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A Critical Incident Approach to Examine the Biking Experience: A Case Study about Commuters from Portugal

Master Thesis

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Statement of Integrity

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

Uma Abordagem de Incidente Crítico para Examinar a Experiência de andar de Bicicleta: Um Estudo de Caso sobre Utilizadores Urbanos de Portugal

Resumo

Utilizar a bicicleta como meio de transporte para deslocações e outras atividades gera muitos benefícios, tais como o potencial para reduzir a poluição atmosférica e o congestionamento do tráfego e, simultaneamente, para aumentar os níveis de atividade física das pessoas. Todavia, tem sido dada pouca atenção ao papel das emoções na experiência de utilizar a bicicleta. Neste contexto, a presente dissertação procura enriquecer esta compreensão, explorando os principais fatores que influenciam o comportamento do utilizador da bicicleta, descobrindo os estados emocionais positivos e negativos despoletados durante a experiência e aqueles que a podem influenciar, e compreendendo o papel das emoções na dinâmica entre os principais fatores e o comportamento do utilizador.

Foi realizado um estudo qualitativo, entrevistando 16 indivíduos que utilizam a bicicleta principalmente para se deslocarem para o trabalho. Utilizando a Técnica do Incidente Crítico, a avaliação empírica revela vários fatores que influenciam a experiência do utilizador de bicicletas. Estes fatores são: de caráter social; de tráfego e congestionamento; de saúde física e mental; de características da bicicleta; de segurança; de infraestruturas; e de meteorologia e topografia. Além disso, verificam-se estados emocionais positivos e negativos que emergem na interação entre estes fatores e as respostas comportamentais dos ciclistas. Os estados emocionais positivos mais vezes mencionados são a felicidade, a alegria e o relaxamento, enquanto a frustração, a raiva, a tristeza e o medo são as emoções negativas identificadas como tendo um papel crucial na experiência do ciclismo.

Pretende-se que esta dissertação tenha uma tripla contribuição. Em primeiro lugar, explorar os principais fatores que influenciam os momentos críticos da experiência do utilizador de bicicletas. Em segundo lugar, determinar os principais estados emocionais, positivos e negativos, que desempenham um papel nesses momentos. Em terceiro lugar, identificar os principais resultados que podem ser produzidos com base nestes fatores e emoções. No final, com base nos resultados, são sugeridas várias implicações de gestão para os decisores políticos e para as autoridades. Nesse sentido, será sublinhada a necessidade de utilização de estratégias de marketing para promover o uso saudável, seguro e aprazível da bicicleta, bem como a necessidade de prestar atenção à qualidade das infraestruturas e de encontrar técnicas para prevenir questões sociais e de tráfego.

Palavras-chave: Bicicleta; Estados emocionais; Respostas comportamentais; Sistemas de bicicletas partilhadas; Técnica de incidentes críticos.

A Critical Incident Approach to Examine the Biking Experience: A Case Study about Commuters from Portugal

Abstract

Using bikes as means of transportation for commuting and other activities generates many benefits such as the potential to reduce air pollution and traffic congestion and simultaneously increase people's physical activity levels. Nevertheless, scant attention has been given to the role of emotions in the biking experience. In this context, the current dissertation seeks to enrich this understanding by exploring the main factors that influence the bicycle user behavior, discovering the positive and negative emotional states triggered during the experience and those that can influence it, and understanding the role of emotions in the dynamics between the main factors and the users' behavior.

A qualitative study was conducted by interviewing 16 individuals who use bikes, mainly to commute. Using the Critical Incident Technique, the empirical assessment reveals several factors that influence the biking experience. These factors are social factors; traffic and congestion; physical and mental health; bike features; safety; infrastructure; and weather and topography. Moreover, positive and negative emotional states emerge from the interaction between these factors and bike user behavioral responses. The most observed positive emotional states are happiness, joy, and relaxation. While frustration, anger, sadness, and fear are the negative emotions found to have a crucial role in the biking experience.

The contribution of this dissertation is threefold. First, it intends to explore the main factors that influence the critical moments of the biking experience. Second, it aims to determine the main positive and negative emotional states that play a role in these moments. Third, it proposes to identify the main outcomes that can be produced based on these factors and emotions. Ultimately, based on the findings, several management implications are suggested for policymakers and authorities. In that regard, it is emphasized that there is a need to use several marketing communications to promote the healthy, safe and pleasant use of bicycles, as well as to improve the biking infrastructure quality and to find techniques to prevent social and traffic issues.

Keywords: Behavioral responses; Bike; Bike sharing systems; Critical incident technique; Emotional states.

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Acronyms

BSS: Bike Sharing Systems

SSS: Scooter Sharing Systems

WOM: Word-Of-Mouth

CIT: Critical Incident Technique

1. Introduction

Every day people produce many trips due to moving and making various activities (Crocco et al., 2013). The dominant mobility model has been relying mainly on the use of motorized transportation modes, in particular individual cars. However, this model has been criticized due to the high levels of environmental pollution recorded in recent years, the shortage of fossil fuels, and the problems associated with traffic and road congestion (Meschik, 2012). Transport policies are presently directed towards the expansion of sustainable mobility, concentrating on the issues of energy saving and reducing atmospheric and noise pollution (No Ranieri et al., 2018). Based on that, urban mobility have to center mainly on the use of collective modes of transportation and non-motorized vehicles such as bikes and e-scooters (Xing et al., 2010). Conventional modes of transportation like cars and buses have been criticized for their negative impact on the environment sustainability, by causing air quality decrease and temperature rise, and seriously endangering the health of the public (Huang et al., 2019). These transportation means have produced an inelegant urban environment, unfit public transportation service, intense traffic congestion, noise and exhaust gas, unsafe roads with many traffic accidents, and mobility inequalities (Nieuwenhuijsen & Khreis, 2016; Xiping Ding et al., 2019). These problems lead to the need of thinking of several solutions at the level of urban mobility. One solution is the use of two-wheeled transports, especially bicycles and electric scooters (e-scooters) which are forming a new eco-friendly means of transportation (Manzi & Saibene, 2018). In the last years, the success of these two-wheelers as good solutions especially for short distances lead to the emergence of Bike Sharing Systems (BSS), and more recently the Scooter Sharing Systems (SSS). BSS have been spreading rapidly all over the world, becoming key players in modern transportation (Manzi & Saibene, 2018).

Cycling in general, either by using private bikes or using BSS, play an important role in urban mobility and are non-polluting, flexible, economic vehicles that contribute positively to decongesting traffic and benefit the health of users (Van Cauwenberg et al., 2019). It is therefore considered that the use of the bicycle as a means of transportation could be an interesting solution that contributes to solving many environmental, health, and traffic

problems (Midgley, 2011). However, the use of bikes and BSS is facing many challenges and barriers. The use of the bike as means of transportation is very sensitive and subject to several influencing variables, therefore, research has investigated the factors for their potential impact on cycling behavior. Spatio-temporal factors (Corcoran et al., 2014), infrastructure (Hess & Schubert, 2019), system convenience and accessibility (Chen et al., 2019), social (Wang et al., 2018), and environmental factors (Chen, 2016) are well-investigated for their influence on cycling behavior. Although the influence of emotional states on consumer behavior is well recognized in many fields like marketing and retailing (Ladhari et al., 2017), little is known about the role played by emotions in influencing the biking experience (Chen & Chancellor, 2020), and there is a need for more investigations at this level.

The use of bikes, both private and BSS, is seen as a convenient and eco-friendly public transportation mode in cities across the world (Parkes et al., 2013). At the same time, research on bicycle and BSS use is growing exponentially, yet considerable gaps remain (Fishman et al., 2013). For instance, biking rates in several cities continue to fall short of forecasts, and municipalities are not confident of the long-term sustainability and supportability of investing in cycling and improving needed infrastructure (Zhang et al., 2015). Moreover, the use of two-wheeled vehicles is well recognized in countries like the Netherlands, Denmark, and Norway where many people use bicycles in their daily transport (Cerutti et al., 2019). However, the authors assumed that more countries are trying to encourage the use of two-wheels and include them in their main transportation solutions. In this context, governmental organizations try to encourage their employees and citizens, in general, to use more eco-friendly transportation modes to reduce congestion to make people reach work with a fresh mind. For example, in New Zealand, discounted electric bikes (e-bikes) are offered to public sector workers (Genter, 2019). Similarly, the Portuguese government is taking steps towards facilitating the buy and use of bikes in the capital city (Público, 2020). Another initiative emerged in Portugal, in the Municipality of Guimarães, where, within its Sustainable Urban Mobility Plan, a set of 20 e-bikes, were acquired, under the program "EduMove-te: Educating for Sustainable Mobility". This program essentially aims at raising the awareness of the workers in the

Municipality for the adoption of more environmentally sustainable practices during working hours. It also intends to go further and promote, in a sharing system, its use in the respective work-home travels, promoting its dissemination in other contexts and the induction of good practices and initiatives that raise awareness for its use.

Based on the above, this research aims to investigate the cycling experience of individual bike users as well as people that use bike-sharing systems especially to commute. The main objective is to determine the main barriers and challenges that users face during their biking experience and investigate the main factors and emotions that influence the cyclists' attitudes and behavior. The results of this study contribute to provide a better understanding of the cyclists in general and and BSS users, in particular. The cyclists' emotional state is the main focus of this research and, based on this study, some recommendations and management implications are provided to municipalities, BSS operators, and other stakeholders involved in encouraging and promoting the use of the bike as an eco-friendly and healthy means of transportation.

2. Literature review

The main objective of this section is to present the main theoretical background. This includes reviewing the definition of urban micro-mobility, the shared micro-mobility systems, and the analysis of the behavior of bike users; individual cyclists and BSS users, reviewing the main factors and emotions that influence the bike experience.

2.1. Introduction to Literature Review section

The last decade has witnessed a great growth of two-wheel micro-mobility, especially bikes, which are considered as a key transportation means (Younes et al., 2020). The bike global industry is worth $45bn (£36bn), with more than 100 million bicycles produced in the world each year (Bernhard, 2019). By 2022, this figure is expected to reach $65 billion (World Economic Forum, 2019) (Figure 1). Based on that, the field of shared mobility was also extended to include bike-sharing widespread systems present in hundreds of cities over the world (Shaheen & Chan, 2016).

In the urban context, bikes are not for sports only, but people use bikes to go to school and work, go shopping, visit friends, and cruise in the city center (Fishman et al., 2014; Zhu & Diao, 2020). Moreover, many companies and businesses are completely or particularly including bikes in their business activities. For example, bikes and e-bikes are used by DHL in the UK, and Gothenburg's "armadillo" to send deliveries to city center shops and businesses (The Guardian, 2017). In New York, Amazon and UPS use large numbers of cargo e-bikes that can drive in bike lanes and up onto sidewalks for deliveries (Fehrenbacher, 2020). Other well-recognized businesses that use bikes in their delivery activities are food delivery services like UberEats and Telepizza (Hui, 2016). Glovo, the Spanish start-up on-demand courier service is another example (Glovo, 2020). Policymakers are encouraging and promoting the use of bikes and BSS to solve congestion and parking problems, empower public health, reduce energy and carbon emissions, and solve the first and last-mile problem (Chen, 2016; Fishman et al., 2013; Macioszek et al., 2020; Wang & Zhou, 2017).

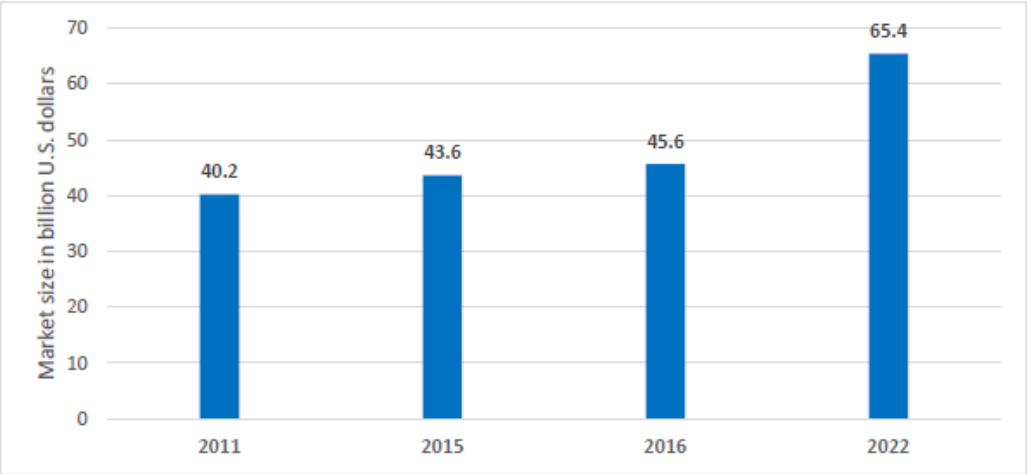

Figure 1. Global bicycle market size from 2011 to 2022 (in billion US dollars). | Information source: (World Economic Forum, 2019) | Redesigned by the author.

