Factors Influencing User Behaviour in Micromobility Sharing Systems: A Systematic Literature Review and Research Directions

Abstract

In light of the Micromobility Sharing Systems (MSS) boom, specifically bike and scooter sharing, related academic studies have grown accordingly in the last few years. However, contributions are scattered, particularly regarding the knowledge about the user of these systems. This article provides a systematic review of the studied factors influencing MSS user behaviour and offers insights for future research. An inclusive search of the Web of Science and Scopus databases was performed to identify related literature. The final analysis included 203 articles that met the eligibility criteria. The findings were organised into three main groups that aggregate 25 factors influencing MSS user behavioural responses: (i) temporal, spatial and weather-related factors, (ii) system-related factors and (iii) user-related factors. The review uncovered several neglected factors, as well as theoretical and methodological gaps in the literature. Based on that, the study suggests directions for future studies including researching the emotional influences and outcomes of MSS use, considering environmental beliefs and behaviours in the MSS context, examining negative behaviours and negative assessments of MSS use, and consolidating the use of theoretical frameworks.

Keywords: micromobility; micromobility sharing systems; MSS; user behaviour; factors influencing MSS user behaviour; systematic literature review.

1. Introduction

The last decade witnessed a dramatic growth of Micromobility Sharing Systems (MSS) thanks to Bike Sharing Systems (BSS), which account for their largest share, and the recent rapidly spreading of Scooter Sharing Systems (SSS) (Younes et al., 2020). Several pressing issues have pushed cities into adopting and adding MSS to their set of transportation modes, such as urban growth and the consequent need to solve congestion and parking problems, reduce energy and carbon emissions for environmental and public health reasons; the need to relieve the first and last-mile problem; and the emerging trends of smart cities and flexible multimodal mobility (Chen, 2016a; Fishman et al., 2013; Macioszek et al., 2020; Wang and Zhou, 2017). However, the expansion of MSS also faces several challenges and barriers, including the systems' lack of convenience and ease of use, perceived danger, and the continued superiority of other transit modes like cars (Fishman et al., 2014; Godavarthy and Rahim Taleqani, 2017; Y. Ma et al., 2018).

The growth of MSS has been reflected in emerging literature over the past few years, focusing on different aspects of MSS including technical (e.g., Ji et al., 2014; Wang et al., 2018) and operational issues (e.g., Caggiani et al., 2019; Mooney et al., 2019), health benefits (e.g., Trivedi et al., 2019; Woodcock et al., 2014), safety concerns (e.g., Friedman et al., 2016; Zanotto and Winters, 2017), and impact on traffic (e.g., Jensen et al., 2010; Zacharias, 2002). Additionally, there is a considerable number of studies that aim to understand the MSS user behaviour and related attitudes and responses by exploring their influencing factors. These include studies on attitudes and intentions towards MSS (e.g., Ge et al., 2020; Wu et al., 2019); usage behaviours and patterns (e.g. Benedini et al., 2019; Corcoran et al., 2014; Jahanshahi et al., 2019; Nikitas, 2018), and also relevant user responses to MSS usage such as subjective well-being (e.g., L. Ma et al., 2018), satisfaction (e.g. Ding et al., 2019; Maioli et al., 2019), and loyalty (e.g., Xin et al., 2018). Influencing factors include natural factors like the weather and topography (e.g., An et al., 2019), the built environment (e.g., Lin et al., 2018), MSS characteristics like accessibility (e.g., Bakogiannis et al., 2019) and service quality (e.g., Zhou and Zhang, 2019), and factors connected with user characteristics, such as personality, lifestyle and physical performance and health (Reilly et al., 2020), hedonic motivations (Huang et al., 2019), and socio-demographics (Yang et al., 2020). However, these contributions are fragmented and a

comprehensive overview mapping all factors that influence MSS user behaviour is lacking. Thus, this review intends to reveal all the studied factors influencing user behaviour, and identify the less-studied, neglected, or even missing factors, integrating the extant body of knowledge into a comprehensive framework that sets the state of the art in this area, while also highlighting relevant contributions for theory and for practice.

Systematic literature reviews are well-recognized in transportation and travel research (e.g., Esmaeilikia et al., 2019; Heinen and Buehler, 2019; Prati et al., 2018). Regarding MSS, only three holistic-view studies were found. Fishman (2016) reviewed literature on bikesharing in general, discussing several relevant themes, such as trends, usage patterns and user preferences, barriers and benefits, and operational issues. Although it addresses some user motivating factors, this is not the specific focus of this review. Moreover, this review considered a limited coverage of papers published between 2013 and October 2014, leaving out all the literature that has been growing rapidly in the past few years. Si et al. (2019) conducted a scientometric review to demonstrate topic categories in the context of bike-sharing research and concluded that BSS research mainly focuses on "factors & barriers, system optimization, behaviour & impact, safety & health, and sharing economy" (p. 415). Eren and Uz (2020) comprehensively reviewed the literature that discussed the relationship between bike-sharing demand and several factors, like built environment and land-use, temporal, station-level, safety, and socio-demographic factors. Despite these important contributions, to the authors' best knowledge, there is no systematic literature review that categorises the factors that shape MSS user behaviour. The recent growth of MSS all over the world indicates the importance of understanding user behaviour to overcome challenges and barriers that might hinder the successful implementation of these systems.

The rest of the paper is organized as follows: in the next section, the methodology of the review process is presented. Section three presents the findings, starting with a descriptive temporal analysis of the articles included in the review, and then moving to a classification of all factors influencing the MSS user behaviour into three main groups. Section four uncovers the main gaps in the reviewed literature to provide directions for future research. Finally, section five offers a brief conclusion.

