception. For instance, beliefs, such as trust, cognitive absorption and social presence, are increasingly becoming more important. Consequently, to overcome the present limitation researchers have sought to add constructs to the model for better accessing the changing scenario (Benbasat & Barki, 2007).

2.2.2 Theory of Planned Behavior (TPB)

Projected by Ajzen (1985, 1991), Theory of Planned Behavior (TPB) has its origins in the Theory of Reasoned Action (TRA) from Fishbein & Ajzen (1975).

The refinement of TRA gave origin to TPB, which acted as an extension by adding an additional construct of perceived control behavior. This new variable was included, since users do not have a full volitional control and might have incomplete control over intended behavior, as a result of unstable and uncontrollable external context. Thus, the new construct aimed to overcome limitations of the original TRA, by examining and predicting human intentions in situations where individuals might lack control over their own behavior (Sommer, 2011). Hence, the major divergence between TRA and TPB is the addition of a third determinant regarding to perceived behavioral control.

The main objective of social-psychological TPB theory is to access individual´s intention to perform a given factor. Behavioral intention is expected to account for the motivational factors that influence a given behavior, i.e. "the stronger the intention to engage in a behavior, the more likely should be its performance" (Ajzen, 1991).

The conceptual model of TPB lies on three independent determinants influencing behavioral intention: Attitude, Subjective Norm and Perceived Behavioral Control. Attitude toward behavior, refers to the degree to which a person a person has a favorable or unfavorable evolution or appraisal of the behavior in question. Subjective norms state the individuals' perception of the social pressure to adopt the technological system. Finally, perceived behavioral control, refers to the individuals' perception of ease or difficulty of adopting the technological system (Ajzen, 1985, 1991; Matzner, Chasin, & Todenhöfer, 2015b). Consequently, "the more favorable the attitude and subjective norm and the greater the perceived control, the stronger should be the person's intention to perform the behavior in question" (Ajzen, 2002).

Taylor & Todd (1995), as cited in Baker (2012), argued that TPB has been the dominant theory against other competing models in predicting and explaining human behavior. It is focused on information system research, once it provides more information to explain individuals' behavior as well as a complete understanding of the phenomena as it includes variables with very different conceptual scope. For instance, TPB is gaining tremendous momentum on technology implementation and adoption, being successfully adopted by several information systems research areas, such as: online communities, internet banking, e-commerce, and so forth (C. Chen, Fan, & Farn, 2007; Matzner et al., 2015b; McEachan, Conner, Taylor, & Lawton, 2011; Webb, Joseph, Yardley, & Michie, 2010).

- **Criticism and weaknesses toward TPB**

Some researchers advocate that TPB evidence some weaknesses. It is argued , TPB lacks of explanatory power of testing different contexts of information systems (e.g. Benbasat & Barki, 2007). Further, it disregard moderator variables, such as habits, emotions and beliefs, since it is assumed that behavior has a rational foundation (Ajzen, 1991).

Additionally, the model is silent concerning the dependent variable, existing the need to better conceptualize system usage, to incorporate broader perspectives of what users

actually do with the system. A broader perspective of what individuals do with information technologies may include variables related to users' adaptation, learning and reinvention of behavior, which may help to understand the effects on the salient variables, such as individual performance, and whether it is under a mandatory or voluntary context (Benbasat & Barki, 2007; Jokonya, 2017).

To overcome the underlying limitations, Benbasat & Barki (2007) proposed to broaden the model perspectives by decomposing the constructs of the TPB along with others theories within the field of information system, to reach the technological side along with social perspective. Thus, the expanded behavioral view of information systems may include a more realistic representation by having a strong connection with salient outcomes variables, such as individual performance, and its applicability to both voluntary and mandatory usage contexts.

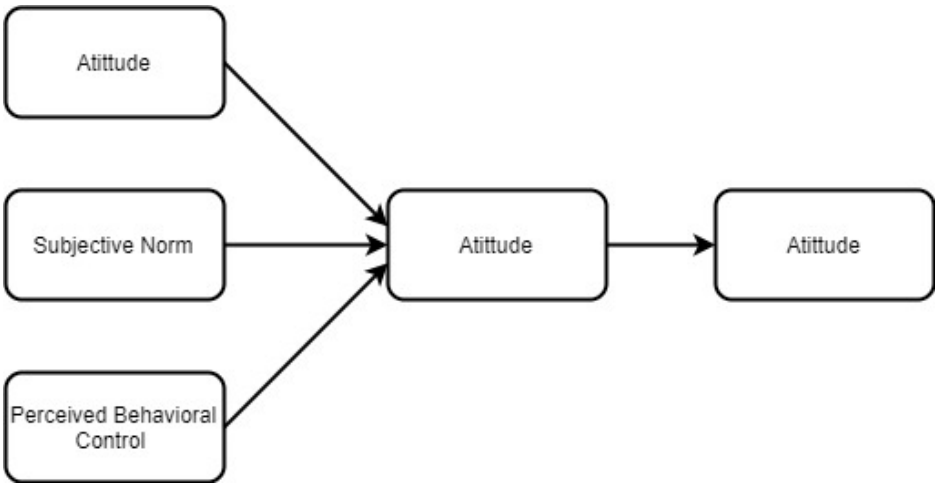

Figure 4: Theory of Planned Behavior adapted from Ajzen (1991)

2.3 Research Framework and Hypothesis Development

To examine the factors influencing users' adoption of shared e-scooter systems in Portugal, this research set up a research framework originated from two established theoretical frameworks: Technology Acceptance Model jointly with Theory of Planned Behavior.

Taylor & Todd (1995), who studied both TAM and TPB models separately, argued that TAM specifies the general determinants to anticipate individuals' behavioral intention to use a new technology. On the other hand, behavioral intention toward technologies cannot be explained solely by cognitive influences accessed by TAM, once studies have evidenced that both personal and social factors have the ability to influence users' interaction with new technologies (Chau & Hu, 2002; H. Chen & Chen, 2009). For this reason, TAM constructs should be incorporated jointly with TPB variables to set up a hybrid and unbiased research framework to access both cognitive and social factors derived from technology usage (Chau & Hu, 2002; C. Chen et al., 2007; H. Chen & Chen, 2009; S. Taylor & Todd, 1995).

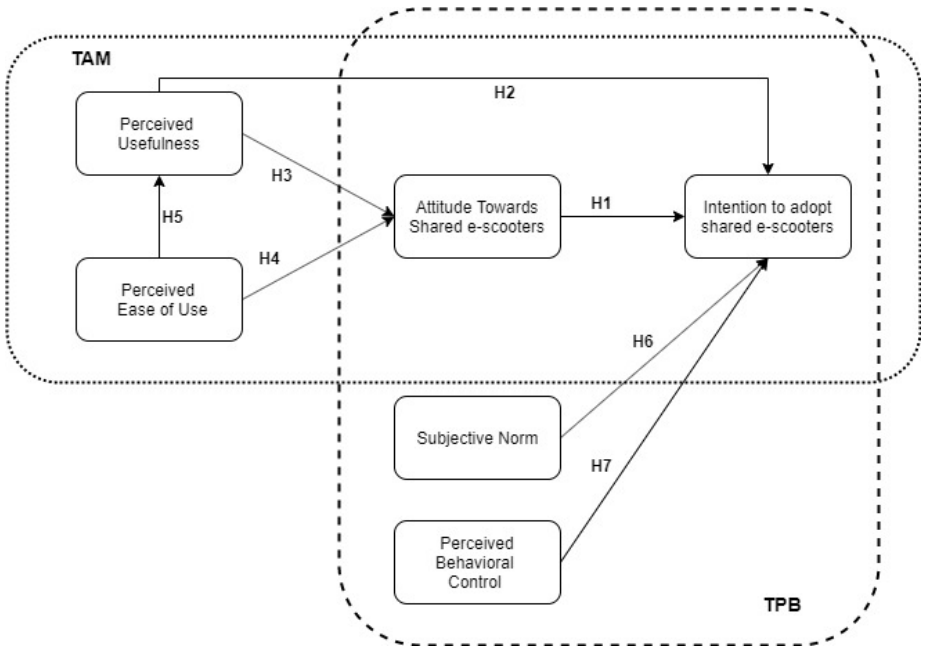

Figure 5: Research Framework adapted from Davis (1989), Ajzen (1991), Taylor & Todd (1995), Chau & Hu (2002)

- **Attitude (ATT)**

Attitude towards using technological systems share boundaries between TAM and TPB frameworks, being overlapped by both models. According to TPB model, Attitude, refers " to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (Ajzen, 1991). TPB model establishes, that Attitudes towards behavior is preceded by behavioral beliefs, whereby users tend to form inner beliefs about the consequences caused from a given behavior performance (Ajzen, 1991; Baker, 2012). Those beliefs differ from an individual to another and have a strong impact by influencing Attitudes toward behavior. Raised on individuals' background where personal traits (such as personality, behavioral characteristics and mentality) play an important role (Baker, 2012), human beings have tendency to favor behaviors with positive and desirable outcomes (Ajzen, 1991).

On the other hand, TAM establishes that Attitudes toward a new technological system are consequences of behavioral beliefs represented by Perceived Usefulness and Perceived Ease of Use (Davis et al., 1989). Based on previous studies, we can argue that the more positive the users' Attitude toward the system, the higher the users' intention to use the system (Davis, 1989; S. Taylor & Todd, 1995)

H1: Attitude towards shared e-scooters has a positive influence on intention to adopt shared e-scooters.