Urban micro-mobility describes the means of transportation that serves to cover short distances, usually the first or last kilometer of a journey. According to a study by McKinsey Center for Future Mobility (2019), about 60% of car journeys worldwide are less than eight kilometers long and could benefit from micro-mobility solutions. Micro-mobility solutions include light vehicles, such as bicycles, scooters, or other small, usually electric, means of transportation (Heineke et al., 2019). Micro-mobility transportation includes two main types; individuals who use their micro-mobility vehicles and micro-mobility sharing systems like BSS and SSS. According to Fabian Simmer (SEAT Digital Officer) "Micro mobility products are important for private customers, but also shared use operators. For the development of this future generation of products, we are taking into account both stakeholders. Based on the time of the day, they should be able to choose between different means of transportation" (Seat Media Center, 2019). In sum, both types of micro-mobility, individuals and micro-mobility sharing systems, help to minimize the number of vehicles in traffic and stimulate other locomotion modes that are available. In this vein, Bullock et al. (2017) discussed how using bikes or bike-sharing systems helps to minimize the use of other transportation means like buses or motor vehicles. Moreover, the authors also discussed how bikes can be used to facilitate the adoption of other public transportation means like buses. Technology has played an important role in introducing micro-mobility-sharing systems. Dong et al. (2018) argued that the presence of advanced

technology helps and supports the use of bikes in general, especially when it comes to bike-sharing systems. Technology facilitates the use of micro-mobility vehicles. Moreover, it enables users to use different types of shared systems like BSS (Goodman et al., 2014). BSS is highly based on technology, as service is, in general, done without the need for human interaction (Matrai & Toth, 2016). The bicycles unlocking for use takes place via electronic devices, either if it is through system stations accessibility or smartphone applications (Hazen et al., 2015).

2.2. The bike Experience

Bike experience varies based on the individual perspective, and it will always depend on the veracity of the perceived advantages and drawbacks (Hamidi et al., 2019). According to Martens (2016), the bike experience differs based on some natural factors like certain geographical locations, resulting in uneven access to the mode of transportation in question. Hamidi et al. (2019) indicated that the surrounding environment around the user may make their experience more or less enjoyable. For example, they discovered that various natural features, like trees, made the experience more pleasant, while rain and bad weather conditions are found to have a negative impact on the biking experience. The bike experience can be enhanced by improving biking conditions such as the infrastructure, increasing the number of bike lanes, and adding more bike docks (Martens, 2007). According to a study conducted in China, five major aspects influence the bike-sharing experience: the acquisition of station space, the program's financial responsiveness, the prices charged, the connections with other means of transport, and the distribution of bicycles by geographical area (Zhang et al., 2014). These conclusions were made at the level of BSS which we are going to discuss in the next section.

2.3. Bike-sharing systems

The constant increase in fuel prices, the amount of growing congestion in metropolitan areas, and the need for green mobility are some of the reasons that are connected to the

demand increasing for shared transportation systems (Manzi & Saibene, 2018). Bike-sharing is a service that allows individuals to make their short-term bike trips for a price, and sometimes free of charge (Festa & Forciniti, 2019). There are two types of bike-sharing systems; docked and dockless (Ji et al., 2020). In the docked systems, users get the bike from one dock and return it to another one at the end of the trip. Docks used to be managed by sales assistants but not anymore with the use of technology to lock and unlock the bikes from the racks. Payments also used to be done manually, however, now payments are made via credit card or bike-sharing systems applications (Mattlamy, 2019). The dockless system is the more advanced bike-sharing system type, relying on GPS and smartphones to allow users to get the bike wherever they find it and to check out the system wherever they wish, i.e. with no need to find any station for the check-out (Ma et al., 2020). Both types of BSS are gradually being embraced by businesses and local councils responsible for planning future mobility schemes. It is worth mentioning that many factors have a substantial positive effect on urban transport and the adoption of bike-sharing systems, this includes, but is not limited to, the distance between stations or parking lots, the type of reservation, the type of vehicles, the usage methods, the landscape, and road network and the user's features (Manzi & Saibene, 2018).

The interest in BSS as a possibility and a complementary means of transport is increasing gradually (Faghih-Imani et al., 2014). BSS offer advantages such as versatile mobility, incentives for physical activity, and support for multimodal transport connections (Shaheen et al., 2010). According to Chen and Huang (2020), BSS operate as creative urban transport modes that intend to meet the needs of multiple travellers. The authors also assume that BSS furnish a connection between existing public transportation stations and the arrival destination. On the other hand, BSS are supplying tourists with a helpful way to travel more simply and flexibly into a destination and to explore truly that experience. Local authorities have implemented BSS for both commuters and tourists as an alternative transportation service. In addition, BSS provide an appealing choice for private transportation, mitigating concerns related to increased carbon emissions, traffic congestion, and the use of non-renewable resources (Supriyo, 2017). BSS contribute to healthy living and greener ecosystems thus supplying consumers with swift movements. A significant number of users have been led to use the system, because it is easy to use,

environmentally friendly, economical, and ideal for short-distance commuting (Zhou & Zhang, 2019).

Together with other alternative transportation sharing schemes, BSS are today, thanks to new technology, a core component of the urban "intelligent city" and have significant positive consequences for housing, public and private participation, and citizens' acceptance (Nikiforiadis et al., 2019).

2.4. Factors affecting the bike and bike-sharing users' experience

Consumer research has identified several factors that influence bike users' behavior. In this section, the main studied factors are grouped and reviewed. Several factors seem to influence this behavior, such as environmental values (Chen, 2016), infrastructure (Hess & Schubert, 2019), accessibility and convenience (Chen et al., 2019), and spatio-temporal factors (Corcoran et al., 2014). The use of bikes is also affected by factors such as travel distance, weather, air quality, temporal variables, payment method, in the case of BSS, cycle lane coverage, and charges (Fishman et al., 2013). Bikes and BSS require investment in critical infrastructure, such as cycle lanes, as well as theft prevention, the provision of sufficient numbers of cycles, safety, and in the case of BSS IT-based modes of payment, docking stations, and other factors (Shaheen et al., 2010). Finally, usage rates of bikes and BSS may also be affected by factors such as gender, car ownership, travel patterns, time available, type of car owned, and station location, and user perceptions of bicycles (Guo et al., 2017).

According to Festa and Forciniti (2019), the most popular reasons for cycling include health reasons, exercise and fitness, convenience, leisure, and enjoyment of an attractive activity. However, the authors also reported several reasons that lead to not ride a bike, including safety variables, traffic and road congestion, bad weather conditions, personal factors, lack of daylight and time, lack of sufficient fitness, being tired, effort, and difficulties with trip-chaining. In the following, we present the literature review related to the main influencing factors.

2.4.1. Temporal and spatial factors

Several studies discussed the relationship between temporal and spatial factors characteristics on the one hand and the cyclist behavior on the other. For example, Froehlich et al. (2009) settled that bike use differ based on the time of the day, location and neighbourhood; and Caggiani et al. (2017) found bikes and BSS availability patterns between space and time.

Firstly, approaching temporal factors, Faghih-Imani et al. (2014) acknowledged that bike usage is affected by temporal characteristics, the authors in this study analyzed time resolution and observed high evening peak hours usage. The findings demonstrated also that bike use increases during the week compared to weekends, and that it can vary considering the time of the year or even the time of the day. Temporal factors can have different impacts on ridership on-campus stations and downtown stations, in this vein, Mattson and Godavarthy (2017) found that students show higher cycling activities when there are fewer students at the campus and that it is higher in spring.

Spatial variables such as bicycle infrastructure and land use/built environment variables can have significant impacts on cycling behavior including the use of BSS. In this vein, BSS usage was found to be increasing when more bicycle facilities are provided, for example, bicycle paths and tracks and stations location (El-Assi et al., 2015). Similarly, Zhang et al. (2017) assumed that BSS demand is influenced by the stations' location and that is an issue that needs to be clarified before the implementation of a sharing system. The authors studied the correlation between nearby stations and concluded that this correlation affects demand, for example, a station that has high demand should also have a high number of bikes on nearby bike-sharing station. So station locations and infrastructures quality are related to BSS demand.

Some researchers have claimed that travel-related perceptions implicitly affect travel behavior through their choice of residential venue. People in specific communities have more choices and easier access to efficient travel modes (Schwanen & Mokhtarian, 2005). Even so, residential environment selection does not always conform to the expected travel actions. For instance, variations in travel activity between two categories of communities, suburban and urban areas, were found in part due to attitudinal influences rather than built environment (Cao et al., 2006). In comparison, individuals residing in residential

areas may be required to use the vehicle when destinations are outside distance walking or cycling (Schwanen & Mokhtarian, 2005).

2.4.2. Accessibility and ease of use

Accessibility refers to how easy is to get a bike, in BSS it refers to how easy is to check in and check out from the system, i.e., the ease of taking the bicycle, use it, and then return it (Fishman et al., 2012). Moreover, it refers to the availability of stations, in the case of docked systems, also, the availability of bicycles to use (Kuo et al., 2021). Besides that, bikes and BSS should be easy to use, meaning that there is an easy interaction with the bike or the system, the system information is available and understandable, and that there is an easy interaction with facilities and services provided by different stakeholders like municipalities and BSS operators (Ma et al., 2018). At the level of docked BSS, Kuo et al. (2020) examined the intention to use the system for two trip purposes and nine different accessibility situations. They found accessibility to influence the intention to use the system. Similarly, Fishman et al. (2012) found the sign-up process, docking station location, and opening hours to impact BSS use. In addition to station location, Shen et al. (2018) found the fleet size, accessibility to bike racks, and easy access to other public transportation means in the city to have a positive effect on BSS use in Singapore. Moreover, the number of stations installed in an area and the capacity of these stations influence the use of bikes and BSS, also influence the installation of infrastructure for this type of system (Faghih-Imani & Eluru, 2016).

Encouraging people to use bikes and BSS is the key goal, however, it is more important and challenging to maintain and improve users' intentions to continued usage of bikes and shared bicycles. In this context, Zhanyouet al. (2020) discuss the importance of the system's ease of use. They suggested that BSS systems should be easy and understandable, and the interaction among users and service providers should be also effortless and comprehensible. Moreover, the authors indicated also that bicycles themselves need to be easy to use. It is worth mentioning in the end, that researchers have found also accessibility and ease of use to enhance users' satisfaction, which in turn, influence positively their intention to use BSS systems (Xin et al., 2018).

2.4.3. Bicycles and systems features and quality

Bike quality and features are very important to provide a good biking experience (Koemle & Morawetz, 2016). Previous studies have discussed the effect of several bike features on cyclists' experience and behavior. Examples of these features are tire pressure, lighting, braking, and gearing systems (Soltani et al., 2019), the ability of the bike to carry the user's belongings (Liu, 2020), bike comfort, and cleanliness (Manzi & Saibene, 2018). Moreover, bike quality (Ma et al., 2020), and attractive design and colors (Bachand-Marleau et al., 2012) are other discussed factors. In general, these bike features and bike quality are found to impact the frequency of using BSS (e.g., Bachand-Marleau et al., 2012), cyclist satisfaction (Manzi & Saibene, 2018), and loyalty in the case of BSS (Jamšek & Culiberg, 2020). It is worth mentioning that bad bike features and malfunctioning bicycles are found to produce negative sentiment and behavioral responses like biking less (Kim & Hong, 2020; Li et al., 2018).

2.4.4. Convenience and perceived usefulness

Convenience and usefulness are well-recognized factors in the literature, especially in BSS-related studies. Convenience refers to comfort levels of bikes and BSS compared to other means of transportation, the ability to avoid traffic and congestions, save time (Ding et al., 2019), and connection to other travel modes (Chen et al., 2019). Perceived usefulness reflects the users' evaluations of to what extent products or services – bikes in our case – can improve their performance (Davis, 1989; Liao, 2016). Several studies discussed the effect of bikes and BSS convenience on satisfaction, loyalty (Xin et al., 2018; Liu, 2020), Intention to use an internal bike system on a university campus (Fernández-Heredia et al., 2016), BSS usage (Li et al., 2018). Regarding perceived usefulness, Shao et al. (2020) found that this factor influence cyclists' satisfaction. Similarly, Zhanyou et al. (2020) reported that bike usefulness positively influences cyclists' satisfaction but also intention to bike more, while Kim and Kim (2020) discussed how perceived usefulness of BSS leads to higher continuance intention toward bike-sharing services.

2.4.5. Price

BSS has challenges that are mainly related with the business model and the costs associated, which includes price and perceived price value. Moreover, the price of a bike is also an important factor at the level of individuals who want to own bikes as a means of transportation (Shaheen et al., 2010). However, price is more studied and investigated at the level of BSS.

Public-private partnership is mostly used when introducing new BSS, meaning that local governments contract private companies or organizations that do not have profit with the services that are provided, to bring BSS to the locals (Lin et al., 2017). The authors also assume that, while the main objective of local governments is to increase the users' numbers, the private companies aim, at least, to seek profits or self-financing as their main goal. The current business model for bicycle sharing generally requires public subsidies, since profit margins are thin (or negative) and competition is fierce (Wang et al., 2018). The main question here is does this partnership bring benefits to both parties and, if so, how do they profit with the adjacent variables?