2. Methodology

2.1. Systematic literature review

This systematic literature review follows the structured approach which is well recognised in the areas of management, transportation, and travel research (e.g., Khalaj et al., 2020; Papavasileiou and Tzouvanas, 2020; Wattanacharoensil and La-ornual, 2019). The systematic literature review is an explicit, reproducible, and structured evaluation of the existing literature related to one or more research questions in a specific field of knowledge (Tranfield et al., 2003). The systematic review differs from traditional narrative reviews in limiting bias by applying detailed and replicable scientific strategies (Cook et al., 1997a, 1997b). The structured evaluation of previous studies results in identifying the gaps and providing directions for future research (Tranfield et al., 2003).

2.2. The systematic review process

The relevant existing literature on the factors that influence MSS user behaviour were collected, analysed, and synthesized following the best practices (e.g. Petticrew and Roberts, 2006, Pickering and Byrne 2014, Pickering et al. 2015). The process includes, first, defining the topic and research aims. Second, identifying databases, keywords and selection criteria. Third, searching and screening articles, and refining the inclusion and exclusion criteria when needed. Forth, extracting relevant material to produce eligible outcomes and summary tables. Finally, presenting findings and revising the review towards its final version (Pickering and Byrne, 2014).

2.2.1. Research aims and objectives

This study provides a review of the scientific knowledge on MSS to:

- Identify the studied factors influencing the different forms of MSS user behaviour.
- Define the main gaps in the literature and provide directions for future research.

Accordingly, the relevant literature is reviewed and interpreted in order to identify key topics for academic research in the future, and points practitioners and policymakers to the

main factors that influence MSS user behaviour, and consequently, that may leverage their mobility business's competitiveness.

2.2.2. Search databases and keywords

To maintain a consistent standard for analysis and ensure high quality of the findings, the selection criteria included articles published in journals indexed in Web of Science (WoS) and/or Scopus. Despite their coverage limitations, these two databases are expert-curated and offer higher confidence in the quality of the selected documents, being among the most established bibliographic data sources and the more widely used in meta-analysis and related studies (Baas et al., 2020; Birkle et al., 2020; Zhu and Liu, 2020).

The sample is composed of peer-reviewed journal articles, written in English. Therefore, books, book reviews and book chapters, editorial notes, conference papers or abstracts, conference reviews, reports, dissertations and theses (the so-called grey literature), and articles written in other languages were excluded. The exclusion of non-journal documents is common practice in systematic reviews (e.g., Le et al., 2019; Prati et al., 2018; Yang et al., 2017), although we acknowledge some relevant information could be missed.

The search included multiple relevant keywords, namely: "two-wheeler mobility system", "bike-sharing system", "scooter-sharing system", "micromobility". Different possibilities of writing some terms were considered (e.g., "bike-sharing", "bikesharing", "bike-share", "bicycle sharing"). Table 1 displays the keywords used in the search. Additional filters were used to focus the search within social sciences.

The main literature search covers articles published until the end of August 2020. No initial date was set for the study's timeframe. Other articles were included in this review through the scanning of the reference lists of some relevant articles, in line with several previous systematic reviews (e.g., Le et al., 2019; Prati et al., 2018; Yang et al., 2017).

Insert Table 1 here

2.2.3. Inclusion/exclusion criteria and screening

Figure 1 presents the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart, adapted from Stevenson et al.'s (2017). As shown, 1157 records were identified. A total of 855 records were excluded for being duplicates, or deemed irrelevant based on the first screening of titles and abstracts, resulting in 302 full-text documents assessed for eligibility. All articles that did not explicitly address factors affecting user behaviour specifically related to MSS were excluded. Finally, conceptual papers that provide theoretical or historical overviews and do not contribute to the objective of this study were also discarded (e.g., Chen et al., 2020a; Wood, 2020). On the other hand, 22 additional articles identified through the manual screening of reference lists were included in the final analysis (Figure 1).

Insert Figure 1 here

A database with the final 203 eligible studies to be included in the systematic literature review was created including each document's bibliographic information, the relevance of the title, abstract and full-text, and the methods. When available, information on the theories used to build the research model and explain the results, and the country(s) where studies were conducted were also tabulated. Furthermore, the factors discussed in each document for their influence on MSS user behaviour were also entered. Content analysis was thus conducted, and the descriptive information was coded and aggregated into groups of factors that influence MSS user behaviour.

3. Findings

3.1. Descriptive analysis

This section offers an overview of the distribution of the 203 publications over time, by journal, by country, and by methods used. We also point out the main theoretical frameworks used.

3.1.1. Distribution of the publications over time

As reported above, no timeframe limit was used in the literature search, which was extended until the end of August 2020. The earliest result obtained is from 2011, revealing that the topic is still emerging. Moreover, the number of publications shows a consistent growth between 2011 and 2020, particularly in the last two years, which concentrate more than half of all studies published (110) during this 10-year period (Figure 2).

Insert Figure 2 here

3.1.2. Key journals over time

Research addressing factors that influence MSS user behaviour was published in 81 different journals (Table 2). The top five journals showing greater interest in the subject published 74 articles, representing 36.45% of all included studies. Over a quarter of the listed journals (57; 28.08%), contributed with only one related publication.