- **Perceived Usefulness (PU)**

Perceived Usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). It underlines the essence of what is behind the usefulness of something. A system with a great Perceived Usefulness is the one in which a user believes in the existence of a positive user performance relationship. Related studies have shown that the more the user believes his/her usage performance will be enhanced after using a new system, the more he/she will be willing to use such system (Yousafzai, Foxall, & Pallister, 2007a). Moore & Benbasat (1991), argued that perceived characteristics of usefulness are more relevant than the primary characteristics of the innovation itself. Since, different adopters might

perceive these primary characteristics in a different way (e.g. price cost is a primary attribute, perception of cost is a secondary attribute).

A technology system is perceived to be useful, when users, by using it, feel their performance on a given task being enhanced. Hence, and following previous studies, Perceived Usefulness positively influences individuals attitude (Chau & Hu, 2002). Additionally, Davis (1989) found a direct link between Perceived Usefulness and Behavioral Intentions. This linkage was empirically supported in a research where normative feelings were connected to individuals' Behavioral Intention (S. Taylor & Todd, 1995). It was shown, that "individuals may develop intentions to use a technology because they perceive it as useful for their job performance, socially important, or convenient even though they do not enjoy using the technology" (Yousafzai, Foxall, & Pallister, 2007b).

H2: Perceived Usefulness has a positive influence on intention to adopt shared e-scooters.

H3: Perceived Usefulness has a positive influence on Attitude towards adoption of shared e-scooters.

- **Perceived Ease of Use (PEOU)**

Davis (1989) characterized Perceived Ease of Use as the "degree to which a person believes that using a particular system would be free of effort", and he goes through the etymological definition of "ease", asserting it as " freedom from difficulty or great effort".

PEOU is closely related to self-efficacy theory from Bandura's (1982), who argued that individuals' judgment, with regard of how well they can execute a given action, requires an introspective analysis (Davis & Venkatesh, 1996). A system self-efficacy is known by its impact on key determinants of a system acceptance, thus it is important to effectively manipulate a system usability to increase the acceptance rate of it. A system perceived as ease of use is likely to increase users acceptance, once they will feel confident using it (Davis & Venkatesh, 1996). Additionally, familiarity with IT appliances is likely to result in an increased acceptance of a technology, and a positive perception of technology's ease of use may lead to strengthening of a positive attitude toward using the technology which, in turn, favor the intention to adopt technology systems (Chau & Hu, 2002). On the other

hand, a technology known as perceived ease of use will positively affect user´s opinion regarding its usefulness (Venkatesh & Davis, 2000).

Previous researchers have found key advantages of understanding what is behind PEOU, to guide users' perception toward users' intention to adopt a given technological system.

H4: Perceived Ease of Use has a positive influence on Attitude towards shared e-scooters.

H5: Perceived Ease of Use has a positive influence on Perceived Usefulness.

- **Subjective Norm (SN)**

Subjective norms refer to the "social pressure of the of the external environment surrounding the individuals on whether to perform a behavior or not, and how family and friends would affect his perception of whether to behave in a certain way or not" (Baker, 2012). It is originated on individuals' normative beliefs in which the likelihood of important referent others approves or disapprove a given performance from individuals' behavior. For instance, referent others may vary among individuals, including family, friends, coworkers, experts, public figures, influencers and so forth. "The strength of each normative belief is multiplied by the person's motivation to comply with the referent in question" (Ajzen, 1991). According to Mathieson (1991), users' motivation to comply with referent others, regards the extent to which the person want to address the wishes of the referent other. Following SN vein and, since individuals are supposed to develop social bonds as members of social networks, normative beliefs are intended to influence users behavior (e.g. reviews from referent others) (Matzner et al., 2015b).

The positive effect of SN in Behavioral Intention is consistent with positive findings from previous researches (Bock, Zmud, Kim, & Lee, 2005; S. Taylor & Todd, 1995).

H6: Subjective Norm has a positive influence on intention towards adoption of shared e-scooters.

- **Perceived Behavioral Control (PBC)**

The construct Perceived Behavioral Control was established in an attempted to deal with scenarios where individuals may lack of complete vocational control over the desired

behavior (Ajzen, 2002). It refers to " one's perceived ease or difficulty of performing the behavior of interest" (Baker, 2012). Thus, Ajzen (1991), states that the actual resources and capabilities a person possesses, dictate the likelihood of behavioral achievement.

Control beliefs deal with the absence of required resource, opportunities and skills to perform a behavior (e.g. adoption of a technological system). Rooted in users' past experiences with the behavior, control beliefs are also influenced by secondhand experiences (experiences with family, friends or even key events in users life) (Mathieson, 1991). Ajzens (1991) claims that " the more resources and opportunities individuals believe they possess, and the fewer obstacles or impediments they anticipate, the greater should be their perceived control over the behavior" (Ajzen, 1991), and consequently the greater the intention to adopt the system. (Chau & Hu, 2002; S. Taylor & Todd, 1995). Higher levels of perceived ability over resources will lead to higher levels of behavioral intention toward a technological system.

H7: Perceived Behavioral Control has a positive influence on intention towards adoption of shared e-scooters.

- **Behavioral Intention**

The construct of behavioral intention, jointly to attitude's construct, are transversal to both models of TAM and TPB. Behavioral intention is assumed to capture the motivational factors that influence individuals' behavior. As stated by Ajzen (1985), behavioral intention is a general indication of an individual readiness to perform a given behavior, and it is expected to change over time.

In sum, intention can be viewed as " how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior" (Ajzen, 1991). The greater the intention to perform a given behavior, the more likely should be its performance (Mathieson, 1991; S. Taylor & Todd, 1995). Therefore, and according to the research framework, the greater Attitude towards shared e-scooters, Subjective Norm and the stronger Perceived Behavioral Control, the more favorable individuals' intention to adopt shared e-scooters should be.

Table 1 Hypothesis summary

Hypothesis summary	
H1	Attitude towards shared e-scooters has a positive influence on intention to adopt shared e-scooters.
H2	Perceived Usefulness has a positive influence on intention to adopt shared e-scooters.
H3	Perceived Usefulness has a positive influence on Attitude towards adoption of shared e-scooters.
H4	Perceives Ease of Use has a positive influence on Attitude towards shared e-scooters.
H5	Perceived Ease of Use has a positive influence on Perceived Usefulness.
H6	Subjective Norm has a positive influence on intention towards adoption of shared e-scooters.
H7	Perceived Behavioral Control has a positive influence on intention towards adoption of shared e-scooters.

3. Research Methodology

3.1 Research approach /objectives

The research approach either concerns with theory testing or theory building and has a direct impact on the research design. The Literature on the research approach (or reasoning) is built upon two contrasting approaches: deductive or inductive. In alternative, research approach can be abductive, which consists in both approaches mixed (Saunders, Lewis, & Thornhill, 2016).

Deductive reasoning occurs when the "research conclusion is derived logically from a set of theory-derived premises (…)" (Saunders et al., 2016). Using the existent literature, the researcher deduces a testable number of prepositions. Prepositions are defines as "a statement about phenomena (concept) that may be judge as true or false" (Cooper & Schindler, 2014a). After that, propositions must be tested by collecting appropriate data to measure and analyze the concept, and thus by the end, prepositions must be either supported or denied with regard to the existing theory (Saunders et al., 2016).

The present research aims to explore the factors influencing consumer adoption based on a deductive approach. Firstly, relevant academic literature is extensively examined, a research framework is built according to the existing theory, and propositions are formulated for empirical testing. Consequently, the authors test the hypothesis by examining the existent correlations between variables. By the end, the theory must be supported or denied.

Inductive approach is used when the available literature is very limited or inexistent. The conclusions are drawn from one or more particular facts and thus, generating untested conclusions. Contrasting to deductive approach, data collection is used to explore a phenomenon and patterns, in order to create a conceptual framework (Saunders et al., 2016).

3.2 Research purpose

The purpose of a research varies according with the nature and the objective of the research project. A study can follow either an exploratory or a conclusive approach.

The primary purpose of exploratory researches is to provide insights about a topic which is not studied yet or when a researcher lacks a clear idea of the problems surrounding the study, and the answers may not offer a conclusion to the perceived problem. While exploratory studies focus on gaining insights about the unknown, conclusive research aims to describe a specific phenomenon, aiming to test specific hypothesis and to examine relationships. It is based on representative samples and the data collected is subjected to quantitative analysis (Malhotra & Birks, 2006; Saunders et al., 2016).

In order to address the research question, the present study follows a conclusive design. Since at this point there is already evidences from previous studies covering individuals' intentions to use a novel technology, which have made references to TAM and TPB model.

Conclusive design, in turn, can be divided into two distinct research approach: descriptive and explanatory. Descriptive research has its purpose on gaining an accurate profile of events, persons and situations. Descriptive studies are normally concerned to find out *who, what, where, when or how* a subject population has certain characteristics as well as discover the degree of association among different variables in a correlational way. On the other hand, explanatory studies establish causal relationships between variables, emphasizing a situation or a problem in order to explain relationships between variables (Cooper & Schindler, 2014a; Saunders et al., 2016).

The purpose of this thesis research project is to gain insights on consumers intentions to adopt shared e-scooters. Therefore, this study must follow a descriptive research, in which, associations between different variables such as Perceived Usefulness and perceived ease of use onto attitude toward shared e-scooter must be demonstrated.

3.3 Research design

Research design is a framework for conducting the research, it specifies the details concerning the methodological choice in which the research should be founded.

The first methodological choice a researcher deals with, is whether to follow a quantitative, qualitative or a mixed approach research design method.

Both quantitative and qualitative can be dissociated among them, by distinguishing between numeric data (e.g. statistics) and non-numeric data (e.g. words, images, footages) (Saunders et al., 2016).