Médard de Chardon et al. (2017), suggest alternative ways to improve BSS profit and, consequently, their performance that is self-funding through user fees and advertising, but, they also supposed that the adoption of these metrics would be criticized for lack of equity consideration. In the Taipei Youbike case study, Lin et al. (2017) concluded that the metro user's fee and period influence the decision to use BSS as a transportation mode. They also found that the basic fee influence negatively irregular BSS users, at least more than the regular ones.

BSS regular users are very satisfied with the system mainly because it is affordable and there is a low-cost variable associated (Fishman et al., 2013; Shaheen et al., 2011). The low price variable causes a probable social equity effect, which is also seen as a benefit (Fishman, 2015). Potential users could be attracted by discounts, which can help increasing their numbers, but have to be effective and provide clear alternatives and benefits (Grewal et al., 1998). Goodman and Cheshire (2014), affirm that BSS membership cost influence users demographics and equity, and Hoffmann (2016) assume that there are membership discounts available, but they do not satisfy issues on a larger scale, like access and station placement. On the other hand, Chen et al. (2020) indicate that there are two possible scenarios linked to pricing strategies: the high-price strategy is

applied when BSS are better assumed at the convenience factor; the higher price, here, does not mean lack of demand, it means a time-saving advantage that increases costumers to adopt BSS, so higher price and higher demand provide, consequently, higher profits. The low-price strategy has a disadvantage associated to convenience and attracts low-evaluation costumers. The authors also mention that the high-price strategy should be applied in crowded areas because this type of area influence positively the BSS usage to turn the congestion around. On the opposite way, BSS usage expansion is associated with their reduced rental cost, which is an attraction to price-sensitive customers (Garrard et al., 2012). There is also a third strategy that has been adopted, to expand the BSS market, which is the application of subsidies for potential customers directly or indirectly (Zhou et al., 2020). Verplanken et al. (1998) define price value as a benefit associated with the users' cognitive tradeoff between perceived applications quality and the price that they have to pay for using them.

Dockless BSS operate differently. The rental business is based on a time-sharing leasing mode, and it can be paid with a mobile phone (Li et al., 2018). The authors also suggested that this new business model can benefit both parties, customers or public and private organizations. Some sharing bike enterprises apply a paying system that multiplies the price, based on the number of hours that the customer uses the bike, which means that, the first hour is free, the second one will have a cost associated, the third a higher one, and so on (Guo et al., 2017). Finally, the gas and gasoline/fuel increasing prices can provide the adoption of bikes and BSS which do not have that kind of costs associated, so it is a more promising opportunity for potential users (Younes et al., 2020).

2.4.6. Regulations

The number of people using bicycles and e-bikes as a mode of transportation has been growing rapidly and spontaneously, which may cause some problems with laws on public roads, and the adoption of new practices and norms is required (MacArthur & Kobel, 2014). As a result, more confrontations between this mode of transportation and vehicle drivers, pedestrians, other bicycle riders, and even scooter users are to be expected (Wang et al., 2021). Given the present rules, numerous nations and jurisdictions in the United States are introducing new regulations and procedures primarily for e-bikes (MacArthur & Kobel, 2014; Fishman & Cherry, 2015). Wang et al. (2021) think that following existing

laws on different issues, such as wearing a helmet or riding in the correct lane, are some of the most important aspects in ensuring the safety of bicycle users.

2.4.7. Purpose of use

In business terms, purpose means whether the product or service matches the intended functions of the consumer (Mohd et al., 2013). According to Liu et al. (2018), the main implementation goal of bikes is to solve "the last kilometer" problem. In this context, bicycle usage as daily means of transport is optimized in narrowed distances and enables people to use environmental-friendly transportation modes, which is also a purpose of use mentioned by some cyclists/bicycle users (Zainuddin et al., 2016). In the same vein, the main goals of bicycle use are decreasing energy consumption, private vehicle usage, and environmental pollution, while it contributes to the improvement of congestion quality and promotes short distance usage (Chen & Lu, 2016).

Fernández-Heredia et al. (2016) suggest that supporting bikes as a healthy and eco-friendly means of transportation and convenience are the variables that encourage more people to use bicycles. The first one is related to the positive willingness to the bicycle and the second one is linked to transportation mode convenience, flexibility, and efficiency. In some studies, bicycle purpose of use is associated with leisure (Chen & Chancellor, 2020). The authors mention that when using BSS, people use the system more often for leisure than for commuting. Chen and Chancellor (2020) assume that five factors influence the relation mentioned before, which are expected efficiency, social impact, price value, hedonic motivation, and routine.

For those who do not own a car, having a positive cycling mindset has a poorer positive impact on both bicycle commuting use and length. In terms of commuting for other reasons, residents of densely urbanized areas have a greater positive correlation with cycling length than residents of less urbanized areas (Gao et al., 2019).

Several studies have discovered several purposes for using bikes, some particular to e-bikes and others to bicycling in general (Kaplan et al., 2015). Bicycle users intend to use bikes as a means of transportation replacing other vehicles like cars, in this case, they are basically using bikes to commute, go to work, or school (Cairns et al., 2017), furthermore, in some cases, people who used already mechanical bicycles as a mode of transportation

might also intend to shift to e-bike (Jones et al., 2016b). Moreover, MacArthur et al. (2014) found that, among other purposes of use, bikers utilized the bike to exercise while doing other things, to see friends and people in general, and to conduct local excursions. Focusing especially on e-bikes, it was found that the riders' goal is to be able to ride longer distances with less physical exertion as compared to a mechanical bicycle. The same study discovered the rationale that the users aim includes replacing polluting modes of transportation; the physical health advantages it offers; and the simplicity of being able to see friends and people in general. Furthermore, according to Van Cauwenberg et al. (2019), the two most common reasons for biking are commuting and service trips, as well as shopping. Finally, it has been found that the goal of bike users is to feel peaceful, i.e. relaxation (Wolf & Seebauer, 2014).

2.4.8. Green value and sustainability factors

Some studies have shown that multiple types of customer behavior can theoretically affect product greenness. One research, for example, found that customers were willing to pay up to 10% more for a green product; that means, customers who are more conscious of environmental concerns are more willing to pay a higher price for green products/services (DeMedeiros et al., 2016). Other researches have indicated that customers can spend more on green products/services (Casadesus-Masanell et al., 2009). Besides that, through specifically affecting loyalty or implicitly influencing loyalty by functional, emotional, and social meaning, green value has also been found to have high evidential support to post-consumption behavior (Koller et al., 2011). On the opposite way, despite the increasing in users' perceptions of green value and sustainability, Di Pietro et al. (2015) found that when people need to make a decision related to transport equipment tools or transport equipment greenness, they prefer the tools/function rather than greenness. The consequence of this, allied to the second paragraph, is that government policy can provide green transport, which offers a high degree of green perceived value to create green loyalty to green transport, such as encouraging bike use or providing BSS (Chen, 2016).

In the last few years, sustainability and green value have gained more importance and are seen as one of the most important issues to be solved by governmental entities. Encouraging the use of bikes and adopting initiatives like BSS are the top strategies to

promote and highlight sustainability and green value. Dudow (1998) defined green transportation as a service that does not affect negatively the human being or ecological conditions, even if it is for short or long terms. Public bike usage contributes to cities' sustainability, which helps to perform lower gas emissions and wastes, reduces land use and noise pollution (Gehlert et al., 2013). Since BSS do not only provide comfort to people but also completely incorporates the principle of environmental benefits, it is important to urge consumers to embrace bikes and BSS for this purpose. Public and private entities are concerned with environmental issues and health sustainability so they are searching for a safe path to increase bikes and BSS usage (Wang et al., 2018).

Chen (2016) assumed that to increase bike users' number governmental entities have to adopt policies associated with green value loyalty perceived by certain users. The author also affirms that governments can be an exceptional track to help people to understand the importance of improving the environment and prevailing the green thinking, by providing new forms of green transportation. In this guideline, the author states to achieve transport sustainability goals the users and potential users have to perceive bikes as a green service and that service is one of the best tools to conquer it.

Gehlert et al. (2013) represent green value as a customer expectation of the utility of commodity-focused on perceived favorable environmental impacts. The green perceived value applied to bikes and BSS is a collection of characteristics correlated with the understanding of environmental importance, which may promote an interesting Word-Of-Mouth (WOM) impact and improve reuse intentions (Verhagen et al., 2012). On the other hand, they describe green perceived usefulness as a degree to which people believe that in some aspect of their life, a bike infrastructure may lead to environmental progress in an organizational context and includes efficiency, significance, and competitiveness for self-health interpretation, traffic improvement and the value of green usefulness.

2.4.9. Social factors

The biking experience like any consumption experience has a social side (Bakker, 2017). Social variables can influence the cycling experience and the bike users' attitudes and behavioral responses in several ways. These social variables include the subjective norms

which mean the effect of the social circle and others on the bike user behavior. The mentioned social circle includes family and friends (Eccarius & Lu, 2020).

Cerutti et al. (2019) indicate that the social factor is directly linked to the proclivity of users to develop sustainable practices based on socially shared aims. In this vein, Chi et al. (2020) argue that bike users intend to compare themselves to others. Moreover, Xiao and Wang (2020) highlighted the social role in biking experiences by the tendency of cyclists to share biking experiences and share information about bike brands for example. Sherwin et al. (2014) report that social interaction among bike users is raising bike importance in society and influencing the growth of cyclists' number. Ge et al. (2020) assume that the decision to use bikes and/or BSS can be influenced by social encouragement. The authors mention that individual commuting habits are referred to as personal preferences, although the user's general understanding of bike usage is referred to as social reinforcement. They also state that the respondents' perceptions of social support came from three different atmospheres, which are: family, friends, and social groups. Concluding, the authors, consider that positive attitudes regarding bike usage and desire to use bikes are positively predicted by social support.

Sun et al. (2019) analyzed Chinas' strategy and found that, to address the issue of negative externalities of bikes, the Chinese government and news media have conducted comprehensive advertising and education activities on civilized cycling since the beginning of bike usage and that actually, the entire society has achieved a relatively welcoming cycling environment, which affects and governs users' cycling habits and acceptance of cycling.

Several studies investigated the effect of social factors on bike user behaviors. In this vein, several social variables like subjective norms are found to impact the choice of bike brand (Xiao & Wang, 2020), well-being (Ma et al., 2018), and intention to use BSS (Kaplan et al., 2018).

2.4.10. Health factors

Cycling is well-known as a healthy activity that provides many physical and mental benefits. One of the reasons bikes and BSS were adopted and encouraged by transportation policymakers is because they help in reducing gas fuel usage and traffic congestion (noise

pollution), which improve public health (Shaheen et al., 2010). Moreover, Mattson and Godavarthy (2017) state that all cities have to encourage biking and implement BSS to improve the citizens' health in urban areas. In this vein, Woodcock et al. (2014) discussed the positive effect of implementing BSS on users' health. In general, the main health benefits of adopting bikes as means of transportation are physical and mental health benefits, reduction of gas emissions, and fuel usage (Cerutti et al., 2019; Shaheen et al., 2010). Moreover, Meschik (2012) and Brown et al. (2009) discussed several health outcomes of biking such as weight control and willpower and disease prevention.

Health factors are found to influence several behavioral responses like the acceptability of bikes (Nikitas, 2018), usage of BSS (Li et al., 2018), satisfaction (Ding et al., 2019), and biking more frequently (Reilly et al., 2020).

2.4.11. Hedonic factors

Hedonic correspond to people's perception of their enjoyment dimension related to something (Mathwick et al., 2001). Hedonic factors and their value are related to emotion, interest, and enjoyment (Liu et al., 2018). Enjoyment is assumed as a type of motivation that people feel when they are interested in doing something (Ryan & Deci, 2000).

Voss et al. (2003) found that hedonic benefits are more often understood by customers/users during the usage process experience. The consumption experience has a relation with hedonic benefits (Chitturi et al., 2008). Liu et al. (2018) suggest that the emotional and enjoyable part of the buying experience is given by hedonic benefits perceived by the customers.

Zhang et al. (2015) found that biking is an enjoyable activity. This activity is pleasant and hedonic because it includes pleasure, relaxation, and fun while cycling (Wu et al., 2019). Wu et al. (2019) also discussed that the hedonic side of the biking experience can be enhanced when bike users do do have to worry about where to park a bike, or if their bikes are going to be stolen. Moreover, Gumussoy (2016) discussed that the purpose of biking can influence the hedonic side of the biking experience; people are more likely to feel the hedonic side of the biking experience when their purpose the use is to have fun or for relaxation purposes.

Previous studies found that the hedonic factors and motivations have a positive effect on the intention to use bikes and BSS (Wu et al., 2019), the biking experience (Bejarano et al., 2017), satisfaction (Chen & Huang, 2020), and well-being (Zhang et al., 2017).