Many journals have been granting more space to the topic in recent years. The fact that several journals only started to publish related articles as of 2019 is an indication of the topicality of the issue. This is the case of the Journal of Cleaner Production (7 articles), Transportation Research Part D (5 articles), Case Studies on Transport Policy (4 articles), Travel Behaviour and Society (4 articles), Transportation Letters (3 articles), Environmental Science and Pollution Research (2 articles), International Journal of Logistics Research and Applications (2 articles), and Journal of Transport and Health (2 articles).

Insert Table 2 here

3.1.3. Key countries over time

The geographical analysis of the articles considers the place of data collection or case studies, and not authors affiliations. Table 3 shows that the 203 studies were conducted in 29 countries over five continents; Asia (50.25%), North America (24.63%), Europe (16.78%), Oceania (3.76%), and South America (2.35%). Three of the articles (1.48%) investigated MSS from more than one country, namely Ahillen et al. (2016), who examined

the dynamics of bike-sharing using data from two systems in Australia and the USA; Sarkar et al. (2015), who compared BSS cycling patterns in six countries; Brazil, England, Italy, Spain, Taiwan, and the USA; and Médard de Chardon et al. (2017), who collected data from 75 BSS all over the world.

China and the USA combined concentrate the majority of the research on the topic (57.14%), followed by Europe (16.78%). Around 44.12% of the latter were conducted in only two countries: Spain (10 studies) and Greece (5 studies). There are only eight and five studies respectively from Oceania and South America, most from Australia and Brazil. Finally, although some countries, such as South Africa, are implementing MSS, there seem to be no studies from Africa yet.

Insert Table 3 here

3.1.4. Research methods used

Table 4 shows the kind of research methods used in the literature over time. The quantitative approach has the lion's share with 196 documents (96.55%). Nearly sixty percent of these used surveys for data collection, 35.71% relied on big data and trip records, and nine studies (4.59%) utilized multi-source data or other data collection methods. Experimental-designed research is notably scant. Only one quasi-experimental study has been detected (Wang and Lindsey, 2019a). The most recognized statistical analyses are Structural Equation Modelling and different types of regression analyses. Several other types of analyses were used, including descriptive statistics, correlation analysis, cluster analysis, ANOVA, and *t*-test.

Qualitative research is scarce, appearing in only three studies (1.48%). The data collection techniques are interviews (Bejarano et al., 2017), focus groups (Fishman et al., 2012), and text mining (Kim and Hong, 2020). Four studies (1.97%) use a mixed-method approach (Bakogiannis et al., 2019; Hess and Schubert, 2019; Karki and Tao, 2016; Serna et al., 2019).

Insert Table 4 here

3.1.5. Key theories used

Table 5 presents the theories used most frequently in the included documents. Forty-three studies (21.18%) rely on theories to develop their research framework. The most recognized two theories are the Theory of Planned Behaviour (TPB), used in 12 studies (5.91%), and the Technology Acceptance Model (TAM), applied in seven studies (3.45%). TPB, which extends from the Theory of Reasoned Action (TRA), connects people's beliefs to behaviour, and suggests that individuals are more likely to perform specific behaviours when they know they can do them successfully (Ajzen, 1991). Furthermore, TPB indicates that behavioural intention and actual behaviour are not the same although actual behaviour is predicted by intentions (Ajzen, 2015). TAM is another extension of TRA that replaces all attitude measures with perceived ease of use, and usefulness. TAM also considers actual behaviour (use) as an outcome of behavioural intention to use technology (Bagozzi et al., 1992; Davis, 1989). Other approaches, such as Attribution Theory or the Theory of Reasoned Action, are used less expressively in just one or two of the included studies. It is noteworthy that more than 75% of the included studies are not based on any specific theory, simply building on previous literature and empirical gaps.

Insert Table 5 here

3.2. Factors influencing MSS user behaviour

In this section, we focus on the main purpose of this systematic literature review by revealing all the studied factors influencing MSS user behaviour. The content analysis identified 25 factors that were organised into three main groups: (i) temporal, spatial and weather-related factors, (ii) system-related factors, and (iii) user-related factors. Appendix A identifies the coverage of these factors in all the reviewed articles.

3.2.1. Temporal, Spatial and weather-related factors

The first group includes contextual factors: temporal and spatial related factors and weather conditions. The latter is considered in this group of factors as it is typically studied jointly with temporal variables (e.g., Corcoran et al., 2014), and topography (e.g., Fishman et al., 2012).

The literature reveals how MSS user behaviour can be affected and altered due to several *temporal-related factors*. These include contextual variables, as the time of day, day of the week, the month and season when individuals use MSS (e.g., Bao et al., 2018; Mattson and Godavarthy, 2017), daylight hours (e.g., Scott and Ciuro, 2019), morning/afternoon peak hours, weekdays/weekend (e.g., Faghih-Imani et al., 2017; Nolan et al., 2016) and average annual sunshine hours (e.g., Serna et al., 2019), holidays, weekday governmental shutdowns, and festivals (e.g., Younes et al., 2020), but also the academic semester (e.g., Corcoran et al., 2014; Kutela and Teng, 2019). MSS use is usually higher in the Spring and Summer months, and lower in Winter; higher on weekdays than on weekends and (school) holidays, and daily peak hours are typically in the early morning and mid to late afternoon (e.g., Ahillen et al., 2016; Faghih-Imani et al., 2017; Lin et al, 2020). Besides these, temporal factors also incorporate variables directly related to the BSS service, including average travel and parking time (e.g., Ma et al., 2020a; Xin et al., 2018), average time required to access the docking station (e.g., Molinillo et al., 2020), MSS operating hours (e.g., Shaheen et al., 2011; Zhu and Diao, 2020), and timesaving compared to using other transportation means (e.g., Link et al., 2020).