Quantitative approach is normally associated with deductive approach, in which the ultimate goal is to get use of data to test an underlying theory. On the other hand, it may also be used to funding theory development. Therefore, the current research underlines a quantitative research approach, where the relationship between hypothesis (variables) are examined, being measured by numerical data and analyzed using a range of statistical data (Saunders et al., 2016). When using quantitative approach, the researchers attempt to measure the precision of something by describing, explaining and predicting events. It must be generalizable and replicable. On the other hand, quantitative approach focuses on depth understanding and interpretation of events.

The researchers use deductive hypotheses, these hypotheses underline existing subjects regarding a particular domain. Hypotheses are formulated and then examined with base on quantitative methods by gathering data from the population, recurring to a sample technique. To gather the necessary data, the researchers use a single data collection technique, an online questionnaire, also known as mono quantitative research tool. (Malhotra & Birks, 2006).

The reason for choosing quantitative methods in detriment of others concerns the fact of fulfilling the purpose of the research, which is to access consumer intention to use shared e-scooters by using pre-established models. Over the years, both models have been used in innumerous quantitative studies with regard of attitudinal and behavioral researches covering several distinct fields: electronic tolls (C. Chen et al., 2007); electronic commerce (Pavlou & Fygenson, 2006), car sharing (Kim et al., 2019), and so forth.

3.3 Data collection

3.3.1 Method of data collection

In order to collect the fundamental data to support the research, an online self-administered questionnaire was designed and administered. “The self-administered questionnaire is ubiquitous in modern living” (Cooper & Schindler, 2014a), and attempts to reach a close approximation of the reality. Questionnaires are usually associated with deductive research approach and it tends to be used for descriptive researches (Saunders et al., 2016).

Although this research used questionnaire as research instrument, there are other survey techniques, namely structured observation, structured interviews, telephoning interviewing, among others. The questionnaire method with structured questions was preferred over the remain methods, since it allows to collect standardize data from large populations with limited time and resources (Cooper & Schindler, 2014a).

In addition, the questionnaire was designed using the online platform google forms, which, compared with the traditional paper addressed questionnaires, offers considerable benefits, such as money saving, effectiveness in data collection, smooth interface with other data processing platforms (e.g. SPSS), and enabling the respondents to remain in anonymity.

Finally, the questionnaire was administered via online platforms, more precisely WhatsApp groups, Facebook groups, and other social media platforms. This strategy seems to fit with the target population which sits under 35-year smartphone users.

3.3.2 Instrument design

The questionnaire was designed to be self-completed in a structured way, meaning that the questions are pre-specified regarding to the response alternatives and the response format without getting in direct contact with the researchers. The research instrument was originally developed in English and then translated to Portuguese, once the target population is Portuguese native, making the communication easier.

The research instrument was design in accordance with the data which needed to be collected, adapting questions that were used in past questionnaires in topic-related

studies. The original scale items were taken from previously studies covering information system research field and reworded to include the topic of consumer intentions to use shared e-scooters. By adopting questions from past questionnaires, the reliability and validity of the research instrument can be assessed, reducing the risk of developing our own questionnaire (Saunders et al., 2016).

The questionnaire was introduced by presenting a simple introduction, since it was important that all respondents had a clear understanding about the purpose of the ongoing study. Further, a brief explanation about shared e-scooters was made in order to acknowledge the respondents who did not get in touch with phenomenon.

The research instrument is divided in two main sections. While the first section specifies the scope of the research, the second section, beside collecting classification questions, aimed to address the investigative questions of the study. Investigative questions consist in 5 target variables: Perceived Usefulness, Perceived Ease of Use, Attitude, Subjective Norm, Perceived Behavioral Control, and Behavioral Intention. Each target variable ranges from 3 to 5 structured closed-ended questions.

Except classification questions, where category questions are used so that each respondent answers can fit only one category, the remain questions were measured in a 5-point Likert-style scale. This type of measure was largely used by previous studies on new technologies adoption, in which the respondents are asked to rate their perceptions according with a 5-point rating scale ranging from strongly disagree to strongly agree.

Table 2 Instrument design of research variables

Construct	Code	Item	Source
Perceived Usefulness	**PU1**	Using shared e-scooter, would allow me to move more quickly.	(Davis, 1989)
	PU2	Using shared e-scooter, would improve my mobility performance.	
	PU3	Using shared e-scooters would be beneficial in financial terms.	
	PU4	Overall, I would find shared e-scooter useful in mobility process.	
Perceived Ease of Use	**PEOU1**	I would find easy to set up the shared e-scooter provider application	(Davis, 1989)
	PEOU2	I would find easy to manage how to use a mobile device to spot and unlock the shared e-scooter.	
	PEOU3	I believe that it would be easy for me to become a competent driver of shared e-scooter.	

	PEOU4	I would find shared e-scooter to be a flexible mean of transport.	
	PEOU5	Overall, I would find shared e-scooter easy to use.	
Attitude	**ATT1**	I believe it would be a good idea to use shared e-scooter in my mobility.	(S. Taylor & Todd, 1995) (Kim et al., 2019)
	ATT2	I believe would be positive to be able to use shared e-scooter as my mobility mean.	
	ATT3	I believe using shared e-scooter is a wise idea.	
	ATT4	Overall, I have a positive attitude toward shared e-scooter.	
Subjective Norm	**SN1**	People who are important to me, think that I should use shared e-scooter.	(S. Taylor & Todd, 1995) (Bhattacherjee, 2000)
	SN2	The People I know would think that using shared e-scooter is a good idea.	
	SN3	I would use shared e-scooter if my friends were already using it.	
	SN4	I would be influenced to use shared e-scooter if I saw it on social media.	
Perceived Behavioral Control	**PBC1**	I believe that I would be able to use shared e-scooter on my own.	(S. Taylor & Todd, 1995) (Bhattacherjee, 2000)
	PBC2	I believe that I have the knowledge, resources and the ability to use shared e-scooter.	
	PBC3	I believe that using shared e-scooters is entirely within my control.	
	PBC4	I would feel safe when using shared e-scooters.	
	PBC5	Overall, I am capable of using shared e-scooter.	
Behavioral Intention	**BI1**	I intend to use shared e-scooter in the future.	(Kim et al., 2019) (Bhattacherjee, 2000)
	BI2	I would consider using shared e scooter rather than any other transportation mean.	
	BI3	I intend to use shared e-scooter as much as possible.	
	BI4	I intend to recommend others to use shared e-scooter.	

3.3.4 Population and Sampling Design

The basic idea of sampling is, by picking some of the elements in a population, the researchers may draw conclusions about the entire population (Cooper & Schindler, 2014). While population is the total collection of elements who share common characteristics comprising the universe for the purpose of the research problem (Malhotra & Birks, 2006), the target population of the present research should take into account the

target elements, who are characterized by possessing the information whom the researcher has targeted. Therefore, this study targets individuals who live in Portugal, possessing a smartphone device and living in urban environments. Which means, an individual wishing to ride a shared e-scooter necessarily must own a smartphone to find and unlock the e-scooter.

The elements of sample are selected in accordance with probability or nonprobability procedures. The probability sampling is based on the assumption of random selection, in which a regulated procedure assures that each element is known nonzero change of being selected. This type of sampling relies heavily on change. Conversely, non-probability sampling is arbitrary and subjective, where each member of the population may be "judge" arbitrarily or consciously selected by the researcher and does not have known change of being included in the sample. In a nutshell, the main difference between both sampling methods concerns whether the samples are based on random assumption or not (Cooper & Schindler, 2014).Thus, the present study uses non probability sampling, since the researchers have interference on the process, by "selecting" the respondents individually.

Finally, the distribution of the questionnaire followed convenience and snowballing sampling techniques. Convenience sampling attempts to obtain a sample of convenient elements, whereby the researchers have a direct impact on the sampling element´s selection. Moreover, with regard to snowballing sampling, an initial group of respondents are selected by the research to answer the questionnaire and immediately are invited to refer the questionnaire to other respondents, possessing similar characteristics and who, in turn, identified others (Cooper & Schindler, 2014).

The questionnaire was distributed via WhatsApp, Facebook groups and Facebook messenger.

3.3.5 Time horizon

The questionnaire was introduced following a cross-sectional study design. This type of study is carried out once and represent a snapshot of one point in time. Whereas longitudinal studies involve a fixed sample population elements which are studied repeatedly over time, longitudinal studies provide several views of the same sample and

viewed together enable investigator to access the changes occurred whilst the study was carried out.

The present study was carried out on November 26, 2019 and closed on December 6, 2019.

3.4.3 Pilot test

A pilot test was conducted days before the questionnaire being made available to the public. It aimed to test the questionnaire on a small sample of respondents to identify and consequently solve potential problems (Malhotra & Birks, 2006). According to Saunders et al. (2016), the pilot sample size is small, hence the minimum number to be relevant must be 10 respondents, although it can vary according to the targeted sample size.

The pilot test reached 10 respondents who belonged to the targeted population. The respondents were selected in accordance with different demographic and personal characteristics, in order to cover respondents with different backgrounds.

After the administration of the questionnaire, the pilot respondents were interviewed to collect the valuable feedback. The pre study revealed several weaknesses regarding the repetitive nature of some questions, in which the respondents were not able to dissociate one question from the following ones, emphasizing that several questions were asking the same matter. The repetitive nature of several questions led respondents to answer all the questions with the same answer. Therefore, amendments were carried out by rewording the problematic questions in a more detailed manner.

In addition, the questionnaire was initially drafted in English and then translated to Portuguese language by the researchers and subsequently reviewed by a person who works in the translation field. Hence, there were no reported problems in understanding the questionnaire language.