2.4.12. Safety and security factors

Bieliński et al. (2019) stated that cyclists' safety is being considered more important nowadays due to the fact that roads are more congested hence dangerous. Lack of safety increases the disadvantages of cycling, especially when cyclists' and pedestrians' safety is in danger. The traffic safety environment is a crucial factor that influences everyone using the road (Ge et al., 2020). A safer road environment influences behavioral intentions towards bikes (Gehlert et al., 2012). There is a relation between traffic safety and cycling structure (Bakogiannis et al., 2019). Hence, to improve safety conditions at the level of bike users, previous studies suggested adding more bike lane color, adding more lanes, and distinguishing between bike lanes and pedestrian lanes (Fetterman et al., 2015). Hassan et al., (2017) added to that by suggesting adopting early social learning strategies and safety awareness campaigns in schools, so students from an early age develop safe biking behavior. Security is another similar factor that influences the biking experience, and it is more about feeling secure and exposing less to road problems, bike damage, and being disturbed or stolen by others when biking (Therrien et al., 2014).

Safety and security factors are found to influence cyclists' satisfaction (Ge et al., 2020), intention to bike more (Hess & Schubert, 2019), willingness to shift mode to bikes (Ma et al., 2020), and adoption of BSS (Efthymiou et al., 2013). Moreover, feeling unsafe while biking is found to negatively impact bike use and the adoption of BSS (Bieliński et al., 2019).

2.4.13. Attitude towards cycling and other transportation means

Several studies have discussed bike user attitudes. These attitudes can be towards transportation means in general, like the attitude towards the car and public transportation use, bus or subway use, car ownership, lack of transport, and so on (Wang et al., 2018), or can mean the attitude associated with using and owning the bike only. The attitude

towards transportation means, in general, can be influenced by several factors and use beliefs like health factors, opinion about the need to reduce pollution and congestion, the usefulness of the transportation mean, its safety, and security (Fishman et al., 2013). The attitude towards cycling is influenced by the same factors considering the use of the bike as the main transportation mean. Positive attitudes toward cycling is a variable that contributes to choosing the transportation mode in users' daily life (Kaplan et al., 2015). People's attitudes toward modes of transportation are essential for policymakers who want to improve bus ridership, biking, or cycling (Gao et al., 2019).

Previous studies have found that the attitude towards transportation means has an impact on the likelihood of biking or using BSS (Milakis, 2015; Therrien et al., 2014), switching from an existing transportation mode to using the bike (Campbell et al., 2016), and bike user satisfaction (Albiński et al., 2018). Moreover, some studies found that owning a bike increases BSS use (Guo et al., 2017; Milakis, 2015), while owning a car influences negatively the use of BSS (Wang et al., 2017).

2.4.14. Weather and topography

Weather conditions and topography are other natural factors that influence the biking experience. Weather conditions include rain and wind speed (Corcoran et al., 2014), temperature, humidity, and heat (Fishman et al., 2012), cloud-cover, sun (Wang et al., 2018), and snow (Godavarthy & Taleqani, 2017). As for the topography variables, they include the presence of steep terrain (Patel & Patel, 2020), slopes (Liu, 2020), and hills (Fishman et al., 2012).

Many previous studies have discussed the effect of weather conditions and found that these conditions influence intention to use the bike (Xu et al., 2020; Gebhart & Noland, 2014), intention to use BSS (Kim, 2018), satisfaction (Albiński et al., 2018), and the intention to switch from other transportation modes to biking (Campbell et al., 2016). Previous studies also have found that bad and difficult topography have a negative impact on bicycle riding frequency (Ma et al., 2019), and adopting BSS (Mateo-Babiano et al., 2016). Moreover, Liu (2020) found that bad topographical conditions have a negative impact on bike user satisfaction.

2.5. Emotions and experience

In this section, the concept of emotions, and their role in the consumption process and outcomes are discussed. After that, the previous studies that investigate and discuss the role of emotions in travel experiences are reviewed.

2.5.1. The role of emotions

Emotion is characterized as a mental state of preparation that arises from cognitive appraisals of events or feelings, has a phenomenological structure, is accompanied by bodily processes, is frequently expressed physically (e.g., in gestures, speech, and facial features), and may lead to specific actions to affirm or cope with the emotion, depending on its meaning and background for the person (Lazarus, 1982). In the same vein, Levenson (1994) adds that emotions represent adapting modes to new environment demands being short duration psychophysiological phenomena. The emotion as a distinctive factor is the way that it arises, so emotions appear when people find an answer to their evaluations about something that contributes, or not, to one's well-being (Bagozzi et al., 1999). Based on that, incident, and situational personal meaning are reasons that trigger specific emotions (Levenson, 1994; Bagozzi et al., 1999). Hetland et al. (2019) claim that emotions develop as a result of the activity's overall purpose being met. They also state that, if a goal is fulfilled in full or in part, the individual will be rewarded with a good emotion such as contentment, happiness, or mastery. However, if the aim is not met, the experience will be evaluated negatively, resulting in dissatisfaction and bad sentiments. All emotions have an important role in people's lives and they reflect someone's way to make some decisions. Emotional value is defined as the perceived value of a service's ability to elicit emotions or emotional states (Sheth et al., 1991). According to Lin (2004), emotional/affective responses are influenced by the holistic mental image that individuals form based on elements. Lazarus (1999) assume that this leads to cognitive appraisal and interpretation of the affective response. Based on that, individuals, in a final instance, respond behaviourally to the event (Mehrabian & Russell, 1974).

2.5.2. Emotions in the consumption process and outcomes

Academics in consumer sectors, such as retailing and marketing, investigate the various emotional states of consumers, as evidence from earlier studies show that these emotional states impact consumer purchasing behavior (Mogilner et al., 2012; Philips & Baumgartner, 2002; Simonson, 1992). There is a link between emotional states and the intention to engage in certain consumer activities (Hosany & Prayag, 2011).

Although emotions are used to understand customer behavior (Saintives & Lunardo, 2016), there is a dearth of study in this area, and there is a lot more to investigate (Millán et al., 2016). This restriction, according to the authors, occurs because it is thought that customers are focused on other activities rather than feeling emotionally aroused, which they claim is not the case. As a result, it is argued that every type of experience, whether utilitarian or hedonic, is impacted by emotions (Caru & Cova, 2003). When it comes to decision-making, Bagozzi et al. (1999) indicate that we may evaluate if it would make us feel better or worse, which is based on expectation. Similarly, Philips and Baumgartner (2002) argue that before making judgments, customers erroneously forecast their emotional state. Decisions can be made both rationally and emotionally, psychologically speaking (Soscia, 2007). Furthermore, numerous research has indicated that customer behavior and purchase intention are more emotional than cognitive (e.g., No Hirschman & Holbrook, 1982; Caru & Cova, 2003) As a result, it is proposed that distinct emotional states reflect different decision-making processes.

2.5.3. Emotions and travel experience

Emotions and emotional states are also antecedents of travel experiences (Millán et al., 2016). Fitt (2015) found that perceptions of leisure biking were often connected to fun and pleasantness. Participants in Fishman et al. (2014)'s study ranked fun as the fourth most important factor that attracted them to use BSS. Such perceptions sound to exceed national and cultural boundaries, as Chen (2016) also state that people's intentions to use BSS in Taiwan were significantly affected by positive and escape emotions. Choi and Choi (2020) found that the perceived emotional values have a significant positive effect on environmental factors and perceptions. Moreover, the externalities, rational and emotional

values, all are found to be positively related to user satisfaction, while the perceived risk is negatively associated with user satisfaction. The authors argue that the invisible values of emotional sharing are much more important than the visible profits in the economy of sharing.

Although the mentioned above studies have investigated the role of some emotions in the cycling experience, the emotional states of bike users remain as not well-discussed topics and more effort should be put into this direction. One of the main objectives of our study is to explore the main positive and negative emotions that play an important role in the whole bike user experience.

2.6. Section conclusion

In this section, the main theoretical background is presented and discussed. This includes shedding light on the importance and great growth of micro-mobility two-wheelers, the growth in bike's business and use, how cities are adopting bikes as main transportation modes to reduce congestion and improve environmental and health aspects. Thereafter, the biking experience is also discussed whereas illustrating the main factors that can contribute to improving this experience. Next, we discussed BSS as a valid alternative to vehicle ownership. Thereafter, the main factors that influence the bike and BSS experience are reviewed. This includes the following factors: temporal and spatial factors; accessibility and ease of use; bicycles and systems features and quality; convenience and perceived usefulness; price; regulations; purpose of use; green value and sustainability factors; social, health, hedonic, safety and security factors; attitude towards cycling and other transportation means; and weather and topography. Moreover, this section discussed the role of emotions in the consumption process and outcomes and the role of emotions in travel experiences.

3. Methodology

To study bike user behavior, research has used quantitative (Chi et al., 2020), qualitative (e.g., Bejarano et al., 2017), and mixed-method techniques (Hess & Schubert, 2019). Since the aim of this study is to explore the factors that influence the bike experience at the level of people who use the bike to commute, the study is qualitative using the Critical Incident Technique (CIT) for data collection. Bitner et al. (1990) suggest CIT as essentially a classification technique that employs the analysis of content data from critical stories or incidents. This method invites individuals to describe certain incidents and can be used to analyze consumer descriptions of both negative and positive critical incidents (Jones, 1999). Therefore, it does not simply consider any incident, but rather incidents that are memorable because they were considered particularly positive or negative. CIT allows the exploration of several factors that influence the user experience in critical time and this will usually last in the users' minds. In addition, this technique allows probing the main emotions involved in the user experience during a satisfactory and unsatisfactory time. CIT consists of a set of procedures to collect direct observations of human behavior to facilitate its potential usefulness in solving practical problems and developing broad psychological principles (Flanagan, 1954).

According to Creswell (2009), a qualitative investigation is based on the attribution of meanings to the expressions of language that people use to express feelings, emotions, or perceptions about their experiences. Therefore, we understand the research process as being a qualitative approach above all, taking into account the main objectives to be achieved. As far as research logic is concerned, this is inductive, since it refers to a study in which theory is developed from the observation of empirical reality. In this way, general lessons can be induced from particular elements. According to Collis and Hussey (2005), the inductive method goes from the specific to the general.

To fulfil each of the foreseen objectives, the paradigm adopted is the phenomenological one, which is eminently qualitative, subjective, humanist interpretivism and seeks to minimize the distance between the researcher and what he/she is investigating. By adopting this paradigm, the most natural thing is to analyze small samples. According to Giorgi (1994), the phenomenological paradigm focuses on the human consciousness during the whole process of research, living social situations, and showing itself as one of

the approaches that best captures the essence of human experience and its interaction with environments.

In the direct process, the purpose of the research is known by the interviewee and the most important techniques are focus groups and in-depth interviews (Malhotra, 2001). In this dissertation, are used in-depth interviews built on CIT, hence, the primary data is collected via conducting interviews. Malhotra (2001) defines the in-depth interview as unstructured, direct, personal, seeking to discover the motivations, beliefs, and attitudes of the participants regarding a subject.

3.1. Purpose and significance of the study

Concerning the literature about bike user behavior, scarce attention has been given to the emotional states and their role in influencing the whole biking experience. In other business areas, such as marketing and retail, the influence of different emotional states on consumer behavior is well-recognized (e.g., Baker et al., 2013; Helmefalk & Hultén, 2017; Machleit & Mantel, 2001). However, very little is known about the role of emotions in the bicycle user's experience and the transportation field in general. Therefore, there is a need for further research in this area. This dissertation considers emotions as a factor that need to be better understood to get more knowledge about their role in this field. Understanding the user emotional experience would provide us with more information to base recommendations on how to improve the biking experience since different emotional states are expected to influence the cyclists' decision-making, just like any consumer decision-making about other products or services.

This study focuses only on a sample of urban bicycle users who use the bicycle as means of frequent transportation. This is to understand what the pains of these users are, the main emotions and feeling they experience during the bike use, and how they react to these emotions and feelings, thus contributing to questioning ourselves in the future why other people probably do not use the bicycle as a daily means of transportation. Based on the results of this dissertation, it is expected to provide several recommendations and tips for policymakers and other involved stakeholders like municipalities and operators of BSS to improve the bike user experience.

3.2. Research questions and objectives

Qualitative research is expected to help to explore and determine the main factors that impact a specific phenomenon (Creswell, 2009). The author also suggested the importance of having clear and specific research questions and sub-questions which is expected to produce better research outcomes.

In this thesis, the central question is: What are the main factors that influence the cyclists' user behavior, and how different emotional states (positive and negative) can play a role in the bike user experience? The study aims at finding answers to the following research questions:

1. What are the main factors that influence the bike user experience?

2. What are the main emotional states triggered by these factors?

3. What are the main behavioral outcomes related to these factors and emotional states?

Based on these questions, the main objectives of this research are:

1. Determining the main factors that influence the bicycle user experience;

2. Determining the positive and negative emotional states that appear during the experience and influence it;

3. Determining the main behavioral outcomes of these factors and emotions.

4. Understanding the role of the emotional states in the relationship between the influencing factors and the user behavior;

5. Providing policymakers and authorities with tips and recommendations on how to improve citizens' biking experience.

After introducing the research questions and objectives of this study, the research design is presented next. In the following, the qualitative approach with a focus on CIT, data collection method and procedures, sampling and characterization of participants, and data analysis procedures are discussed.