Around a quarter of the included studies investigate how temporal factors affect user behaviour, namely MSS acceptability (e.g., Nikitas, 2018), willingness to shift transport mode to bike-sharing (e.g., Ma et al., 2020a) and the choice for using public bicycles (e.g., Wang et al., 2017), intention to use MSS (e.g., Gámez-Pérez et al., 2017), MSS actual adoption (e.g., Shaheen et al., 2011) and usage (e.g., Shen et al., 2018; Zeng et al., 2020), station usage (e.g., Hyland et al., 2018), usage regularity (e.g., Ji et al., 2020), travel destination (e.g., Zhao et al., 2015) and trip duration (e.g., Caulfield et al., 2017). Some of these studies also assess the effect on user responses such as (di)satisfaction and complaints (e.g., Kim and Hong, 2020; Xin et al., 2018).

Spatial-related factors include the built environment, MSS infrastructure, distance and topography. *The built environment* refers to land use characteristics, including facilities and station attributes (Faghih-Imani et al., 2014; Mateo-Babiano et al., 2016; Y. Zhang et al., 2017). Land-use is the most studied factor, appearing in 68 articles (32.66%) to refer to population and building of residential areas (e.g., Rixey, 2013; Zhao et al., 2015), employment density (e.g., Alcorn and Jiao, 2019), road density (e.g., Chen et al., 2020a),

and floor area ratio of residential, commercial, industrial (e.g., Nolan et al., 2016; Shen et al., 2018), educational (e.g., Caspi et al., 2020) and cultural buildings (e.g., Ma et al., 2020a). It also considers BSS station density (e.g., Médard de Chardon et al., 2017), as well as the number of surrounding bus stops, metro stations, hubs (e.g., Scott and Ciuro, 2019), and train stations (e.g., Faghih-Imani et al., 2017; Wang et al., 2016). Land use also includes street connectivity (e.g., Jiao and Bai, 2020) and two-wheeler pathway length (e.g., Bieliński et al., 2019). Besides, the presence of cafés/bars/restaurants (e.g., Faghih-Imani et al., 2017; Maas et al., 2020), other retail shops (e.g., Wang et al., 2020) and recreational centres (e.g., He et al., 2019) are also researched.

Similarly to temporal factors, favourable land-use features tend to have positive influence on user behaviours, like MSS acceptability (e.g., Chevalier et al., 2019) and willingness to use MSS (e.g., Curto et al., 2016), MSS usage (e.g., Jiao and Bai, 2020; Nolan et al., 2016), frequency of use (e.g., Bachand-Marleau et al., 2012; Wang et al., 2016), travel time and trip destination (e.g., Zhao et al., 2015), and user responses, such as satisfaction (e.g., Liu, 2020).

MSS infrastructure is also well-recognized in the literature for its influence on MSS user behaviour being studied in 42 articles (20.69%). MSS infrastructure incorporates all sharing infrastructure provided by MSS, including dedicated bike lanes (e.g., Sun et al., 2017), parking (e.g., Xin et al., 2018), number, location and variability of docks/stations (e.g., Bieliński et al., 2019; Xu & Chow, 2019), complete and clear markings and signs (e.g., S. Ma et al., 2019), transportation network connectivity (e.g., Welch et al., 2020), and night-time illumination (e.g., Zhang et al., 2015). Better infrastructure usually has positive effects on intentions to use MSS (e.g., Xu et al., 2020), MSS usage (Chen and Chancellor, 2020; Yiyong Chen et al., 2020), cycling behaviour in general (e.g., Benedini et al., 2020), user satisfaction (e.g., Ding et al., 2019; Zhang et al., 2015), and the spatiotemporal patterns of MSS use (e.g., Liu and Lin, 2019).

In addition to land-use and infrastructure, several articles address the effect of *distance* on MSS user behaviour, including the distance between MSS stations/docks and home, work, and other destinations and places like city centre/downtown, schools, parks, or lakes (e.g., Fishman et al., 2014; Zhu and Diao, 2020), distance to transit stops (e.g., Y. Du et al., 2019;

Liu and Lin, 2019), riding distance (e.g., Ji et al., 2020), and trips with the same or different origin and destination (e.g., Caulfield et al., 2017). These variables are found to be associated with MSS usage (e.g., Fishman et al., 2014; Link et al., 2020; Zhu and Diao, 2020), usage regularity (e.g., Ji et al., 2020, travel patterns (e.g., Y. Du et al., 2019; Zhao et al., 2015), and trip duration (e.g., Caulfield et al., 2017).

Another spatial-related factor is natural *topography*. Seven articles (3.47%) discuss the effect of topography aspects like hills (e.g., Fishman et al., 2012), presence of slopes (e.g., Liu, 2020), and steep terrain (e.g., Patel and Patel, 2020), which negatively affect the choice for a bicycle and riding frequency (e.g., S. Ma et al., 2019), MSS usage (e.g., Mateo-Babiano et al., 2016), and user satisfaction (e.g., Liu, 2020).