4. Data analysis and results

4.1 Data collection and sample characteristics

A total of 201 individuals were successfully selected as eligible for this study from a universe of 208 questionnaires answered. As shown in table 3, among a population of 201 individuals, 95 respondents were men (47,5%) and the remain 106 respondents were belonging to the female counterpart (62.5%). The biggest portion of the respondents represented 18-24 years old group corresponding to 66,7% of total population followed by 25-30 group (18,9%), >35 (11,9%) and 31-35 (2,5%) years old group. The majority of the eligible populated reported to be either studying or working, accounting respectively 46,3% and 41,3%.

When asking the respondents about previous experience with shared e-scooters, 43,3% of the eligible respondents reported previous usage of shared e-scooters system. In the opposite way, 56.7% answered negatively, reporting no prior experience.

Finally, the ones who reported previous experience with shared e-scooters, 54% claimed only tried once shared e-scooter system, 34,5% reported that get use of shared e-scooters only several times a years and 11,5% pointed out that used ride shared e-scooters several times a month.

Table 3 Demographic characteristics of the respondents

Characteristic	Criteria	Frequency	Percent (%)
Gender	Male	95	47,3
	Female	106	62,7
	Total	201	100
Age	18-24	134	66,7
	25-30	38	18,9
	31-35	5	2,5
	>35	24	11,9
	Total	201	100
Occupation	Student	93	46,3
	Student and Employed	11	5,5
	Employed	83	41,3
	Self employed	7	3,5
	Other	7	3,5
	Total	201	100
Previous experience with shared e-scooters	Yes	87	43,3
	No	114	56,7
	Total	201	100
Shared e-scooter ride periodicity	Several times a month	10	11,5
	Several times a year	30	34,5
	Only tried it once	47	54
	Total	87	100

4.2 Data analysis and results

To analyze the data, SPSS statistics 26 and AMOS 26 were employed. As a statistical modeling tool, Structural Equation modeling (SEM) was applied, using the software package AMOS 26. SEM is a "general term that has been used to describe a large number of statistical models used to evaluate the validity of substantive theories with empirical data" (Lei & Wu, 2007).

SEM present three key characteristics: estimation of multiple and interrelated dependence relationships; ability to represent unobserved concepts in these relationships, accounting for measurement error in the estimation process; and focus on explaining the covariance among the measurement items (set of relationships) (Hair, Black, Babin, & Anderson, 2014).

The data analysis was consequently divided in two steps procedure, in which the measurement model was firstly examined for instrument validity and reliability, resulting in a refinement of the model. Followed by analysis of the structural model investigate the strength and direction of the relationships among the theoretical constructs hypothesized in table 1.

4.2.1 Measurement model

The measurement model is used to validate the research instrument through confirmatory factor analysis (CFA) procedure. It specifies the measurement theory showing how constructs are operationalized by a set of measured variables. Essentially, a pre validated scale is employed to specify how sets of measured items represent a set of constructs specifying the number of variables forming each construct. CFA is employed to test whether à priori theoretical pattern of variables loading on prespecified constructs i.e. variables loading on specific constructs represents the actual data or not. It enables the researchers to either reject or confirm pre-conceived theory (Hair et al., 2014).

The hypothesized research model is built up by 26 variables (items) that are attached to 6 constructs: Perceived Usefulness, Perceived Ease of Use, Attitude, Subjective Norm, Perceived Behavioral Control and Behavioral Intention.

A previously used scale was applied to technology related studies, being adjusted to the environment of shared e-scooters. According to the procedures stated by Hair et al. (2014), a researcher should consider how all of the individual constructs will come together to form an overall measurement model. The measurement model was grounded by underlying the assumptions of unidimentionality and reasonable number of items per construct. Unidimentionality measures established that a set that measured variables i.e. indicators can be explained by only one underlying construct. Moreover, good practices regarding minimum items per construct establishes a minimum of three significant items (indicators) per construct, preferable four, in order to provide adequate identification for the construct.

- **Measurement model validity**

The measurement model validity depends on establishing acceptable levels of goodness-of-fit for the measurement model and finding specific evidence of construct validity.

The basic goodness of fit encompasses three type of measures: absolute measures, incremental measures, and parsimony measures. The common rules set that using three to four fit indexes provides adequate evidence of model fit, thus it was recommended to report at least one incremental index and one absolute index, in addition to the chi square ($\chi 2$) value and the related degree of freedom (Hair et al., 2014; Schreiber, Stage, King, Nora, & Barlow, 2006). Following the common rules, the researchers decided to use the indexes reported in table 4.

Table 4 Model fitting indices

Fit Indices	Recommended values	Measurement model	Structural model	Reference
Chi-square	-	334,9	375,9	
Chi-square/df	≤ 3	1,444	1,586	
RMESA	<0,06	0,048	0,054	
TLI	>0,90	0,97	0,96	(Schreiber et
CFI	>0,90	0,97	0,96	al., 2006)

Table 4 report goodness of fit tests resulting from both measurement and structural model. Overall, the majority of the test exceeded the recommended cutoff level regarding the model fit, indicating a very good fit between the model and the observed data.

Following the guidelines of goodness of fit, the next procedure aims to examine the construct's validity. Construct validity is the extent to which a set of measured items reflects the theoretical latent construct those items are assigned to measure (Hair et al., 2014)

The criteria underlying validity is made up of two main components: convergent validity and discriminant validity. Convergent validity specifies that a given construct should converge or share high proportion of variance in common.

Three steps criteria to access convergent validity establishes were employed:

(1) Standardized loadings estimate (λ) should be 0,5 or higher and ideally 0,7 or higher.

(2) Average variance extracted (AVE) should exceed 0,5 or higher.

(3) Construct reliability should be 0,7 or higher to indicate adequate internal validity.

Discriminant validity is the extent to which a construct is truly distinct from other constructs, emphasizing uniqueness of the construct. Hence, AVE estimates for two constructs should be greater than the square root of the correlation between the two constructs.

Table 5 displays standardized regression weights (loading estimates). The loading estimates present relatively good values. The lowest loading obtained is 0,584 linking behavioral intention to item BI2 and the highest loading is 0,926 connecting behavioral intention to item BI4. Overall, the average items are loaded above 0,7, which is indicator of good estimation of the latent variables (constructs). Moreover, the statistical significance of the individual items, predicting the main constructs are also based on the ratio of the parameter estimate to its standard error (t-value). As a common rule, absolute value, of this ratio t-value should be greater than 1,96 to be considered significant.

Table 6 exhibits the remain indexes regarding construct validity. The average variance extracted (AVE) ranged from 0,557 to 0,784, exceeding the 0,5 cutoff rule. Construct reliability (CR) ranged from 0,833 to 0,922, which suggest an adequate reliability of the construct by exceeding the cutoff value of 0,7 presenting, also, adequate internal validity. While discriminant validity measure, is shown when the square root of each construct's AVE is larger than its correlations with other constructs. As illustrated, in Table 6, all AVE estimates are greater than the corresponding inter-construct squared correlations. Therefore, discriminant validity was also met. In addition, maximum shared variance (MSV) is lower than AVE, which represent a measure of acceptable discriminant validity.

Table 5 Factor loading estimates and t-values

Observed variable	Latent construct	Standardized factor loading	Standard Error (SE)	t-value (C.R)
PU1	PU	0.870	*(a)*	*(a)*
PU2	PU	0.899	0.062	16.450
PU3	PU		**(Deleted)**	
PU4	PU	0.816	0.063	14.025
PEOU1	PEOU	0.886	*(a)*	*(a)*
PEOU2	PEOU	0.840	0.050	19.926
PEOU3	PEOU	0.916	0.052	19.554
PEOU4	PEOU	0.884	0.049	17.714
PEOU5	PEOU	0.899	0.050	18.324
SN1	SN	0.886	*(a)*	*(a)*
SN2	SN	0.819	0.067	12.863
SN3	SN	0.756	0.080	11.239
SN4	SN	0.696	0.084	10.225
AT1	ATT	0.839	*(a)*	*(a)*
AT2	ATT	0.836	0.066	14.637
AT3	ATT	0.894	0.064	15.952
AT4	ATT	0.886	0.066	15.796
PBC1	PBC	0.654	*(a)*	*(a)*
PBC2	PBC	0.752	0.124	8.734
PBC3	PBC	0.722	0.137	8.233
PBC4	PBC		**(Deleted)**	
PBC5	PBC	0.842	0.133	9.264
BI1	BI	0.700	(a)	(a)
BI2	BI	0.584	0.101	9.195
BI3	BI	0.904	0.114	11.810
BI4	BI	0.926	0.121	11.924

Note: (a) not estimated when loading set to fixed values (i.e.,1.0).

Table 6 Model validity and reliability measures

	CR	AVE	MSV	MaxR(H)	SN	PU	PEOU	ATT	PCB	BI
SN	0,866	0,619	0,291	0,880	**0,787**					
PU	0,897	0,744	0,428	0,903	0,382	**0,862**				
PEOU	0,948	0,784	0,311	0,950	0,231	0,440	**0,885**			
ATT	0,922	0,747	0,428	0,925	0,508	0,654	0,514	**0,864**		
PCB	0,833	0,557	0,311	0,848	0,156	0,310	0,558	0,316	**0,746**	
BI	0,866	0,626	0,326	0,923	0,539	0,431	0,294	0,571	0,347	**0,791**

Note:
1. The main diagonal shows the square root of the AVE
2. Significant at p<0,01 level is shown below diagonal values

Furthermore, the items PU3 and PBC4 were deleted, according to their poor performance based on modification indexes. In addition, poor loading and trouble in reaching a proper unidimensionality, were also noted.