3.3. Research design

The methods and techniques applied in this research are discussed in this section. In addition to that, the interviews, including sample characteristics and all related information are highlighted and examined. Because the objective is to understand the role that emotions play in the bicycle user experience, qualitative research based on interviews was employed. In-depth interviews help to provide a deeper understanding of the role of several factors and emotions that influence the biking experience. In-depth interviews allow direct interaction between researchers and individuals resulting in a better understanding of the topic under investigation (Creswell, 2009). The use of CIT also provides a good understanding of the user experience since it focuses on the critical moments that could have a high impact on someone's emotions, feeling, and behavioral responses (Jones, 1999).

This section will be split into five primary topics (1) qualitative approach and CIT; (2) data collection methods and procedures; (3) sampling and characterization of the participants, (4) data analysis procedures, and (5) code saturation.

3.1.1. Qualitative approach and CIT

Qualitative research is an appropriate approach when there is little knowledge on a certain field of study, or when there is a dearth of research on a particular phenomenon (Creswell, 2009). This turns out to be the primary rationale for using a qualitative method in this study since there is a paucity of research that takes emotions into account while examining bike user behavior (Chen & Chancellor, 2020). Morse (1991) indicated that the qualitative method may be essential in these sorts of circumstances where little knowledge is known about a specific topic because the issue is relatively new or undiscovered; the topic has seldom been handled with a specific sample, or current theories do not apply to the sample.

The CIT is an appropriate approach for creating the essential circumstances stated above, i.e. a research method that permits achieving an answer in an area where there is a shortage of study (Patton, 1990). This study uses CIT to explore the particular emotions cyclists feel when different factors influence their bicycle experience, and the future

decisions they make after the incident. According to Flanagan (1954, p. 327) CIT is “a set of procedures for collecting direct observations of human behavior in such a way as to facilitate their potential usefulness in solving practical problems and developing broad psychological principles”. CIT's main goal is to understand, from the individual perspective, the incident, based on his/her own cognitive, affective, and behavioral components (Chell, 1998). CIT is a good source to provide significant data, especially when research aims to explore a new set of factors and emotions that influence behavioral responses in some specific situations (Gremler, 2004). In this particular case, the use of this technique is applicable, especially that we are investigating specific and critical moments of bike user experiences.

The CIT approach usually asks the interviewees to tell a story about a specific experience they had, which can be either pleasant or unpleasant, positive or negative (Gremler, 2004). The author also assumes that, in the data analysis, researchers will first determine the incidents that play a role in the research, and then the development of main categories and subcategories. This technique can be used through conducting interviews, written questionnaires, and record forms. In this research, interviews were used as a qualitative data collection tool.

3.1.2. Data collection method and procedures

For this study, the critical incidents were, initially, collected from Guimarães Municipally workers who use the Municipally Bike Sharing System. Since only four people were interviewed from Guimarães Municipally, the sample was extended by interviewing individuals who own a bike and use it in urban areas basically to commute, but also to shop, and for leisure. Moreover, two more people who use BSS to commute were also interviewed. To reach these objects, the snowball sampling technique was applied by contacting potential individuals through social media, and by asking our interviewees to introduce us to their friends and colleagues who qualified to be part of this research.

To reach the goals of CIT, participants were asked to think of a particular incident, a negative or positive story that happened during their cycling experience, and describe it in detail. To do this procedure the following questions were applied:

1. Think about an incident that made you particularly satisfied or dissatisfied when you were using a bicycle in a daily experience... Can you recall any stories?

2. Try to describe this incident...

3. Where and when this incident happened?

4. For how long the incident lasted?

5. For how long has it stayed in your mind?

6. What exactly made it particularly satisfying or dissatisfying?

7. Can you describe it emotionally? What kind of emotions did you experience?

8. Did you take any decisions based on this experience?

9. Can you recall another incident?

According to Funches (2011), a structure of relations and a sequence of ideas must be considered while using CIT. In this study, a critical incident is a particular experience that is influenced by some factor or reason, which leads to specific or several emotions, and makes the interviewee take any future decision based on that. The incidents that were not directly related to the interviewee and that were focused in a general and subjective story were removed, for example:

"I was not worried about having to leave the bicycle somewhere. I pick it up at one place and drop it off at another place and that's the end of the story." (Interview #6, female, 26 years old)

"I always tell the same story... In Holland, bicycles were made available for free for all people to use. Some people used them and others just didn't care and took the bicycles and threw them in the canals... I have seen several cases here in Portugal where systems are implemented in which, first, they don't take care of the maintenance, or else there is no adhesion and since the number of bicycles that were purchased is small, it didn't pull people to use them. And that's it, systems die." (Interview #3, male, 31 years old).

Based on that, five incidents mentioned in different interviews and one complete interview were found to be ineligible under the conditions mentioned.

All the interviews followed the same process: first, they were recorded, then transcribed, coded, and analyzed. In a general way, the interviews took, approximately, forty minutes. Sixteen interviews were conducted with urban cyclists that use frequently personal bicycles (e-bikes or traditional bikes) or BSS. One interviewee did not correspond to the research objectives and CIT components, which led to his interview being removed. In summary, the final sample includes fifteen interviews. That final sample provided seventy-two incidents in total.

3.1.3. Sampling and characterization of the participants

Sixteen individuals were interviewed in the data collection process. One interview was excluded because it did not produce any incident that fulfills the purpose of the study. The remainder of the sample includes 15 participants (mean age: 45,53), four of them use the Guimarães Municipality BSS; two use other BSS systems while the rest use their own mechanical or electrical bike. Four of the participants (26.67%) are females. Participants use the bike 16,47 km per day, on average, and most of them use it more than four days a week (4,73 day, on average). Regarding the participants' occupation, three are teachers (20%); two are architects (13,33%); two are senior technician (13,33%); one is a technical assistant (6,66%); one is environmental engineer (6,66%); one is commercial technician (6,66%); one is consultant (6,66%); one is law assistant (6,66%); one is physical therapy technician (6,66%); one is public transport guard (6,66%); and one is insurance manager (6,66%). All of the interviewees use the bicycle to commute, as this was one of the requirements to be part of the sample and this research. Eight participants use it also for relaxation (53,33%); four to go shopping (26,67%); two to skip the traffic (13,33%), and one to ride the children to school (6,66%). It should be mentioned that the purpose of use of four of the participants is only to commute (26,67%). Table 1 summarizes the sample characteristics. Finally, 72 incidents were derived from these interviews, on average every participant contributed with around 5 (4,8) incidents.

Table 1. Sample characteristics

Number of participants	Cycling type	Age	Gender	Profession	Purpose of use	KM per day	Number of days a week	Number of incidents
1	MUN BSS	46	Male	Environmental engineer	Commute	4KM	4 days	4
2	MUN BSS	53	Female	Technical assistant	Commute, Relaxation, and Shopping	20KM	5 days	4
3	MUN BSS	31	Male	Senior technician	Commute	5KM	1 day	4
4	MUN BSS	44	Male	Senior technician	Commute	4KM	4 days	3
5	Mechanical bike	57	Male	Teacher	Commute	20KM	2 days	2
6	Other BSS	26	Female	Architect	Commute, Skip the traffic and Shopping	8KM	7 days	4
7	Other BSS	27	Male	Architect	Commute, Skip the traffic, and Relaxation	4KM	6 days	5
8	Mechanical bike	68	Male	Teacher	Commute and Relaxation	15KM	7 days	6
9	Electrical bike	64	Male	Teacher	Commute	15KM	3 days	3
10	Electrical bike	47	Male	Commercial technician	Commute and Shopping	30KM	5 days	6
11	Electrical bike	45	Male	Consultant	Commute and Relaxation	10KM	6 days	7
12	Electrical bike	42	Female	Law assistant	Commute and Relaxation	25KM	5 days	6
13	Electrical bike	46	Male	Physical therapy technician	Commute and Relaxation	30KM	6 days	6
14	Electrical bike	43	Male	Public transport guard	Commute and Relaxation	12KM	4 days	5
15	Electrical bike	44	Female	Insurance manager	Commute, Shopping, Relaxation and Ride her daughters	15KM	6 days	7

3.1.4. Data analysis procedures

Data analysis followed the guidelines provided by previous research using CIT (Chell, 1998; Funches, 2011; Gremler, 2004), and the procedures developed by Flanagan (1954).. Due to COVID-19, all interviews were performed online and recorded. Following the completion of the interviews, they were transcribed and translated from Portuguese into English. They were coded after transcription and translation, taking into consideration the script, and the relevant responses to the questions. This implies that the interview script was written to match the critical event, eliciting information about: the reasons/factors that produced the incident; the emotions felt by the users at the time of the incident; as well as any subsequent actions made in light of these factors and emotional states.

As a result, all codes were tallied and assigned the number "1" whenever they were indicated, always leaving a record of the extract uttered by the interviewee. For example, interviewee number 10 said:

"What happened was that the bus driver must have been late or he didn't like cyclists, so even without signaling he was going to turn left to enter the bicycle path access, he put me at continuous risk... it was a bus with two axles behind, longer than usual, and he didn't return to his line and so I had to make an encroachment maneuverer, on guard to avoid being smashed by the bus"

Based on that, the factor codes "Social Factor (Social problems because traffic)" and "Traffic and Congestion (Difficulty to deal with cars/buses/trucks)" got each one "1 point" mention. Also in the same incident, the interviewee said that, based on the mentioned story, he felt "afraid" and "frustrated", so the codes of the negative emotions "Afraid/Fear" and "Frustration" got each one "1 point".

To evaluate the codes, they were first split into three primary groups: factors, emotions, and outcomes. Then, one by one, into subgroups: all causes; good and negative emotions; and all decisions. Finally, the connections between these variables were assessed to understand their relationships. Mainly we refer here to the influence of different factors and emotional states on bike users' behavioral responses and decisions.

3.1.5. Code saturation

Saturation is defined as the moment at which data gathering provides no new information in comparison to previously collected data (Dworkin, 2012). Some qualitative research specialists ignore the question of how many interviews are optimal, whilst others claim it depends on a variety of circumstances (Morse, 2000). Guest et al. (2006) assumed that sample sizes are determined by the idea of saturation, which is defined as the point beyond which no new information is detected. Nonetheless, they claim that, while this notion is beneficial intellectually, it is not as useful in reality. The authors disclose the results of an examination of 60 interviews, which revealed that the saturation point was achieved at the twelfth interview and that the main components and elements were already in place by the sixth interview. Except for the overall number of interviewers, this data appears to be very comparable to the interviews performed in this dissertation.

Starting from interview #7, respondents started to repeat similar information that includes factors, emotions, and responses that have been already mentioned in previous interviews. However, only in interview #13, it was noted that no new factors were mentioned. Hence, we considered interview #13 our saturation level, although we maintained the data collection for three additional interviews to make sure saturation level was achieved.

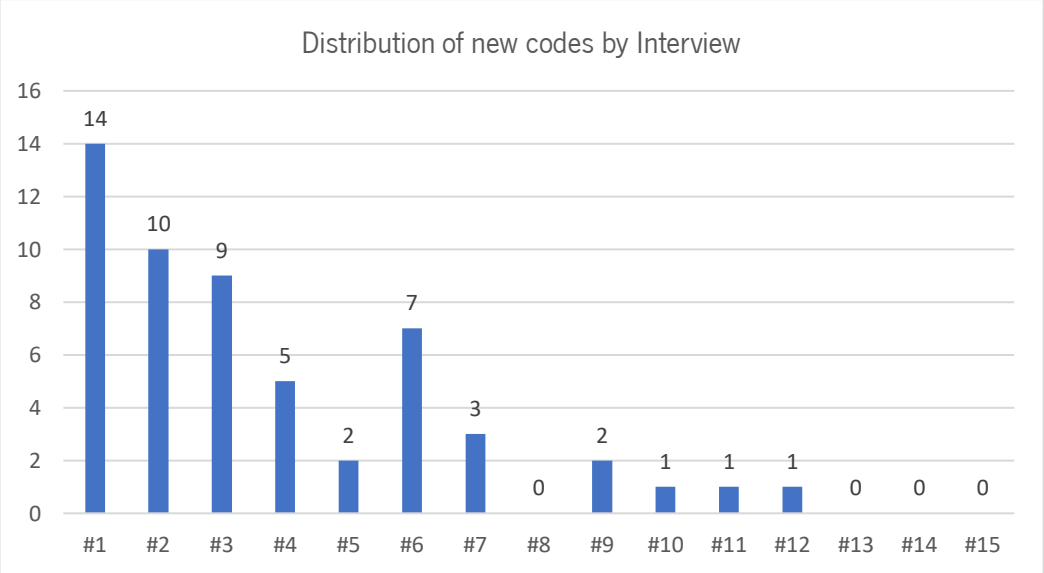

Figure 2. Distribution of new codes by interview

3.4. Conclusion of the chapter

This chapter reports the study's purpose and significance; the research questions and their main objectives; and the research design, which includes the qualitative and CIT approach, data collection methods and processes, interview participant sampling and characterization, data analysis processes, and code saturation.