Meteorology is considered together with temporal and spatial factors since it is predominantly studied along with them (e.g., Caulfield et al., 2017). *Weather conditions* include temperature, humidity, rain (e.g., Faghih-Imani et al., 2017; Médard de Chardon et al., 2017), wind speed (e.g., Corcoran et al., 2014), daily precipitation (e.g., Mattson and Godavarthy, 2017), heat (e.g., Fishman et al., 2012) and heat warnings (e.g, Rabassa et al., 2020), cloud-cover, sun (e.g., K. Wang et al., 2018), and snow (e.g., Godavarthy and Rahim Taleqani, 2017). Forty studies (19.70%) analyse the link between *weather* and MSS user behaviour. Results typically show that high temperatures (but not too high) are favourable, while low temperatures, rain, high humidity, strong winds and snow discourage user behaviours such as the intention or likelihood of using MSS (e.g., Xu et al., 2020; Gebhart and Noland, 2014), MSS usage (e.g., Kim, 2018; Xu & Chow, 2019), trip duration (e.g., Caulfield et al., 2017), switching from an existing transportation mode to MSS (e.g., Campbell et al., 2016), satisfaction (e.g., Albiński et al., 2018), and avoidance (e.g., Rabassa et al., 2020). Weather conditions seem to affect recreational trips more than commuting (An et al, 2019).

3.2.2. System-related factors

System-related factors include convenience and usefulness, economic factors, accessibility, ease of use, service quality, vehicle features and quality, regulations and app-related aspects.

Two of the most studied system-related factors, appearing in 52 articles (25.74%), are *convenience and usefulness*. Convenience refers to the benefits and comfort levels of MSS compared to other travel modes, avoidance of traffic jams, and timesaving (Ding et al., 2019; Ma et al., 2020b), considering also parking, stations, intelligent cards, and MSS apps (Yang and Long, 2016), provision of courtesy helmets (Jain et al., 2018), and connection to other travel modes (J. Chen et al., 2019). Thirty-seven articles (18.67%) investigate convenience which was found to promote the intention to use MSS (e.g., Kuo et al., 2020), willingness to participate in MSS (e.g., Yang and Long, 2016), adoption of MSS (e.g., Efthymiou et al., 2013) and MSS usage (e.g., Fishman et al., 2014; Li et al., 2018; Soltani et al., 2019), willingness to pay for MSS services (e.g., Abolhassani et al., 2019), MSS membership (e.g., Fishman et al., 2015), increased use over time by casual riders (Jain et al., 2018), loyalty (e.g., Xin et al., 2018), and user satisfaction (e.g., Liu, 2020).

Usefulness is a component adopted from TAM (e.g., Chen, 2016a; X. Ma et al., 2019) and refers to how using MSS makes travel more efficient and useful (L. Ma et al., 2018). The articles reviewed link usefulness to positive attitude towards MSS (e.g., X. Ma et al., 2019), willingness to use MSS (e.g., Curto et al., 2016), continuance intention (e.g., Zhanyou et al., 2020), likelihood and frequency of using MSS (e.g., Bachand-Marleau et al., 2012), intention to sustainably use MSS (e.g., Shao and Liang, 2019), and user satisfaction (e.g., Liu et al., 2018), green loyalty to MSS (e.g., Chen, 2016a), trust and subjective well-being (e.g., L. Ma et al., 2018), and bike-sharing system loyalty (e.g., Jamšek and Culiberg, 2020).

Economic factors are included in 40 studies (19.80%) and refer to MSS travel cost (e.g., J. Chen et al., 2019) and perceived price value (i.e., value for money) (e.g., Chen and Chancellor, 2020), price of the annual ticket (e.g., Serna et al., 2019), discounts (e.g., T. Zhou et al., 2020), money-savings (e.g., Cerruti, et al, 2019), affordable plans (e.g., Qian et al., 2020), and pricing strategies (e.g., Chen et al., 2020b). The cost of other transit modes (e.g., Li et al., 2018) and weekly gas prices (e.g., Younes et al., 2020) are also considered.

Economic factors influence acceptability of MSS (e.g., Nikitas, 2018), switching from an existing transportation mode to MSS (e.g., Campbell et al., 2016), MSS adoption (e.g., Efthymiou et al., 2013) and usage (e.g., Jurdak, 2013), origin-destination travel patterns

(e.g., Du and Cheng, 2018), willingness to pay (e.g., Guo et al., 2017), riding frequency (e.g., Reilly et al., 2020), choice of bikesharing brand (e.g., Xiao and Wang, 2020), and user satisfaction (e.g., Guo et al., 2017; Soltani et al., 2019). As would be expected, perceiving MSS as a more affordable alternative is positively associated with increased use (e.g., Cerruti, et al, 2019; M. Du et al., 2019; Soltani et al., 2019) and satisfaction (Guo et al., 2017). Aspects like deposit requirement and deposit returning speed appear not to affect the choice of MSS brand (e.g., Xiao and Wang, 2020).

Accessibility refers to the presence/absence of quick access to MSS (Du and Cheng, 2018). It is investigated in 36 studies (17.82%) and includes aspects like the sign-up, check-in/out process and opening hours (e.g., Fishman et al., 2012; Shen et al., 2018), availability of bikes/scooters (e.g., Wahab et al., 2018), availability of stations (e.g., McNeil et al., 2018), access to destinations, including transit stops (e.g., Jia and Fu, 2019), and access to system information (e.g., Xin et al., 2018). Accessibility is generally positively associated with the intention to use MSS (e.g., González et al., 2018), acceptability of BSS, and expected BSS usage patterns (e.g., Nikitas, 2018), MSS usage (e.g., Lathia et al., 2012), demand for campus bikesharing (e.g., Aliari et al., 2020), trip frequency (e.g., Wang and Lindsey, 2019a), adopting cycling in commuting trips (e.g, Jia and Fu, 2019), and user satisfaction (e.g., Soltani et al., 2019).