In a nutshell, the model solution is believed to be proper since there were not reported out-of-range fit indexes values, and both convergent and discriminant validity were confirmed.

4.2.2 Structural model

In the previous step we tested the fit and construct validity of proposed measurement model, grounded upon TAM and TPB literature and then tested recurring to confirmatory factor analysis procedure by measuring the covariance between all measured items. Once, a suitable measurement model was obtained, we hit the second step by testing the structural theory. The following stage involve testing validity of the structural model, and its corresponding hypothesized relationship between latent construct as shown in the research framework (Figure 6).

While measurement theory, tests how well the indicator variables of theoretical constructs relate to one another, the structural theory is a conceptual representation of the structural relationships between constructs (set of structural equations) (Hair et al., 2014).

- **Structural model validity**

Once a research theory is proposed, the first step is specifying the measurement theory and validating it with CFA. After that, the structural underlying theory is specified and embodied by a set of structural relationships between constructs that were previously hypothesized.

To assess the structural model validity, a comparison between structural model and CFA model is made. The comparison of structural model fit to the CFA model aims to access the degree to which the structural model decreases model fit due to its specified relationships. The structural model fit is accessed by employing the same guidelines as the CFA model.

A similar set of fit indexes was used to examine structural model. Table 4 display the outcome of the fit indexes. It shows the results were quite similar comparing with previous analysis CFA's fit. In addition, it is required the chi-square ($\chi 2$) from structural

model to be higher than the chi-square from CFA model. The measures are within the range that would be associated with good fit, suggesting a good overall fit.

- **Hypothesis testing**

Table 7 present standardized path estimates, alongside to, standard error of its correspondents t-values. The majority of the hypothesis were supported, except H2 that reveled values with low significance, meaning that the significance is below the critical level of 0,05 i.e. p>0,05. Hence, Although the estimate is in the hypothesized direction, it is not supported.

In a detailed manner, Intention to adopt shared e-scooter is predicted positively by attitude (H1; β= 0,345; t= 3,651; p<0,01), in addition to, Subjective Norm (H6; β= 0,350; t=4,788; p<0,001) and Perceived Behavioral Control (H7; β=0,174; t=2,384; p<0,05) . In other words, for every unit increase in Attitude, Subjective Norm and Perceived Behavioral Control, its effects would contribute respectively 0.345, 0.350 and 0.174 units increase in Behavioral Intention. Furthermore, among these positive associations, Subjective Norm is the one having strongest effect on the intention to adopt shared e-scooter (β=0,350).

For the other hand, Perceived Usefulness (H3; β=0,527; t=7,133; p<0,001) and Perceive Ease of Use (H4; β=0,282; t=4,211; p<0,001) are positively correlated with Attitude, being in this way, important antecedents in forming attitude toward shared e-scooters adoption. Moreover, the Perceive Ease of Use is having a positive influence on Perceive Usefulness (H5; β=0,447; t=5,967; p<0,001), showing evidences that Perceive Ease of Use promote Perceived Usefulness towards shared. Meanwhile, Perceived Usefulness (H2;β= 0,051; t=0,560; p>0,05) failed to having influence toward Behavioral Intention, meaning that this hypothesis was the only one being rejected in this research.

Table 7 Path validation results

Hypothesis	Path	Estimate (β)	Standard Error	t-value	Result
H1	ATT→BI	0,345	0,067	3,651	Supported
H2	PU→BI	0,050	0,066	0,560	Not supported
H3	PU→ATT	0,527	0,076	7,133	Supported
H4	PEOU→ATT	0,282	0,070	4,211	Supported
H5	PEOU→PU	0,446	0,075	5,967	Supported
H6	SN→BI	0,350	0,041	4,788	Supported
H7	PBC→BI	0,174	0,062	2,384	Supported

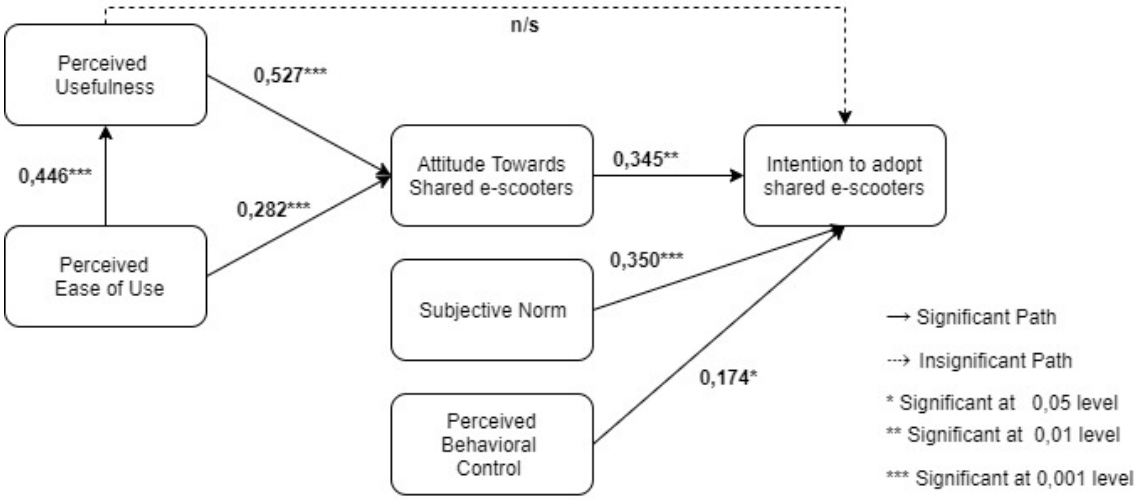

Figure 6 Standardized path estimates for the structural model

5. Empirical findings

5.1 Validity of Theory Applied in Empirical Context

The present study aims to reveal insights on the critical antecedents of shared e-scooters users' intention regarding its service adoption by integrating both TAM and TPB theoretical frameworks. Overall, the explanatory strength of the research was accessed, and the majority of the hypothesis were confirmed.

The research model was drawn from the established model of TAM pulled out from the human behavior literature regarding the users' acceptance and usage of technology, this theory models how users accept and use a given technology (Davis, 1989). In addition, TPB model, grounded in the psychological field, was used to predict individuals' intention to engage in a specific behavior over which people has the ability to make use of its self-control (Ajzen, 1991). Both models were employed as a complimentary of each other. Since, TAM is more suitable to capture individuals' behavior intention's regarding technology side and, for the other hand, TPB suits more on human behavior intention to perform a given behavior.

The models were employed in a research context aimed to draw conclusion about the novel technology of shared e-scooters system in Portugal. Therefore, the main purpose of this research is to reveal the factors that contribute to users' intention of share e-scooters regarding its service adoption.

Firstly, the analysis of Constructs reliability revealed that measurement concepts of Perceived Usefulness, Perceived Ease of Use, Attitude, Subjective Norm and Perceived Behavioral Control reach an internal consistency over 0,85 which a very good measure. Using previous instrument questions help to reach such a good internal consistency, reveling that the measurement instruments employed by Davis (1989), S. Taylor & Todd (1995), J. Schor (2017) and Bhattacherjee (2000) were suitable to research users' adoption of shared e-scooters.

Secondly, the correlations between concepts (constructs) were checked by analyzing the strength of each path illustrated in the path diagram. Using a covariance matrix as input, the relationship between any two concepts is equal to the parameter estimate between those two constructs. Out of all included concepts, only Perceived Usefulness did not

influence Behavioral Intention, alongside with Perceived Behavioral Control. In accordance with previous findings from diverse author this outcome may diverge across distinct research fields.

In the following section, the underlying factors correlation strength (table7) will be analyzed in detail and possible explanation will be made, alongside with previous research findings.

5.2 Interpretation of Factors Influencing Users Intention toward shared e-scooters

5.2.1 Attitude

Variable Attitude is a common predictor of both underlying models (i.e. TPB and TAM) and it is described in the literature as "individuals' positive or negative feelings about performing the target behavior" (Yousafzai et al., 2007a). In this research, Attitude (H1; β= 0,345) was found to be the second most significant determinant of Behavioral Intention with almost similar strength as Subjective Norm variable does (H6; β= 0,350). Both Perceived Ease of Use and Perceived Usefulness variables are part of TAM framework, being successfully confirmed as predictors of Attitude, which in turn, was successfully confirmed as predictor of behavioral intention. Respectively, Attitude, is also, part integrant of TPB framework jointly to Subjective Norm, Perceived behavioral Control. This findings are supported by Yousafzai et al. (2007b), whose research focus TAM meta-analysis research. Essentially, Attitude's variable evidence that, most of the characteristics, that leads to the behavior intention, primarily come from internal individuals' characteristics. For instance, are referred as internal characteristics of Attitude, predictors with reference to usefulness and easiness of shared system adoption.

Our findings suggest the similar strength of Attitude and Subjective Norm toward Behavioral Intention. Prior studies found the similar evidence, for example Bhattacherjee (2000), who did a research about e-commerce services found, a significance strength of Attitude and Subjective Norm, toward Behavioral intention, respectively β=0,486 and β=0,482. Similar, results were reported by C. Chen et al. (2007), in a research about electronic tolls systems, it was found, that Attitude could positively influence Behavioral Intention to adopt the system as strongly as Subjective Norm does.

- **Perceived Usefulness**

Perceived Usefulness is part of TAM framework, being hypothesized in the research model as positively predicting both Attitude's variable and Behavioral Intention's variable.