The first part described the gap we discovered in studies in this field, which is a dearth of study that includes emotions while analyzing bike user behavior. Furthermore, the relevance of evaluating this information in this area was emphasized based on the research, knowing that the effect of emotional states on customer behavior is widely known in various sectors such as marketing and retailing (Ladhari et al., 2017). As a result, it is necessary to assess how these constructions respond in terms of bicycle riders' attitudes and behavior, allowing important information to be defined and provided to policymakers and authorities.

The main research questions were presented in the second major topic addressed in this chapter, beginning with the central question of the dissertation: What are the main factors that influence cyclists' user behavior, and how different emotional states (positive and negative) can play a role in the user experience? After that, the chapter describes how this was disassembled into ones that are more objective. It was also mentioned what the major aims were to answer these questions. Defining the research questions and objectives aided in the development of the following sections, allowing the researcher to recognize the recommended path to take in the research design.

As previously stated, the final topic focuses on the study design, in which numerous issues are described and detailed. This section discusses why qualitative research is important and why CIT is used as a research approach. It is considered that these approaches are the most appropriate for describing how data analysis and processing were performed. The method followed in each interview was also described, as well as how they were coded to fulfill CIT criteria. Following that, the sample was summed and described in general. We then evaluated all participants and stated how they utilized bicycles as a mode of transportation on average. The methods utilized in data analysis were then discussed, such as what the prerequisites were for the interview to be examined and how it was removed

if these conditions were not met. Finally, in this section, code saturation was defined and analyzed, and it was determined that there is some dispute in what the optimal aims in this parameter are.

4. Results

Results from CIT defined seven main influencing factors that impact bike users' emotions, behaviors, hence the biking experience in general. Moreover, the results determine the positive and negative emotional states elicited by these factors. Finally, the findings indicate the main positive and negative outcomes and behavioral responses produced in such critical biking moments.

4.1. Influencing factors

Based on Table 2, the primary reasons/factors of incidents include social factors; traffic and congestion; physical and mental health; bike features; safety; infrastructure; and weather and topography. The social factor is the most recognized factor that was found to influence bike user behaviors and experience. It was indicated in 14 interviews (93.33%). Typically, people reported several incidents that are specifically related to the **social factor**, some of these incidents are positive. The positive stories included social recognition and social interaction with others, as the following quotes exemplify:

"My son friends said I am the coolest mom" (Interview #1, Female, 46 years old).

"It was the fact that afterward when he talked to me, he had already noticed me and thought that was cool that a girl was riding a bike, that was full of gumption" (Interview #12, female, 42 years old)

"It's good seeing people around you, you get to know your surroundings and the city" (Interview #7, male, 27 years old)

Table 2. Influencing factors

Influencing Factors	Incidents, Freq (%)	Interviews, Freq (%)
Social factors	31 (43,06%)	14 (93,33%)
Traffic and congestion	19 (26,39%)	13 (81,25%)
Physical and mental Health	9 (12,5%)	8 (53,33%)
Bike features	11 (15,28%)	10 (66,67%)
Safety	9 (12,5%)	8 (53,33%)
Infrastructure	13 (18,06%)	11 (73,33%)
Weather and topography	10 (13,89%)	9 (60,00%)

However, more incidents that consider the social side are negative. In this vein, respondents reported social rejection, social conflicts due to traffic problems, difficulty dealing with pedestrians, police, and scooter users. The following excerpts from the interviews illustrate this type of situations:

"People not being able to realize that this is a different time and that bicycles are to be used by both adults and children" (Interview #1, female, 46 years old)

"A motorist who honked at me and went off on a tangent passed me and it just brought out the worst in me, I insulted him" (Interview #11, male, 45 years old)

"An e-bike does not make any noise, we have many tourists, and sometimes people got a little scared "(Interview #4, male, 44 years old)

"I felt that I was overreacting because I was on a bicycle and I noticed that there was no one coming across the crosswalk, and a police officer stopped me" (Interview #6, female, 26 years old)

"I felt that he was a person on a scooter who was not aware of the care that he had to take when using the public road" (Interview #10, male, 47 years old).

The analysis of the sub-codes shows that social recognition was mentioned 10 times, social interaction with other people (2 times), social rejection (4 times), social conflict due to traffic (10 times), difficulty to deal with people (5 times), difficulty to deal with police (1 time), and difficulty to deal with scooters (2 times). This data leads to a total of 34 indications of influencing social variables. It is worth mentioning that social recognition and social problems are seen to be more relevant. On the other hand, conflict with people, difficulty to deal with the police, and difficulty to deal with scooters, seem to be less relevant in this particular study. The previous information is considered less relevant because those kinds of incidents were mentioned just a few times, and never had another interviewee that recalled a similar incident.

The main emotions triggered by positive social incidents were happiness (10 times), joy (3 times), and relaxation (2 times), and the main outcomes of these positive incidents were the desire to bike again (6 times), satisfaction (5 times), and intention to continue doing what the interviewees were doing (5 times). Conversely, the negative social incidents were linked to negative emotional states like frustration (13 times), anger (10 times), and fear (7 times). These negative incidents were leading to different behavioral responses like having a more careful cycling behavior (14 times), changing the cycling behavior (4 times), and intention to keep what they were doing (4 times).

The second most mentioned factor that influences bike user behaviors is **traffic and congestion**. It was indicated in 13 interviews (81,25%). The interviewees only reported negative incidents related to traffic and congestion. So, traffic and congestion variables influence cyclists' user experience in a negative way. These incidents included stories related to the difficulty to deal with cars, buses, and trucks; difficulty to deal with other cyclists; and fear of hitting pedestrians, as the following quotes exemplify:

"I think there are many motorists who have no respect for cyclists, they pass too close, they honk their horns and that is it" (Interview #8, male, 68 years old).

"When he passed me, he did it in a very close way, and then the bus stopped and I approached the driver" (Interview #13, male, 46 years old).

"Some people ride on the street, on the road, some people ride on the sidewalk" (Interview #6, female, 26 years old).

"The e-bike does not make any noise, we have many tourists, and sometimes people got a little scared" (Interview #4, male, 44 years old).

All of the above-mentioned traffic and congestion-related sub-codes were indicated by 13 interviewees. However, the particular case of difficulty to deal with cyclists and fear of hitting pedestrians were mentioned only 1 time. The most mentioned variables are the difficulty to deal with cars, buses, and trucks, which are mentioned 18 times, and found to harm the biking experience.

The emotions triggered by traffic and congestion reasons were all negative. The most frequently mentioned in this particular context were anger (15 times), frustration (7 times), and fear (4 times). These negative incidents were leading to different behavioral responses like having a more careful cycling behavior (13 times), changing the cycling behavior (3 times), or sometimes just maintained their current behavior (2 times).

In approximately half of the interviews, cyclists' **physical and mental health** was found to enhance the biking experience. Biking for being healthier and biking for relaxation was discussed in 8 interviews (53,33%). All of them were related to positive emotions and outcomes of the biking experience. The quotes below illustrate this factor:

"Biking outside and being in touch with natural light is important to get a good mood for the rest of the day (Interview #7, male, 27 years old).

"I stopped running and I picked up a bike to do the rest of the path, and I keep doing exercise using the bike" (Interview #6, female, 26 years old).

Interestingly, incidents in which biking is associated to relaxation and mental health were almost as twice as many incidents that associate biking with physical health. The first one was mentioned 7 times while the second was mentioned only 3 times. This may reveal

that bicycle users use them more for mental health than physical health, or the mental health variable is more important for those who use bikes, and it has a higher influence on the biking experience. Moreover, the fact that the main purpose of the bike use for our sample is commuting can also explain why physical health is less important in this context. The main emotions triggered by health incidents were happiness (7 times), joy (4 times), and relaxation (3 times), and the main outcomes of these positive incidents were the desire to bike again (9 times), the intention to continue doing what the interviewees were doing (4 times), and satisfaction (3 times).

Bike features and their effect on cyclists' emotions and behaviors were mentioned in 10 interviews (66.67%). In most of these interviews, the features were mentioned one time only. Occasionally, people reported that they had incidents that were related to bike features like low or high speed, tires and pedals, loss of breaks, lack of warning features, GPS, or charger, and finally bike quality variables. Almost all of the mentioned bike features and bike-related variables were discussed at the level of negative incidents indicating that the lack of these features is always associated with negative experiences, except for one, which revealed that the bike, in the first contact, seems to have good quality. The following excerpts exemplify this factor:

"No matter how electric it is, it does not have the same speed of a car" (Interview #1, female, 46 years old).

"Sometimes reaching a speed around 50km/h, is very fast". (Interview #2, male, 53 years old).

"...the tire size is a defect, in the width; it is very thin..." (Interview #2, male, 53 years old).

"I lost my breaks" (Interview #3, male, 31 years old).

"The e-bike almost does no noise, and there are no warning features" (Interview #4, male, 44 years old).

"...the bicycle is not an appropriate means of transport to use GPS" (Interview #7, male, 27 years old).

"I was a little upset because I could have brought the charger" (Interview #9, male, 64 years old).

"Seeing that the model has a lot of quality, I thought it would be a much weaker thing and in reality, it is not. It is a great product developed by the city council". (Interview #11, male, 45 years old).

For instance, the sub-codes high speed breaks lost, no GPS features, charger needs, and bike quality; were mentioned only one time. Low speed and no warning features, which were related to other factors, were mentioned two times each. The one that was referenced the most was tires and pedals reason, which was mentioned three times.

The emotions linked to positive bike features, which were mentioned only one time, were happiness and joy; and the main outcomes of these positive incidents were the desire to bike again and higher levels of satisfaction. However, the negative bike features incidents happened more often, and they were mainly linked to negative emotional states like frustration (5 times), fear (3 times), sadness (2 times), and awareness (2 times). These negative incidents led to different behavioral responses like having a more careful cycling behavior (9 times), intention to discontinue biking (1 time), and interestingly one participant reported the intention to bike in an unsafe way.

Similar to health and mental health, **safety** was mentioned less often. However, it was noted in more than half of the interviews (53, 33%). In summary, once in a while, there was an interviewee that mentioned safety as a factor that influenced their experience. Just like the factor bike features, safety was discussed only once in almost every interview. Respondents indicated stories about unsafe ways, respect to safety issues, and danger of roads, as illustrated by the following quotes:

"I had a few drinks and by the time I got home... I took the bike because I didn't want to leave it at work all weekend and I ended up scraping a car mirror" (Interview #7, male, 27 years old).

"I've always had some care and respect for cars, to get as far to the right as possible and respect the traffic signs" (Interview #3, male, 31 years old).

"The road is very dangerous. The accidents that happen quite often on the Braga-Póvoa de Lanhoso road. It has very tight curves, cars can't see us" (Interview #8, male, 64 years old).

In summary, the sub-code biking unsafely was the most mentioned, appearing six times in five different interviews. This indicates that 33.33% of the interviewees, dangerously rode their bicycle at least once. Safety issues were mentioned only once, which cannot reveal sufficient significance. Finally, the danger of road variables was noted twice.

The emotions indicated after safety-related incidents were all negative. The most frequently reported in this particular context were frustration (5 times), fear (4 times), and anger (3 times). These negative incidents were leading to careful or negative behavioral responses, mainly being more careful with their cycling behavior; only one of the incidents that mentioned safety did not react in this way. Therefore, having a more careful cycling behavior was indicated (8 times), changing the cycling behavior, intention to keep what they were doing, and dissatisfaction was mentioned one time each.

The **infrastructure** was discovered to be the third most influential factor that affects bike user behaviors and experiences. Eleven interviews discussed infrastructure variables (73.33%). People typically reported occurrences directly connected to infrastructure, which were invariably associated with a bad experience. There was not a single person who positively discussed an infrastructure-related incident. No enough cycling paths, road conditions, and confusion in lanes were all infrastructure-related variables that were found to negatively influence the user's emotions and behaviors, as illustrated by the following execerpts:

"I prefer to use the road shoulder to free the road for cars. Because there are no bike lanes in the road that connects Braga to Guimarães" (Interview #2, male, 53 years old).

"...the infrastructure created is no better, it makes it dangerous. The road has no conditions..." (Interview #13, male, 46 years old).

"I couldn't understand where I could ride my bicycle if it was on the road or the sidewalk so by default I always used the road" (Interview #6, female, 26 years old).

Infrastructure sub-codes were mention by 11 interviewees that recall at least one incident that was caused by infrastructure issues. However, the cycle path was mentioned only five times. Similarly, the road conditions were noted six times by the interviewees. Finally, confusion in lanes was the less mentioned one with only two times. It is worth mentioning that 73.33% of the interviewees recalled an infrastructure-related incident.

The emotions triggered after infrastructure incidents were also all negative. The most frequently used in this particular context were frustration (6 times), anger (5 times), and awareness (2 times). These negative incidents led to several behavioral responses like having a more careful cycling behavior (6 times), changing the cycling behavior (3 times), referring to changing their circulation route (2 times); and intention to discontinue using the bike as transportation mean (2 times).

Weather and topography is the last factor associated to critical incidents when riding the bike. This factor was discussed in nine interviews (60 %). All of these mentions were related to negative cyclists' user experience. In general, each of these interviewees mentioned weather and topography variables one time, except for interviewee #8 who mentioned this factor in two different incidents. The main variables discussed in these incidents were steep terrain at the level of topography, and the weather variables of cold and rain. Illustrations from the interviews are provided below:

"...it goes up a little bit and there is an area that has a steeper ramp" (Interview #4, male, 44 years old).