MSS *ease of use* refers to the simplicity and understandability of using shared vehicles (X. Ma et al., 2019) and interacting with information systems, facilities, and MSS services (L. Ma et al., 2018). Twenty-five studies (12.6338%), some of them based on TAM (e.g., X. Ma et al., 2019), mostly find that ease of use positively influences green intention of MSS consumption (e.g., Chen and Lu, 2016), intention to cycle frequently and for multiple purposes (e.g., Kaplan et al., 2015), continual use intention (e.g., Kim and Kim, 2020), orderly parking intention (e.g., Shao and Liang, 2019), trust and subjective well-being (e.g., L. Ma et al., 2018), MSS usage and satisfaction (e.g., Guo et al., 2017) and BSS loyalty (e.g., Chen, 2016a; Jamšek and Culiberg, 2020).

Service quality is discussed in 21 articles (10.40%), that use the SERVQUAL dimensions of Parasuraman et al. (1988), along with other service-related variables like MSS efficiency (e.g., Maioli et al., 2019), cleanliness and maintenance (e.g., Xin et al., 2018), service level

(e.g., Li and Tang, 2019), complaint channels, and staff service (e.g., Liu, 2020). MSS service quality usually helps increase MSS acceptance (e.g., Jahanshahi et al., 2019) and intention to adopt MSS (e.g., Hazen et al., 2015), MSS usage (e.g., Zhang et al., 2015), frequency of use (e.g., Bachand-Marleau et al., 2012), loyalty (e.g., Xin et al., 2018), continuance intention (e.g., Shao et al., 2020), and user satisfaction (e.g., Zhang et al., 2015).

Twelve articles (5.94%) investigate the influence of *vehicle features and quality*, including lighting, braking and gearing systems, tyre pressure and vehicle cleanliness (e.g., Soltani et al., 2019), practical bicycle frame design (e.g., Chen and Lee, 2018), vehicle comfort and functioning (e.g., Manzi and Saibene, 2018), ability to carry personal belongings (e.g., Liu, 2020), attractive design (e.g., Bachand-Marleau et al., 2012), and quality (e.g., Ma et al., 2020a). Such characteristics tend to be positively related to the likelihood and frequency of using MSS (e.g., Bachand-Marleau et al., 2012), choice of bikesharing brand (e.g., Xiao and Wang, 2020), MSS usage (e.g., S. Ma et al., 2019), service performance evaluation (e.g., Chen and Lee, 2018), user satisfaction (e.g., Manzi and Saibene, 2018), and loyalty (e.g., Jamšek and Culiberg, 2020). Malfunctioning bicycles, on the other hand, cause negative sentiment (e.g., Kim and Hong, 2020) and decrease MSS usage (e.g., Du & Cheng, 2018; Li et al., 2018).

Governmental and system operational *regulations*, like claim and punishment mechanisms (e.g., Xin et al., 2018); station and returning rules (e.g., Zhu et al., 2020), mandatory helmet use, speed limit, parking locations, and ban on riding on footpaths (e.g., Lo et al., 2020) are found in 11 studies (5.94%) and tend to have a negative effect on MSS usage (e.g., Li et al., 2018; Lo et al., 2020; Médard de Chardon et al., 2017), service performance evaluation (e.g., Chen and Lee, 2018), user sustainable behaviour (e.g., Chi et al., 2020), MSS membership (e.g., Fishman et al., 2015), user satisfaction, complaints, and loyalty (e.g., Xin et al., 2018).

Finally, nine articles (4.46%) research MSS *app-related aspects*, referring to registration via the mobile application (e.g., Soltani et al., 2019), picking/dropping features (e.g., Manzi and Saibene, 2018), availability of relevant data (e.g., Patel and Patel, 2020), app completeness regarding the rental process (e.g., Nikiforiadis et al., 2019), and app user

interface design (e.g., Jia et al., 2018). Studies investigating these application features usually find their presence and quality have a positive influence on the willingness to shift to MSS (e.g., Nikiforiadis et al., 2019), attitude towards uncivilized behaviour (e.g., Jia et al., 2018), and user satisfaction (e.g., Manzi and Saibene, 2018).

3.2.3. User-related factors

Another group of factors discussed in the articles relates to users and includes socio-demographic variables, attitudes, sustainability and green motivations, social factors, safety and security issues, perceived value, health concerns, hedonic value, the purpose of MSS use, and perceived behavioural control.

A large number of documents (66; 32.51%) consider the role of *socio-demographic* variables, usually as controls or for description, like age, gender, ethnicity (e.g., Kaviti et al., 2019), having children (e.g., Therrien et al., 2014), education (e.g., J. Chen et al., 2019), occupancy, income (e.g., Aguilera-García et al., 2020), residence in more or less deprived areas (e.g., Ogilvie and Goodman, 2012), and nationality (e.g., Maas et al., 2020). They discuss their effect on a wide range of MSS user behaviours, including the willingness to use MSS (e.g., Feng and Li, 2016), switching from an existing transportation mode to MSS (e.g., Campbell et al., 2016), MSS usage (e.g., Faghih-Imani and Eluru, 2015; Liao, 2016), spatiotemporal patterns of public bicycle use (e.g., Wang and Lindsey, 2019b), MSS station usage (e.g., Hyland et al., 2018), cycling behaviours (e.g., Beecham and Wood, 2014), choice of MSS brand (e.g., Xiao and Wang, 2020), and membership (e.g., Raux et al., 2017; Schoner et al., 2016).