Research findings revealed that Perceived Usefulness appeared to have no direct influence on users' intention to adopt shared e-scooters (H2; β= 0,050), failing to corroborate the previous hypothesized path. Although, it can indirectly influence Behavioral Intention through variable Attitude as hypothesized in the research model. This outcome may be explained by the novelty of the shared e-scooter system in which users are still in their initial stage of adoption, trying to discover more about the usefulness of the service. This finding is consistent with C. Chen et al. (2007) and H. Chen & Chen (2009), whose research focus, was the implementation of a new technology and, besides us failed to confirm the correlation between Perceived Usefulness and Behavioral Intention. Consequently, the hypothesis H2 is rejected.

On the other hand, Perceived Usefulness appear to have a considerable impact on user´s Attitude (H3; β=0,527). In particular, our findings are consistent with a meta-analysis research, which indicated the strength correlation of Perceived Ese of Use is much weaker than the relationship of Perceived Usefulness toward Behavioral Intention (Yousafzai et al., 2007b). Others also emphasized similar results (e.g, Chau & Hu (2002); Kim et al., (2019)). Furthermore, shared mobility devices appear to be useful (e.g. flexibility, accessibility, speed) to the ones who adopt them, this evidence may cause direct impact on users' perception, being corroborated by several studies (Chang et al., 2019; Hardt & Bogenberger, 2018).

- **Perceived Ease of Use**

The importance of users facing a convenient service is underlined by a significant influence of Perceived Ease of Use factor on users' Attitude (H4; β=0,282). Following evidences from Davis & Venkatesh (1996), it is stated that, a user-specific system characteristic have a significant impact on key determinants of acceptance. Further, this correlation emphasizes user-usability positive significance, by which shared e-scooter users are perceived as possessing a reasonable, and positive knowledge about the system.

Additionally, the significant correlation between variables, may be supported by the system effortless usability tools, which have enabled a friendly usage of the shared devices. This issue may be addressed by the universal system-like usability of shared e-scooter platforms (e.g. combination of GPS and cellular connectivity to whichever vehicle is being rented and charging users by the minute and immobilizing the device wherever it is left at the end of the trip) as stated by Hern, (2018). On the other hand, the current study research found a considerable strength between variables of Perceived Ease of Use toward Perceived Usefulness (H5; β=0,446), this correlation uncovers individuals' performance benefit by adopting the shared system and is supported by previous studies (C. Chen et al., 2007; M. Lee, 2009).

The latter findings, reveal that users' perception of easiness and usefulness of shared e-scooter systems may indirectly lead to their intention to adopt the system through their Attitude as indicated by Yousafzai et al. (2007b). Moreover, we found the effect of Perceived Usefulness on Attitude greater than that of Perceived Ease of Use [(H5; β=0,527) > (H3; β=0,282)]. This evidence is supported by Yousafzai et al. (2007b) in a TAM meta-analysis which uncovered similar evidence through more than 100 TAM related studies. Further, this evidence was also proved empirically by C. Chen et al. (2007), Bhattacherjee, (2000), and Kim et al. (2019) in their researches, in which the effect of Perceived Usefulness on Behavioral Intention was greater than that of Perceived Ese of Use. Even though, Perceived Ese of Use might not be important in determining the level of use of a system, however, it may influence the initial decision to adopt a system in voluntary usage context. Consequently, its importance may be relevant, when targeting student samples (Yousafzai et al., 2007b).

5.2.2 Subjective norm

Subjective Norm variable appear to be the most significant variable influencing directly Behavioral Intention (H6; β= 0,350). Interestingly, current finding are not in accordance with those from Armitage & Conner (2001) who did an meta-analysis review with focus on TPB. However, this research found different results, and goes in line with Bhattacherjee, (2000) who found similar findings regarding the substantial correlation between Subjective Norm and Behavioral Intention, suggesting it's the key importance to adopt sharing e-scooters systems.

A study from S. Taylor & Todd (1995), have shown that Subjective Norm strength, may be affected by the phase of implementation of the technology. It was found, Subjective Norm being more important in the early stages of system implementation when users have only limited experience using the technological system and was more important predictor for people without prior experience (C. Chen et al., 2007; S. Taylor & Todd, 1995). In particular, the subject of this study i.e. shared e-scooter, where introduced recently in Portugal during the year of 2018. Hence, the shared system is still at its maturing stage. Additionally, consumer studies, suggest that in the absence of firsthand experiences with a product or service, individuals may rely on secondhand opinions for deciding among behavioral choices. Secondhand experiences may be an efficient, inexpensive, and convenient way of forming intentions about using new or unproven. Simultaneously, evidences acquired via secondhand experiences from friends, relatives or trusted people may be used to influence and manipulate attitudinal judgements for justifying behaviors with uncertain outcomes (Bhattacherjee, 2000).

From another point of view, Portuguese cultural insights may shed lights over the significant strength of Subjective Norm variable in this study. Hofstede (2011), a cultural researcher, who develop an extensive work involving cultural dimensions among innumerous countries all over the world, argues that Portuguese people, in comparison, with the rest of European countries, have collectivists traits, while behaving in society. Thus, the value of collective thoughts is favored higher, rather than individual beliefs. In other words, Portuguese folks take their own decisions and perceive themselves as “We” rather than “I” (Andrijauskien & Dumciuviene, n.d.). Consequently, Portuguese individuals tend to value others opinion, weighted by the motivation to comply with social groups, when deciding to engage in a given behavior.

5.2.3 Perceived behavioral control

Perceived Behavioral Control appeared to have a significant effect on Behavioral Intention (β=0,174), but to a lesser extent than Attitude and Subjective Norm did. The reasonable effect of Perceived Behavior Control on Behavioral Intention implies that behavior control is an input to, but not a key influential factor of user´s adoption of shared e-scooters.

The latter results suggest, shared e-scooter are reasonably simple to use, emphasized by its widely availability and reasonable pricing, which leads to higher levels of facilitating

conditions across shared system. High control beliefs imply that potential adopters may take the previous variables (i.e. simple to use, availability) for granted where their absence may hinder the system adoption. In addition, empirical findings suggest that the familiarity and acceptance of shared mobility are fostering the rapid adoption of micro-vehicle sharing. Predominantly, Millennials (i.e. those born between 1982 and 2000) are booming consumer demand. Born and raised in an era of ubiquitous technology, making them the first generation of "digital natives" and viewed as the generation that will bring about transformative changes in the transportation sector. At the same time, changing attitudes and preferences coupled with increased virtual connectivity (e.g. online shopping and social media activity) are empowering technical skills, abilities and facilitating conditions (i.e. technological conditions) over control of new technological systems. This generation, taking part of an extreme confidence and capacity, rapidly employed technologies, thus revolutionizing how travelers execute trips by employing a big range of cutting-edge system (e.g. global positioning systems, smartphone applications, mobile payment technologies).The ubiquity and affordability of these technologies are facilitating the easy access and effective matching of supply and demand to new technological systems (Chang et al., 2019).

Following , Ajzen (1991) research, who established that a behavior may be internally controllable when an individual perceives that he or she possesses control over personal resources, such as requisite skills, confidence and ability to perform the behavior. It encompasses the possession of internal and external constraints of behavior, thus the more resources and opportunities the fewer obstacles or impediments they anticipate and the greater perceived behavioral control over the behavior (S. Taylor & Todd, 1995).

On the one hand, relatively uncomplicated technology systems, reasonable cognitive skills and relatively high learning capacity may have decreased the effects of Perceived Behavior Control on shared system acceptance. Consequently, high control beliefs imply that potential users may take these variables for granted. Based on the previous findings, it can be argued that Portuguese people's ability to use those systems as well their resources to do so influence their Behavioral Intention.

On the other hand, Digital Economy and Society Index 2019 (DESI), which summarizes relevant indicators on Europe´s digital performance, reported Portugal as 19th out of 28 member states ranked. The study reveals some interesting findings regarding the performance of several indicator characterizing Portuguese digital environment. DESI,

measured human capital skills jointly to digital skill, evaluating the aptitudes required to take advantage of the performance in this subject. It is pointed out, that in 2019, Portuguese population lacked basic digital skills comparing with the EU average. In similar vein, the usage of Internet Services by citizens, which encompass online activities (e.g. searching for news, browse social networks, communication, online shopping and online baking), has not progressed, comparing with previous year, remaining ranked as 23th out of 28 member states. Moreover, connectivity dimension reveals that Portugal performs well in the deployment of fast and ultrafast broadband connectivity (European Comission, 2019). A reasonable explanation for this modest observation is that, the technology system operation in general may not be particularly complicated, especially when considering millennial population, although may be challenging for those more aged.

In this way, the findings of the current research are in line with the results reported by previous studies about technology adoption. The latter studies, have evidenced a modest correlation strength between Perceived Behavioral Control and Behavior Intention (Bhattacherjee, 2000; Mathieson, 1991; Yu, Yi, Feng, & Liu, 2018).

6. Conclusion

What are the influencing factors on consumer Behavioral Intention when adopting shared e-scooters in Portugal?

The countless innovative IT systems that support the continuous movement of people are continuously challenging the mobility status quo. As a result, the micro-mobility vehicles have been developed, implemented and adopted rapidly, consequently increasing the importance of examining the critical factors of technology acceptance by individuals. The particular interest and significance of IT system research is whether or not these considerations might differ from those reported by prior IT systems acceptance research targeting end users.

Drawn from a theoretical established and relevant literature, a research framework for technology acceptance, aiming to provide a foundation upon which a research model could be able to explain the acceptance of shared e-scooter systems, was proposed. Empirical data was gathered from contributors via a questionnaire and consequently, employing Structural Equation Modeling (SEM), relationships were tested, among the hypothesized constructs drawn from the research model.