"...in the meantime, the weather changed. I do almost 4 km and I had to "run" it... even so, I got home all wet" (Interview #8, male, 64 years old).

"When we left the garage we were immediately wet. We had waterproof jackets, but no pants" (Interview #11, male, 45 years old).

In this particular section, there are no conclusions that can be taken about the sub-code steep terrain and hills, because it was mentioned just one time. Interestingly, eight interviewees (53.33%) indicated that cold and rain were the main reasons that influence negatively their biking experience. These weather variables were noted nine times as an

influencing factor. Based on that, there is a negative relation between cold and rain, and the user experience.

Only one interviewee linked weather-related incidents to a positive emotional state (namely happiness).This respondent reported the positive outcome of the desire to bike instead of using other means of transportation. However, the rest of the interviewees linked weather and topography-related variables to negative emotional states like frustration (6 times), sadness (5 times), and anger (2 times). These negative incidents were found to lead to several behavioral responses like changing behavior in specific weather conditions (4 times), having a more careful cycling behavior (3 times), and radically discontinue biking (3 times).

4.2. The role of emotions

Table 3 shows the distribution of positive and negative emotions over the 72 reported incidents. Participants reported good feelings in 20 occurrences (27,78%) and may have had more than one positive emotion per episode. Participants, on the other hand, felt negative feelings in 52 events (72.22%), with the ability to feel more than one negative emotion in each episode, as previously mentioned. As can be observed, the causes for the occurrences described by the respondents caused them to experience unpleasant emotions more frequently, indicating a higher rate of negative recall. Nonetheless, the amount of references to good feelings is considerable, which indicates that the participants sought to share pleasant stories about their experiences as well.

Table 3. Emotion type

Emotion Type	Incidents, Freq (%)	Interviews, Freq (%)
Positive	20 (27,78%)	11 (73,33%)
Negative	52 (72,22%)	14 (93,33%)

A large number of respondents (26,67%) did not mention any sort of positive occurrence in their experience as a bicycle user, while 11 (73.33%) mention good incidents in their experience as a bicycle user. In contrast, 14 participants (93.33%) addressed incidents that made them experience unpleasant feelings, and just one respondent (6.67%) indicated completely positive feelings (table 4).

Table 4. Positive emotions

Positive emotions	Incidents, Freq (%)	Interviews, Freq (%)
Happiness	17 (85,00%)	9 (60,00%)
Pride	3 (15,00%)	2 (13,33%)
Joy	8 (40,00%)	7 (46,67%)
Sympathy	1 (5,00%)	1 (6,67%)
Safe/Secure	1 (5,00%)	1 (6,67%)
Calmdown (contentment and relaxation)	4 (20,00%)	4 (26,67%)
Hope	1 (5,00%)	1 (6,67%)

Regarding emotions, this study suggests that both positive and negative emotional states play a crucial role in the relationship between different influencing factors and the behavioral responses of bike users. Positive emotional states were detected in 20 different incidents. The most recognized positive emotional states were happiness (17 times) and joy (8 times) which have been indicated in 19 incidents (95,00 %). We dealt with happiness and joy as one single emotional state, following Izard (1977) who listed both of them as of enjoyment indicators. Happiness and joy seem to be triggered by factors like social (11 times); specifically social recognition (9 times), and the possibility to have direct contact with people (2 times); physical and mental health (7 times); and, finally, cold and rain, and bike features (specifically the quality of the bike), both were mentioned just once leading to feeling happiness and/or joy. The emotional state of happiness was found to produce positive outcomes and behavioral responses by our respondents like increasing desire to bike more often (16 times); satisfaction (8 times); intention to continue biking, by maintaining behavior (5 times); and positive WOM (2 times).

Other well-recognized positive emotional states are calmness, which indicates contentment and relaxation, and pride. Calmness has been discussed in four incidents and found to be predicted by physical and mental health (3 times) and social recognition (1 time). This emotional state influences several outcomes like increasing desire to bike more often (4 times); satisfaction with the experience (2 times); and intention to keep the previous behavior (1 time).

Pride is an emotional state that has been mentioned in three incidents. Social acceptance (2 times), and physical health (1 time) produced pride feelings which in turn influence several outcomes and behavioral responses like satisfaction (2 times); increasing desire to bike more often (2 times); and positive WOM (1 time).

In the end, sympathy, feeling safe/secure, and hope are also positive emotions. Each of these emotional states was discussed once. Sympathy was felt because of being well recognized by using her bike to do her job, and this situation led to higher levels of satisfaction and talking positively about the biking experience (positive WOM). Moreover, crowded roads made one of the respondents feel safer (more secure) because he feels

less secure in the open road where cars and other vehicles are faster. Feeling safe lead this respondent to prefer using congested roads and desire to bike more in crowded places. Finally, one of the respondents got some compliments for cycling. That made her feel the hope of a changing society towards girls cycling. She reported that this hope makes her wanting to bike more and encourages others to bike.

Negative emotions were indicated more by our respondents, probably, because people tend to remember the bad experiences more compared to the positive ones (Jaakson et al., 2017). Moreover, it is noted that negative emotions lead to more critical outcomes. The negative emotional states were indicated in 52 incidents (Table 5).

Table 5. Negative emotions

Negative emotions	CIT, Freq (%)	Interview, Freq (%)
Tension	3 (5,77%)	3 (20,00%)
Contempt	2 (3,85%)	2 (13,33%)
Aware/Concern	7 (13,46%)	4 (26,67%)
Fear	11 (21,15%)	7 (46,67%)
Frustration	29 (55,77%)	12 (80,00%)
Sadness	12 (23,08%)	7 (46,67%)
Anger	19 (36,54%)	10 (66,67%)

The most recognized one was frustration (29 mentions) which has been the result of social problems, mainly with people and cars (10 times); traffic and congestion issues (8 times);

bad infrastructure (6 times); weather and topography that made the journey hard (6 times); safety issues, like driving in unsafe ways, and roads that are particularly dangerous (5 times); and, bad bike features (4 times). Frustration is found to influence and produce several outcomes, mainly being more careful with cycling behavior (16 times) and changing their attitude (9 times), which were related to changing attitude in a general way, or by changing their circulation route, or having increased their attention to the weather. Other outcomes were produced also, such as the intention to maintain their behavior (4 times); the intention to bike less (2 times); and noted just once the dissatisfaction with that particular situation.

The second most recognized emotion was anger (19 mentions) which has been mainly the result of traffic and congestion problems (12 times), and social problems (9 times), which represents 67,74% of the factor related to the negative emotional state of anger. However, other distinguished reasons produced anger, these reasons are bad infrastructure (5 times); safety issues (2 times); unpleasant weather and topography (2 times); and bad bike features (1 time). Anger is found to influence and produce several outcomes. The most relevant one was being more careful with their cycling behavior (11 mentions). Moreover, there were more than four different outcomes produced by anger; maintaining the behavior in the future (5 times); changing the behavior (3 times), and dissatisfaction and positive WOM (1 time each).

Another well-recognized negative emotional state was sadness (12 mentions) which has been mainly the result of unpleasant weather (5 times). However, this particular emotional state has been noted for many different reasons, such as bad bike features (3 times); social problems (2 times); traffic and congestion conflicts (2 times); and safety issues (2 times). Sadness is found to influence and produce mainly the outcome of being more careful with their cycling behavior (8 times), which represents 66.67% of the total of outcomes produced by this negative emotional state. More outcomes were influenced by sadness; intention to maintain the attitude (2 times); change the behavior (2 times); intention to practice unsafe decisions in the future (1 time).

Fear is an emotional state that was noted in 11 incidents. This emotion has been influenced by several different reasons, which have almost all of them the same significance. Based on that, fear was the result of social problems (6 times), safety issues (4 times), bad bike

features (4 times), and traffic and congestion problems (4 times). There was also one mention of bad infrastructure that resulted in this particular emotional state. The emotional state of fear was found to produce negative outcomes and behavioral responses by our respondents. The main outcome and maybe the obvious one has been being more careful with their cycling behavior, which was mentioned 8 times. However, the interviewees also mentioned that this emotional state had produced the intention to continue biking, by keeping their behavior (3 times), and dissatisfaction (1 time).

Awareness was stated in seven different incidents (13.46%). Several factors contributed to producing this particular emotional state, such as bad bike features (3 times); traffic and congestion problems (3 times); social problems (3 times); bad infrastructure (2 times); unpleasant weather, and topography (1 time); and safety issues (1 time). Awareness is found to influence and produce several outcomes, mainly being more careful with their cycling behavior (6 times), which represents 85,71% of the total outcomes. However, there was another different outcome produced which is changing the cycling route.

Finally, tension and contempt were the two less mentioned negative emotions, being referenced respectively in 3 and 2 incidents. Tension was revealed after the following reasons: traffic and congestion problems (2 times); bad bike features (1 time); and social problems (1 time). The incidents that mentioned tension as an emotional state followed different outcomes, such as: insisting on the same behavior, having more careful cycling behavior, and changing attitude. Contempt was triggered based on social problems and bad infrastructure. The incidents that mentioned contempt as an emotional state produced as outcomes the intention to maintain her behavior, in one of them; and being more careful in their cycling behavior, which was mentioned in both of them.

4.3. Outcomes and behavioral responses

Even though the previous analyses presented the main findings, there is some relevant information to be discussed. For instance, the frequency of outcomes per subject and the significance of the outcomes indicated by interviewees with good and/or negative causes and feelings.

The most remarkable outcome is being more careful in the next bicycle usage. This was mentioned on 33 occasions, on average, more than once in each interview (45.83%). The

urge to ride a bike more regularly was the second most common outcome. It was stated by 66.67% of respondents and was mentioned in 16 occurrences (22.22%). The third most common consequence was the desire to continue cycling, which indicates that the respondent intends to repeat the behavior mentioned in the episode. This result was cited in eight interviews (53.33%), leading to the reference in 13 separate occurrences. Almost half of the interviewees (7 times; 46.67%) reported the change in attitude and the outcome satisfaction. The former was stated in 11 distinct instances (15.28%), whilst the latter was mentioned in eight different situations (11.11%). The remaining three outcomes were cited less often. These are as follows: discontent (3 interviews; 20.00%, and 3 incidents; 4.17%); positive WOM (2 interviews, 13.33%, and 3 incidents; 4.13%); and riding unsafely (1 interview; 6.67%, and 1 incident; 1.39%) (Table 6).

Table 6. Outcomes and behavioral responses

Outcomes	CIT, Freq (%)	Interview, Freq (%)
Satisfaction	8 (11,11%)	7 (46,67%)
Dissatisfaction	3 (4,17%)	3 (20,00%)
Positive WOM	3 (4,17%)	2 (13,33%)
Intention to Continue Biking	13 (18,06%)	8 (53,33%)
Intention to Discontinue Biking	4 (5,56%)	3 (20,00%)
Change Cycling Attitude	11 (15,28%)	7 (46,67%)
Biking Safely	33 (45,83%)	15 (100%)
Biking Unsafely	1 (1,39%)	1 (6,67%)
Desire to bike more	16 (22,22%)	10 (66,67%)

In a nutshell, some outcomes occurred only from positive incidents and good feelings, and some other outcomes were produced solely from negative stories and bad emotions, However, there are a few outcomes that resulted from both positive and negative stories. The outcomes that occurred solely from good occurrences were a desire to ride more and a sense of accomplishment. Bike safely, bike unsafely, alter cycling attitude, desire to stop riding, and discontent were the ones that arose only from bad tales. Finally, those that came as a result of both good and bad experiences were the intention to continue riding and positive WOM.

Figure 3 summarizes the above-discussed results. This figure displays all the determined influencing factors, positive and negative emotional states, and outcomes, and behavioral responses. Moreover, it indicates the main paths explored between (1) the different factors and emotions, and (2) the different emotional states and outcomes.