Although some studies find no signifficant gender effects (e.g., Zhao et al., 2015), most find men use MSS more than women (e.g., Aguilera-García et al., 2020; Faghih-Imani et al., 2017; Soltani et al., 2019), especially for commuting (e.g., Beecham and Wood, 2014); women tend to feel less safe (Maas et al, 2020), take longer trips (Faghih-Imani et al., 2017) and prefer to ride (on weekends and) in parks and quieter roads (Beecham and Wood, 2014). Additionally, MSS is most used by university-educated, employed younger people, with relatively higher income (e.g., Aguilera-García et al., 2020; Kaviti et al., 2019; Li et al., 2018; Maas et al, 2020; Therrien et al., 2014). Some studies find ethnic minorities (e.g.,

Kaviti et al., 2019; Oates et al., 2017) and those living in more deprived areas (e.g., Ogilvie and Goodman, 2012) use MSS less or less regularly.

The users' *attitudes* are also researched in the articles reviewed at a broader level of *attitude towards cycling and other transportation means,* and at a specific level of *attitude associated with using MSS*. The first level includes 53 studies (26.24%) that discuss how the user behaviour can be influenced by the attitude towards bicycle technology (e.g., Kaplan et al., 2015), attitude towards car use (e.g., Milakis, 2015), bus or subway use (e.g., Du et al., 2019), bicycle ownership (e.g., Bachand-Marleau et al., 2012), car ownership (e.g., M. Chen et al, 2020), modes of commuting to and from school (e.g., Estevan et al., 2018), wanting to avoid congestion (e.g., Cerruti et al., 2019), lack of transport (e.g., S. Ma et al., 2019) and public transport facilities (e.g., K. Wang et al., 2018).

The included studies associate these attitude-related variables with several forms of MSS user behaviour including the intention or likelihood of using MSS (e.g., Milakis, 2015; Therrien et al., 2014), switching from an existing transportation mode to MSS (e.g., Campbell et al., 2016), willingness to pay (e.g., Kim et al., 2017), MSS usage (e.g., McNeil et al., 2018), trip duration (e.g., Caulfield et al., 2017), as well as MSS membership (e.g., Fishman et al., 2015), and user satisfaction (e.g., Albiński et al., 2018). For instance, having positive attitudes towards cycling and public transport typically increases the likelihood of using MSS (e.g., Z. Chen et al., 2020). Similar results are found relative to walking, using public transport or combining public transport with cycling to commute (e.g., Aguilera-García et al., 2020; Guo et al, 2017; Therrien et al., 2014). Results for car and bicycle ownership are more mixed. Some studies associate owning a bike with higher MSS use (e.g., Guo et al, 2017; Milakis, 2015) while others find the opposite (e.g., Bachand-Marleau et al., 2012). In terms of car ownership, while some studies find no effect (e.g., Z. Chen et al., 2020), others find slight positive (e.g., M. Chen et al, 2020) or sligh negative (e.g., Wang et al., 2017) influence on MSS usage.

At a specific level of attitude associated with using MSS, 15 studies (7.43%) analyse how perceptions of MSS influence its acceptance (e.g., Jahanshahi et al., 2019), intention to use (e.g., Cai et al., 2019; Fernández-Heredia et al., 2016) and adoption of MSS (e.g., Aguilera-

García et al., 2020), willingness to shift to MSS (X. Ma et al, 2020), MSS leisure use (e.g., Chen and Chancellor, 2019), and user satisfaction (e.g., Zhanyou et al., 2020).

Thirty-seven (18.32%) studies tackle *sustainability and green motivations* which reflect MSS users' environmental concerns about conventional transportation means that cause energy-drain, environmental damage, and increase global warming (Huang et al., 2019; Milakis, 2015; M. Zhu et al., 2020). This factor also considers users' awareness of MSS as a transit mode that improves traffic quality, minimizes resource consumption, and reduces harmful gas emissions (Cerutti et al., 2019; Eccarius and Lu, 2020; Ngan and Khoi, 2019). These concerns typically have a positive influence on behaviours like MSS acceptability (e.g., Nikitas, 2018), intention or likelihood of using MSS (e.g., Milakis, 2015; Welch et al., 2020), green intention to use MSS (e.g., Si et al., 2020), willingness to pay (e.g., Kim et al., 2017), switching from an existing transportation mode to MSS (e.g., Campbell et al., 2016), MSS usage (e.g., Aguilera-García et al., 2020), environmental trust in MSS (e.g., Chen, 2019), and user satisfaction (e.g., Maranzano et al., 2020), loyalty (e.g., Jamšek and Culiberg, 2020), and green loyalty (e.g., Chen, 2016a, 2016b).

Most of the 35 articles (17.33%) addressing *social factors* include subjective norms that express the approval and support of family, friends, and strangers to the MSS user behaviour (e.g., Eccarius and Lu, 2020; Si et al., 2020; Xu et al., 2020). Some of these studies discuss subjective norms in light of the TPB theoretical framework (Chen, 2016b). In a few studies, the social factor indicates users' tendency to compare themselves to others (e.g., Chi et al., 2020; Ge et al., 2020), users' social interaction and information exchange about bikesharing brands (e.g., Xiao and Wang, 2020), and cultural value variables (e.g., Patel and Patel, 2020; Yin et al., 2018). Social factors appear to influence the choice of MSS brand (e.g., Xiao and Wang, 2020), and promote adoption of cycling in commuting trips (e.g., Jia and Fu, 2019), intention to use MSS (e.g, Chen, 2019; Kaplan et al., 2018), sustainable shared-cycling behaviour (e.g., Chi et al., 2020), subjective well-being (e.g., L. Ma et al., 2018), trust in the MSS system (e.g., L. Ma et al., 2018), and bike-sharing system loyalty (e.g., Jamšek and Culiberg, 2020).