The results of this study indicate that Subjective Norm was the strongest predictor regarding intention to adopt shared e-scooters, followed by Attitude that revealed similar correlation toward intention, and Perceived Behavioral Control. In contrast to the designed research model, Perceived Usefulness does not directly contribute to Behavioral Intention. Additionally, the results demonstrate that Perceived Usefulness and Perceived Ease of Use positively influence Attitude, as well as Perceived Ease of Use influences Perceived Usefulness.

6.1 Theoretical Implications

Findings of this study theoretically contribute to the current literature in several ways. This study successfully enriches the literature of sharing mobility as far as it reveals the antecedents for the individual´s motivation to adopt those systems.

Some research on consumer´s intention to acquire, use or adopt technologic products or services has already been conducted. However, crucial part of those researches has focused on products/services, such as electronic commerce, internet banking, electronic

brokerages, on demand automated services, among others (Bhattacherjee, 2000; Kim et al., 2019; M. Lee, 2009; Pavlou & Fygenson, 2006). While, few have investigated individual´s intention to adopt different forms of sharing economy within the transportation field (e.g. Wang, Wang, Wang, Wei, & Wang, (2018), Kim et al., (2019) ,Matzner et al., (2015)), none have focused its research on shared e-scooters systems. It is clearly evidenced, the existence of a research gap that the researchers wanted to fulfill. Thus, we may argue that this research is one of the first researches examining the behavioral factors underlying the adoption of shared e-scooters, focusing om the Portuguese context.

From a theoretical point of view, this thesis successfully integrated two theoretical models into a unified research model for determining the adoption intention context. More precisely, the present research enriches the literature related with underlying research models, by providing empirical support regarding the validation of explanatory power by integrating TAM with TPB in the context of shared e-scooters systems. Furthermore, this research successfully validated TPB model, by confirming successfully the positive correlation between the hypothesized variables, contrarily to TAM framework, that failed to correlate one of the hypothesized variables (Perceived Usefulness toward Behavioral Intention).

Furthermore, this study revealed that within the Portuguese context, some variables are more prominent than others. Individuals appeared to be more focused on the usefulness of shared system technology rather than on the easiness of it. Additionally, Attitude and Subjective Norm appeared to strongly influence the individuals' intention to adopt shared systems in context of technological novelty.

In addition, the underlying research must be validated in a larger context, gathering further empirical findings that subsequently may provide support for the generalization of the research findings in a broader context, or be applicable in different cultural backgrounds. In this sense, further research is needed to validate our findings in a broader context. It is possible that potential shared e-scooter adopters from a different culture background may reveal different findings, i.e. individuals may perceive differently the different factors influencing the technological system adoption (Chau & Hu, 2002).

6.2 Practical Implications

The findings of this study have important implications for shared e-scooters platforms (providers), by offering valuable information about how to engage with potential consumers in order to attract them to use the underlying services. The results of this research may provide valuable insights about customers behavior. E-scooters platform operators can use them to design and implement services to boost and trigger customers positive behavior toward shared platforms services. Additionally, our research findings are particularly valuable for start-ups with business focusing on the micro-mobility market, and for those looking for gaining further knowledge about their bottom customers.

In the following, we briefly picture how platform operators may address relevant technical issues by linking our results to a specific operationalization. Therefore, two main lines of implication can be drawn to be further explored: users' Attitude including the predictors of Perceived Usefulness and Perceived Ease of Use; and Subjective Norm as the variable accounting for social influence on individuals' intention to adopt the service.

In this light, dissemination and communication of positive perceptions of technology's usefulness and perceived ease of use are crucial, since as our research revealed that individuals are particularly sensitive to those issues. Following this line, shared e-scooter platforms could reinforce the great potential of such devices, by demonstrating the usefulness and easiness of the technology, as communicating it to potential users. Moreover, product utility can be emphasized by showing the product related performance, while engaging with customers on the streets to create a customer-product free trials campaign. Therefore, improving communication, could be a first step to deliver a reinforced positive impact on variable Attitude.

Additionally, studies demonstrated and supported (e.g. Schellong, Sadek, Schaetzberger, & Barrack, 2019) that e-scooter are convenient and flexible devices to quickly get around of increasingly congested cities. More precisely, this type of vehicles are very well suited by increasing mobility performance of trips ranging from 0,5km to 4km, which is equivalent of walking for 5 to 45 minutes. Consequently, this type of device may play an important role in micro-mobility cities scenario turning the people's mobility more effective. Moreover, e-scooters can also be paired with other mobility modes, namely

public transportation, which makes them a convenient solution for traveling the first and last miles from home to public stations. Since, e-scooters rides may complement other modes of transportation (e.g. public transportation, ride hailing platforms), aggregating modes into a single app would be convenient and useful for consumers. Doing so, users could go from the starting point to the end point of their journey by using several modalities of transportation, using exclusively a single application that could be used for planning, booking, and paying their trips (Schellong et al., 2019). Perceive Ease of Use, alongside with Usefulness can be reinforced by employing communication tools with focus on communicating the easy handling of smartphone mobile applications as well as the easiness to use e-scooters.

On the other hand, our research emphasized the relative importance of Subjective Norm. External influence is as important as interpersonal influence in individuals' creation of subjective norms toward technology acceptance. It is suggested that the underlying dynamics, driving consumer adoption of shared e-scooter, may differ from one individual to another, since their motivations to use the service may differ. Understanding such differences is important, once individuals' acceptance of such services is the key factor for platforms to create conditions to survive in such competitive industry. Likewise, platforms should promote public awareness of micro-mobility devices' efficiency, by using both mass media exposure and positive testimonials from current users (e.g. underline the performance of the shared e-scooters in congestion traffic).

6.3 Limitations

The results of this research are subject to a number of limitations, which have to be considered and addressed.

Firstly, this research was conducted among Portuguese population, which limits the scope of the research and does not offer the possibility to compare with other geographic populations. Thus, the results of this research can only be applied to the Portuguese context.

Secondly, for convenience, and due to time constraints, a non-probability sampling method was employed for selecting the respondents included in this research. This sample is nor fully representative of the target population, and the results cannot be generalized

for any other individuals that did not participate in this survey. As survey tool, an online questionnaire was employed in order to collect empirical data, however the response rate was very low comparing with the people that was reached. Essentially, the majority of people reached by the questionnaire was not motivated to, or did not look to, answer the questionnaire.

Thirdly, several decisions regarding the scope and representativeness of the study were made, namely by only including 5 dimensions into the research framework. Doing so, the scope of this research was limited and could be broaden if the authors added more variables. By expanding the research model, this research could have been more in depth and accurate. In addition, given the novelty of the technological systems of shared e-scooters, it would be interesting to conduct longitudinal studies and evaluate whether factors importance change over time or not, as micro-mobility market gets mature.

Lastly, focusing TPB model, it is argued that the model is not the best predicator for external influence, once consumer is not aware of what influence them in their decision-making process. Thus, the explanatory power of this variable might be limited (Benbasat & Barki, 2007).

6.4 Future Research

Future research might include a cross cultural study targeting another geographical location, or even a distinct culture. A comparative study between countries or cultures could provide valuable insights about the main variable's differences in such distinct backgrounds. By conducting a study in distinct countries, shared e-scooter platforms would better fit its services within the local markets, since it would gain a comprehensive knowledge by looking to which variables are more attractive to costumer intentions regarding service adoption.

Additionally, might be worthy to study the different demographics (e.g. gender, income groups) that may exist. It would be interesting to study how different demographic subjects' factors influence purchase intentions, as well as making comparison between demographics. Furthermore, since shared e-scooters were recently implemented, would be worthy to consider a longitudinal study to account how consumer perception evolved over time, and if they maintained their intention over behavior.

Considering the research limitations, the research framework could be broadening, by extending its dimensions, namely incorporating variables related to trust, safety or monetary issues and thus increasing the explanatory power of the model. Further, a qualitative study might help to discover which variables are suitable to be added to the research model or even to explain in a more detailed way the current variables. Normally, this can be done by recurring to in depth costumer interviews or focus groups.

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Appendix

Appendix 1: Questionnaire construction (sources)

- **Perceived Usefulness**

Original Item	Decomposition		Author
	General behavior	Principal Object	
Using CHART-MASTER in my job would enable me to accomplish tasks more quickly.	Using CHART-MASTER	Accomplish tasks more quickly	Davis (1989)
Using CHART-MASTER would improve my job performance.	Using CHART-MASTER	Improve my job performance	
Using CHART-MASTER in my job would increase my productivity.	Using CHART-MASTER	Increase my productivity	
Using CHART-MASTER would enhance my effectiveness on the job.	Using CHART-MASTER	Enhance my effectiveness on the job	
Using CHART-MASTER would make it easier to do my job.	Using CHART-MASTER	It easier to do my job.	
I would find CHART-MASTER useful in my job.	Using CHART-MASTER	Useful in my job	

- **Perceived Ease of Use**

Original Item	Decomposition		Author
	Intended Action	Principal Object	
Learning to operate CHART-MASTER would be easy for me.	Using CHART-MASTER	Ease of learning	Davis (1989)
I would find it easy to get CHART-MASTER to do what I want it to do.	Using CHART-MASTER	Ease of control	
My interaction with CHART-MASTER would be clear and understandable.	Using CHART-MASTER	Ease of interface	
I would find CHART-MASTER to be flexible to interact with.	Using CHART-MASTER	Ease of interaction	

It would be easy for me to become skillful at using CHART-MASTER. likely	Using CHART-MASTER	Ease of skill control	
I would find CHART-MASTER easy to use.	Using CHART-MASTER	Overall ease of use	