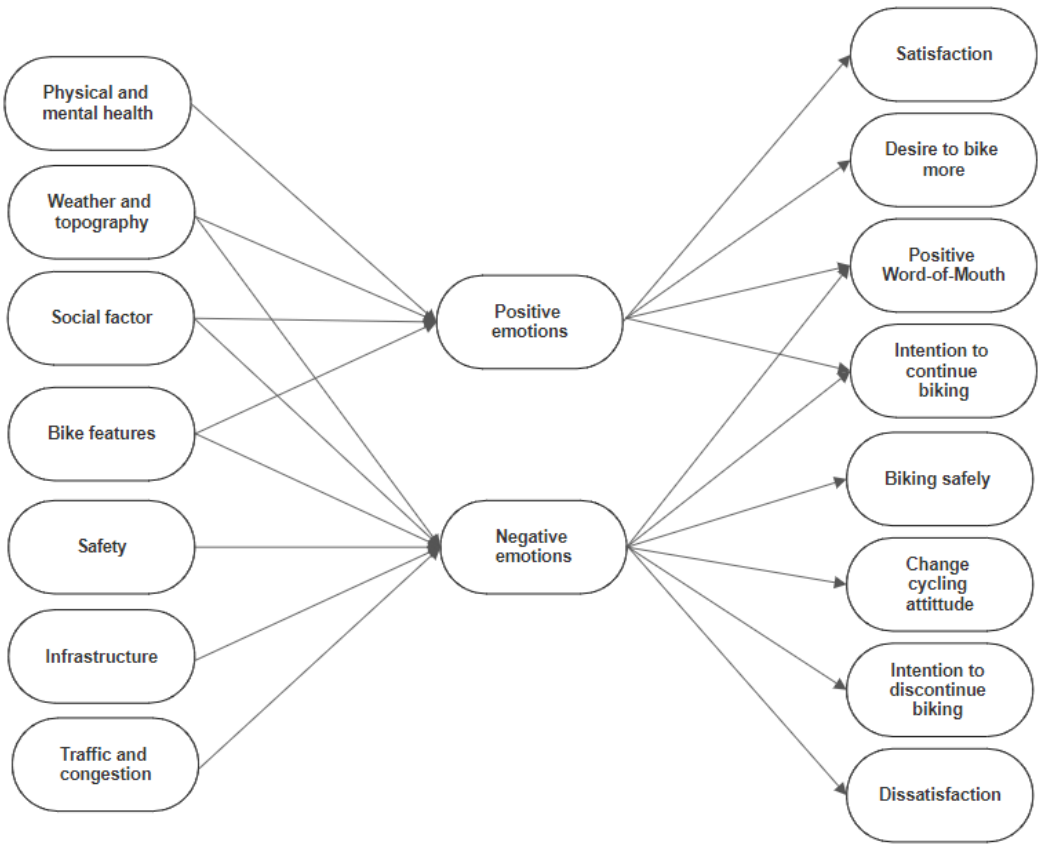

Figure 3. The paths among the influencing factors, emotional states, and outcomes

5. Conclusions, contributions, and limitations of the study

Several studies have determined the main factors that influence the biking experience and investigated the effect of these factors on several bike users' behavioral responses. However, there is a lack of studies that considered the emotional side of the biking experience and the effect of emotional states on bike user behaviors. Based on that, this study used CIT in interviewing 15 Portuguese bike users who use the bike mainly to commute. The results defined seven main factors that influence the bike users' emotions and behavioral responses. These are social factors, traffic and congestion, infrastructure, bike features, physical and mental health factors, weather and topography, and safety factors. In pleasant incidents, positive emotions like happiness, joy, and relaxation were triggered. These positive emotional states lead to positive outcomes and behavioral responses like satisfaction, positive WOM, intention to continue biking, and desire to bike more. In non-pleasant incidents, negative emotional states like frustration, anger, sadness, and fear were elicited. These negative emotions lead to outcomes and behavioral responses like dissatisfaction and intention to discontinue biking. However, sometimes the outcomes of negative emotions were positive, in some cases, negative emotions lead to biking more safely and changing negative attitudes towards cycling. Based on these findings, this dissertation has several contributions to theory and practice. Theoretical and managerial implications, in addition to limitations and direction to future research, are discussed in the following.

5.1. Theoretical implications

This study's findings have major theoretical implications. Firstly, the findings of this study determine several factors that influence the cyclists' emotions and behavior. In this vein, respondents reported incidents related to social, traffic and congestion, infrastructure, bike features, weather and topography, physical and mental health, and safety factors. The findings of this study are in line with several studies that found these factors to influence cycling behavior and the biking experience in general. For example, Ma et al. (2018) found that social values impact cyclists' behavior and well-being. This research findings also concluded that social interaction with others, social recognition, and social rejection

influence the cyclists' behavior positively or negatively depending on the nature of these social factors. This study also found that the cycling infrastructure influences the attitudes and behavior of cyclists. Similarly, Faghih-Imani et al. (2014) discussed the effect of infrastructure on bikes and BSS flows and usage. Furthermore, Zhanf et al. (2017) anticipated that the quality of infrastructure influences bicycle utilization. The finding of this study is also in line with several studies that found that traffic and congestion harm cyclists' behavior and satisfaction (e.g., Li et al., 2019; Therrien et al., 2014; Zhou et al., 2020). However, it is worth mentioning that in contrast to these findings, one of our respondents reported that more congestion and traffic make him feel happier and more secure. This finding was not found in reviewed studies. Furthermore, bike features, especially in bad conditions are found to impact negatively on the biking experience. These findings are also in line with several studies that reported similar findings (e.g., Hess & Schubert, 2019). Moreover, the findings of this dissertation regarding weather and topography variables are in line with several studies (An et al., 2019; Fishman et al., 2012; Zhu et al., 2020) that reported an influence of these variables on cyclists' behavior, satisfaction, and BSS usage. It is worth mentioning that all references to weather and topographical variables, except for one interview, were unfavorable. In all, the humid weather, rain, and cold were variables that negatively influence the biking experience. Finally, the study found similarly to Barbour et al. (2019), Cerutti et al. (2019), and Meschik (2012) that physical and mental health are drivers for more bike use, and similarly to Abolhassani et al. (2019) and Nikitas (2018) that safety factors like road safety influence cyclists behavior and satisfaction. In this vein, Ge et al. (2020) reported a very crucial role of safety concerns which are found to influence cyclists' attitudes and behavioral responses.

Secondly, this study adds to previous knowledge in the field about the role of cyclists' emotional states. This study found that critical moments and incidents trigger several emotional states like happiness and enjoyment, pride and relaxation when these incidents are positive, and negative emotional states like frustration, anger, fear, and sadness when these incidents are unpleasant. This study agrees and confirms Palmer's (2010) findings which indicate that the emotional states of users are determinants of experiential behavior. Cyclists' emotions are not well-recognized in previous literature. However, some studies reported the presence of positive emotional states like happiness, pleasure, fun,

excitement, and pleasantness when using bikes or BSS (e.g., Ma et al., 2018; Zhang et al., 2017). Moreover, Chen and Chancellor (2020) discussed the role of emotions in influencing bike user experience. It is worth mentioning that the main factor that triggers positive emotional states are social recognition and acceptance, and mental health. Positive emotions produced by these factors are usually determinants of outcomes like the desire to bike more and satisfaction. Moreover, the main factors that elicit negative emotional states are traffic, congestions, and traffic-related social problems, social rejection, infrastructure, weather, and topography. These negative emotional states lead to outcomes such as being more careful when cycling especially that many of these emotions like fear were a result of feeling unsafe. Other outcomes in this context are changing attitudes or behavior, intention to bike less, or sometimes just maintaining the biking behavior no matter if not accepted by society.

Finally, the current study determines the main outcomes and behavioral responses produced based on the above-discussed factors and emotions. In positive incidents the main outcomes are intended to continue biking, desire to bike more, satisfaction, and positive WOM, while in negative situations the main outcomes are biking more safely, intention to stop biking, and dissatisfaction. It is worth mentioning that there are more behavioral changes tendency in the case of negative incidents compared to positive ones.

5.2. Managerial implications

At the level of promoting and encouraging the use of bikes, this study offers several suggestions to policymakers and other stakeholders. Based on the findings, it is very important to improve the conditions of the factors that influence the biking experience and to consider the emotional side of this experience. In the following, managerial implications are provided following the study findings.

At the level of influencing factors. It is found that social factors, traffic and congestion factors, infrastructure, weather and topography variables, physical and mental health, safety factors, and bike features influence the cyclists' behavior and the biking experience in general. Based on that, policymakers, BSS operators, municipalities and other stakeholders involved in promoting the use of bikes need to improve the conditions of these

factors and the way they influence the biking experience. That can be done for example by the following:

- Marketing communication tools like advertisements and promotion campaigns can be used to promote the use of bikes as an eco-friendly, healthy, and traffic-less means of transportation. These campaigns have to seek to build more social acceptance towards biking and raise public awareness on the benefits of biking in general. Moreover, regulations should be clear and made also to reduce any social conflict between cyclists and the users of other transportation means like cars, or even between cyclists and pedestrians.
- Promotion campaigns have to deliver the message that the use of bikes reduce traffic and congestions even if it feels sometimes that the use of bikes cause some traffic problems, in the end, these campaigns need to explain the difference between using bikes or an equal number of cars for example and their potential effect on road traffic.
- Policymakers need to improve biking infrastructure and make it more convenient and safe. Adding more bike lanes, improving the quality of these lanes, increasing the number of bike parking, and adding enough and clear bike-related traffic signs can improve the biking experience, make it more pleasant and comfortable, and encourage more people to adapt bikes for commuting and other activities. In this context, BSS operators have also to plan bike lanes, and bike stations in a very good way to improve the biking experience and guarantee easy access to use their services.
- Weather and topography factors are critical and someone might argue that there is no much to do about these variables. However, policymakers and bike promoters can always encourage people to bike during good weather days, for example by sending messages before a sunny week saying “it is great to use your bike in the next week, it will be sunny and warm from this date to this date”. Also, bike-related gadgets and apps can be used to promote cycling in good weather. Moreover, municipalities, in rainy-weather towns, can make sure that all bike lanes are non-slippery. Regarding topography, in cities and towns with difficult topography conditions and steep terrain, policymakers can encourage the use of

e-bikes and facilitate the ownership of these bikes. Moreover, BSS operators need also to consider adopting e-bikes in their systems.

- The physical and mental health benefits provided by bikes need to be included in every promotional campaign. Policymakers and other stakeholders need to indicate these benefits and make it clear that the use of bikes improves the physical and mental health, Besides, policymakers need to show the public the indirect benefits on health like since using bikes improves traffic quality, minimizes resource consumption, and reduces harmful gas emissions.
- About safety, policymakers have to promote safety behaviors when biking and make sure that the majority of the people are safely using bikes and BSS. Moreover, policymakers need to promote helmet use and issue enough regulations to maintain safe attitude and behavior among cyclists and other people interact with them.
- Biking promoters in the end need to remind cyclists of good habits related to using bikes like making sure always that tire pressure and quality are good, bikes have lights and warning gadgets, braking, and gearing systems are working well.

At the level of emotional states, the findings indicated that the above-mentioned factors elicit several emotional states; positive or negative, depending on the incident nature. These emotional states are also found to influence cyclists' decisions and behaviors. Based on that, bike and BSS users' emotion management is needed to improve the whole biking experience and to produce better outcomes of this experience. This can be done by the following:

- Policymakers and bike promoters need to improve the biking experience by finding solutions to social interaction problems, improving the infrastructure and safety road conditions. These improvements will help to increase positive and reduce negative emotional states which, in turn, are expected to produce more positive outcomes like intention to bike more and adopt bikes as the main transportation mean.
- People who are in touch with cyclists in critical situations, like policemen and municipality people, need to be trained to deal with cyclists' emotions, especially

the negative ones. In this vein, anger and fear management needs to be taught for these people to ease critical situations.

- Involved stakeholders need to promote biking using as a healthy, eco-friendly, and time-saving means of transportation. By that, people are expected to feel happier and enjoy their experiences more. Positive feelings toward biking are expected to increase positive outcomes.
- Bike promoters need to promote good bike using habits by training cyclists to deal well with several situations that include unpleasant social interaction, safety issues, and even bad weather conditions. When cyclists are trained and already have an idea about critical situations they will be able to deal more rationally with these negative situations and the effect of negative emotions will be less.

In the end, building a society that accepts cycling and is aware of the importance of using bikes to protect the environment and improve health is a very important starting point for every city/country that would like to promote this kind of ecological transportation mode. Based on that, including useful information about cycling, its benefits, and related regulations is crucial to building a new generation aware of the usefulness of cycling and also aware of how to cycle in a safe, healthy, and legal way.

5.3. Limitations and directions for future research

This dissertation is with limitations. Some of these limitations may lead to future research opportunities. The sample is regional, and not representative. The study was concluded with Portuguese bike users and in a Portuguese context. Generally speaking, the biking culture in Portugal may be less advanced compared to some other European more bike-friendly countries like the Netherlands, and more advanced compared to some non-European countries. Hence, it may be argued that a sample from a different cultural or regional background could lead to different results. Hence, the proposed research questions might be tested again in other contexts or by doing cross-cultural studies that aim to indicate the main differences between two cultures or countries.

Regarding the used methodology, this study relied on a qualitative approach to explore the biking experience in critical moments and determine the main factors and emotions that

influence this experience and bike user behavioral responses. A qualitative approach, especially CIT, is good to define the main antecedents of behavioral responses. However, using quantitative and mixed-method approaches can provide more reliable information and conclusions by confirming the link between several factors and outcomes. Hence, further studies using other approaches (mixed methods or quantitative research) are required to provide more reliability and accuracy to this study' conclusions. These studies are also expected to determine the mediating role of each emotional state, in other words, they will help to see what emotional state exactly mediates the relationship between each factor and each outcome.

Due to the relatively small sample size, it was not possible also to consider the effect of the sample characteristics on the results. Future research could consider and investigate the moderating role of variables like gender, age, educational level, family life-cycle stage, or income. Moreover, future research with a bigger sample size and quantitative approaches in data analysis can also aim to cluster user types. Such user typology can determine the clusters of users regarding different hedonic or utilitarian factors related to the biking experience.

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