- **Attitude**

Original Item	Decomposition		Author
	Intended Action	**Principal Object**	
Using the CRC is a *(bad/good*) idea	Using the CRC	Good idea	S. Taylor & Todd (1995)
Using the CRC is a (*foolish/wise*) idea	Using the CRC	Wise idea	
I (*dislike/like*) the idea of using the CRC	Using the CRC	I like the idea	
Using the CRC would be (*unpleasant/pleasant*)	Using the CRC	Pleasure	

Original Item	Decomposition		Author
	Intended Action	**Principal Object**	
I feel positive about using this service.	Using this service	Fell positive	Kim et al. (2019)
Using this service is a good idea.	Using this service	Good idea	
I enjoy using this service.	Using this service	Joy	
Overall, I have a positive attitude toward this service	Using this service	Overall positive attitude	

- **Subjective Norm**

Original Item	Decomposition		Author
	Subjective Influence	**Intended action**	
People who influence my behavior would think that I should use the CRC.	People who influence my behavior	I should use the CRC	S. Taylor & Todd (1995)

People who are important to me would think that I should use the CRC.	People who are important to me	I should use the CRC	

Original Item	Decomposition		Author
	Subjective Influence	**Intended Action**	
People I knew influenced me to try out e-brokers for managing investments.	People I knew	Influenced me to try out e-brokers	Bhattacherjee (2000)
Mass media reports influenced me to try out e-brokers for managing investments.	Mass media reports	Influenced me to try out e-brokers	
The popular press depicts a positive sentiment for using e-brokers	The popular press	Depicts a positive sentiment for using e-brokers	
People important to me supported my use of e-brokers.	People important to me	Support my use of e-brokers	
People whose opinions I valued preferred that I use e-brokers for managing investments.	People whose opinions I value	Preferred that I use e-brokers	
People who influenced my behavior wanted me to use e-brokers instead any alternative means.	People who influence my behavior	Wanted me to use e-brokers	

- **Perceived Behavioral Control**

Original Item	Decomposition		Author
	Perceived Control	**Intended Action**	
I would be able to use the CRC.	I would be able	To use the CRC	S. Taylor & Todd (1995)
Using the CRC is entirely within my control.	Is entirely within my control	Using the CRC	

I have the resources, the knowledge and the ability to make use of the CRC	I have the resources, the knowledge and the ability	To make use of the CRC	

Original Item	Decomposition		Author
	Perceived Control	Intended Action	
I would feel comfortable using e-brokers on my own.	I would feel comfortable	Using e-brokers on my own	Bhattacherjee (2000)
I would be able to use e-brokers well on my own.	I would be able (on my own)	To use e-brokers	
I would be able to use e-brokers well for managing personal investments.	I would be able	To use e-brokers	
Using e-brokers is entirely within my control.	Is entirely within my control	Using e-brokers	
I have the resources, knowledge and ability to use e-brokers.	I have the resources, knowledge and ability	To use e-brokers	

- **Behavioral Intention**

Original Item	Decomposition		Author
	General behavior	Intended Action	
I will consider using this service.	High likelihood	Using the service	Kim et al. (2019)
I plan to use this service.	High likelihood	Use this service	
I will continue to use this service.	Continuous	Usage of the service	
I will inform other of the goodness of this service.	Willingness of recommendation	Satisfaction with the service (highly likely to use again)	

Original Item	Decomposition		Author
	General behavior	Intended Action	
I wanted to use e-brokers rather than any full-service broker for managing investments.	Potential high usage	Use e-brokers	Bhattacherjee (2000)

My intentions were to use e-brokers rather than any full-service broker for managing investments.	Potential high usage	Use e-brokers	
For managing my personal investments, I intended to use e-brokers as much as possible.	Potential high usage	Use e-brokers	

Appendix 2: Questionnaire (Portuguese)

A intenção dos consumidores para a utilização de trotinetes elétricas partilhadas

Este questionário faz parte de um projeto de pesquisa que pretende aferir os factores que influenciam a intenção do consumidor português para a utilização de trotinetes elétricas partilhadas em contextos urbanos.

As plataformas de trotinetes elétricas partilhadas foram desenvolvidas para transportar pessoas em distâncias curtas e em meios urbanos. Baseiam-se num sistema "dockless" que é acessível a partir de um aplicativo para smartphone, onde os usuários podem encontrar a respectiva trotinete, pagar e desbloquear o dispositivo. Plataformas como Bird, Frog, Circ, Hive, Lime e recentemente a Jump estão disponíveis em algumas cidades como Lisboa, Porto e Coimbra.

A sua resposta a este questionário será utilizada como base de suporte para este projeto de pesquisa destinado à conclusão da dissertação como requisito para a obtenção do grau de mestrado em gestão no ISCTE - IUL.

As informações fornecidas serão tratadas com carácter confidencial, sendo exclusivamente para fins académicos.

Para alguma dúvida relacionada com o questionário e/ou informações adicionais sobre este estudo, por favor contactar o seguinte email: dbieo@iscte-iul.pt

Obrigado pelo seu contributo.

1. Género *

- ◯ Feminino
- ◯ Masculino

2. Idade *

- ◯ 18-24
- ◯ 25-30
- ◯ 31-35
- ◯ >35

3. Ocupação *

- ☐ Estudante
- ☐ Empregado
- ☐ Trabalhador independente
- ☐ Outro

4. Já usou alguma plataforma de trotinetes partilhadas anteriormente? *

- ◯ Sim
- ◯ Não

5. Se respondeu AFIRMAMENTE à questão anterior, por favor indique com que frequência utiliza plataformas de trotinetes eléctricas partilhadas?

- ◯ Diariamente
- ◯ Várias vezes por semana
- ◯ Várias vezes por mês
- ◯ Várias vezes por ano
- ◯ Só utilizei uma vez

6. Por favor indique de que forma concorda ou discorda com as seguintes afirmações. *

	Discordo totalmente	Discordo	Não concordo nem discordo	Concordo	Concordo totalmente
A utilização de trotinetes elétricas partilhadas permitir-me-ia mover mais rápido.	○	○	○	○	○
A utilização de trotinetes elétricas partilhadas permitir-me-ia melhorar a performance da minha mobilidade.	○	○	○	○	○
A utilização de trotinetes elétricas partilhadas ser-me-ia benéfica em termos financeiros.	○	○	○	○	○
No geral, as trotinetes elétricas partilhadas seriam úteis no meu processo de mobilidade.	○	○	○	○	○

7. Por favor indique de que forma concorda ou discorda com as seguintes afirmações.

	Discordo totalmente	Discordo	Não concordo nem discordo	Concordo	Concordo totalmente
Seria fácil para mim manusear a aplicação de trotinetes partilhadas	○	○	○	○	○
Seria fácil para mim localizar e desbloquear as trotinetes elétricas partilhadas através do meu smartphone.	○	○	○	○	○
Seria fácil tornar-me um condutor competente de trotinetes elétricas partilhadas	○	○	○	○	○
Consideraria as trotinetes elétricas partilhas um meio de transporte flexível	○	○	○	○	○

8.Por favor indique de que forma você concorda ou discorda com as seguintes afirmações. *

	Discordo totalmente	Discordo	Não concordo nem discordo	Concordo	Concordo totalmente
Seria uma boa ideia utlizar trotinetes elétricas partilhadas na minha mobilidade.	○	○	○	○	○
Seria positivo utilizar trotinetes elétricas partilhadas como o meu meio de transporte.	○	○	○	○	○
A utilização de trotinetes elétricas partilhadas é uma ideia inteligente.	○	○	○	○	○
No geral, teria uma atitude positiva para com as trotinetes elétricas partilhadas.	○	○	○	○	○

9.Por favor indique de que forma concorda ou discorda com as seguintes afirmações. *

	Discordo totalmente	Discordo	Não concordo nem discordo	Concordo	Concordo totalmente
As pessoas que são importantes para mim pensam que eu deveria utilizar trotinetes elétricas partilhadas.	○	○	○	○	○
As pessoas que eu conheço pensam que eu deveria utilizar as trotinetes elétricas partilhadas.	○	○	○	○	○
Utilizaria as trotinetes elétricas partilhadas se os meus amigos já o tivessem feito.	○	○	○	○	○
As redes sociais influenciar-me-iam a utilizar trotinetes elétricas partilhadas.	○	○	○	○	○

10.Por favor indique de que forma concorda ou discorda com as seguintes afirmações . *

	Discordo totalmente	Discordo	Não concordo nem discordo	Concordo	Concordo totalmente
Seria capaz de utilizar as trotinetes elétricas partilhadas por mim próprio.	○	○	○	○	○
Teria conhecimento, recursos e habilidades necessárias para utilizar as trotinetes elétricas partilhadas.	○	○	○	○	○
O uso de trotinetes elétricas partilhadas está inteiramente dentro do meu controlo.	○	○	○	○	○
Eu sentir-me-ia seguro durante a utilização de trotinetes elétricas partilhadas.	○	○	○	○	○
No geral, sou capaz de utilizar as trotinetes elétricas partilhadas.	○	○	○	○	○

11.Por favor indique de que forma concorda ou discorda com as seguintes afirmações. *

	Discordo totalmente	discordo	Não concordo nem discordo	Concordo	Concordo totalmente
Tenho a intenção de usar trotinetes elétricas partilhadas no futuro.	○	○	○	○	○
Eu consideraria utilizar trotinetes elétricas partilhadas em detrimento de qualquer outro meio de transporte.	○	○	○	○	○
Pretendo utilizar trotinetes elétricas partilhadas o máximo que eu conseguir.	○	○	○	○	○
Pretendo recomendar que outras pessoas utilizem trotinetes elétricas partilhadas.	○	○	○	○	○