A further 27 articles (13.37%) discuss the effect of *safety and security issues* like the perceived risk of damage, theft, security, and traffic (e.g., Therrien et al., 2014; B. Zhou et

al., 2020), but also financial and privacy risks (e.g., Kim and Kim, 2020; T. Zhou et al., 2020). Feeling safe and secure promotes intention to use (e.g., Gao et al., 2019; Therrien et al., 2014) and continuance intention to use MSS (e.g., Kim and Kim, 2020), willing to shift mode to MSS (e.g., Ma et al., 2020a), acceptability (e.g., Nikitas, 2018), adoption (e.g., Efthymiou et al., 2013), and usage of MSS (e.g., Bakogiannis et al., 2019), willingness to pay (e.g., Abolhassani et al., 2019), and user satisfaction (e.g., Cheng et al., 2019; Ding et al., 2019). Feeling unsafe, in turn, discourages MSS use (e.g., Bieliński et al., 2019). Avoiding the risk of theft of owned bike can be a motive to prefer MSS (Bachand-Marleau et al., 2012).

Perceived value relates to users' monetary and psychological evaluation of the costs and benefits of using MSS. If benefits are seen to outweigh the costs, the perceived value is considered high (Kim and Kim, 2020). Twenty-five documents (12.38%) investigate the influence of perceived value on acceptance of MSS (e.g., Jahanshahi et al., 2019), intention to use MSS (e.g., Gámez-Pérez et al., 2017) and green intention to use MSS (e.g., Huang et al., 2019), MSS adoption (e.g., Serna et al., 2019), and usage (e.g., Ye et al., 2020), environmental trust in MSS (e.g., Chen, 2019), green loyalty to MSS (e.g., Chen, 2016a), and user satisfaction (e.g., Zhou and Zhang, 2019).

Nineteen papers (9.41%) discuss the effect of *health concerns* on MSS user behaviour, covering perceptions of physical (e.g., Link et al., 2020; Sun and Dai, 2016), medical (e.g., Barbour et al., 2019; Ding et al., 2019), and mental benefits (e.g., Liu et al., 2018; B. Zhou et al., 2020) of using two-wheelers and their influence on positive attitudes towards MSS (e.g., X. Ma et al., 2019), acceptability (e.g., Nikitas, 2018), willingness to use (e.g., Cerruti et al, 2019; Yang and Long, 2016) and pay for MSS (e.g., Kim et al., 2017), MSS usage (e.g., Li et al., 2018), user satisfaction (e.g., Ding et al., 2019; Liu et al., 2018), and becoming a frequent bike-share user (e.g., Reilly et al., 2020).

The *hedonic value* expresses the entertainment experience and recreational purposes of using MSS (Bachand-Marleau et al., 2012; Liu et al., 2018). Hedonic variables project the emotions of happiness, pleasure, fun, excitement, and pleasantness when using MSS (e.g., L. Ma et al., 2018; X. Zhang et al., 2017). Seventeen articles (8.42%)discuss the influence of hedonic values, which tend to favour the intention to use (e.g., Wu et al., 2019), MSS

user experience (e.g., Bejarano et al., 2017), continuance intention to use MSS (e.g., Kim and Kim, 2020), frequency of using MSS (e.g., Bachand-Marleau et al., 2012), satisfaction (e.g., Chen and Huang, 2020; Y. Liu et al., 2020), trust (e.g., L. Ma et al., 2018), subjective well-being (X. Zhang et al., 2017), and green loyalty to MSS (e.g., Chen, 2016a).

The literature reveals that people use MSS for different *purposes* like commuting, leisure, shopping, visiting relatives/friends, travelling to the city centre (e.g., Aguilera-García et al., 2020) or the suburbs (e.g., Du et al., 2019), exercise and fitness, reach other modes of transportation (e.g., Kaviti et al., 2019), go to university (e.g., Liu and Lin, 2019), go out for business and return home (e.g., Chen et al., 2020a). Twelve papers (5.94%) address the effect of *purpose of use* on willingness to use MSS (e.g., Fernández-Heredia et al., 2016), MSS usage (e.g., Chen and Chancellor, 2019) and frequency of use (e.g., Chen et al., 2020a; Festa and Forciniti, 2019), and selection between membership and casual trip (e.g., Kaviti et al., 2019). Commuting to work or school is one of the most frequent purposes for using MSS in the urban context (e.g., M. Chen et al., 2020; Zhao et al., 2015), although leisure is also common (e.g., Fernández-Heredia et al., 2016; Festa and Forciniti, 2019), especially on weekends (e.g., Guo et al., 2017) and for casual users (e.g., Kaviti et al., 2019; Soltani et al., 2019).

Finally, nine documents (4.46%) use TPB to analyse the role of *perceived behavioural control*, i.e., people's perception of the ease or difficulty of using MSS (Ajzen, 1991). Eight studies link this to intentions to adopt or use MSS (e.g., Xu et al., 2020; M. Zhu et al., 2020), and one study examines its positive effect on green loyalty to MSS (Chen, 2016b).

Figure 3 summarises all the factors investigated in the 203 included articles.

Insert Figure 3 here

4. Future research directions

This systematic literature review shows that, although research on factors affecting MSS user behaviour has attracted much attention in recent years, knowledge is scattered. Different concepts and variables are used to measure similar realities, and many relevant questions seem as yet neglected. By making sense of this complexity, this review allows us to observe that the topic would benefit from studies grounded on a wider range of

theoretical frameworks and methods. Based on the traits and patterns discerned in the review, avenues for future research are proposed next.

4.1. Studying MSS behaviours within integrated urban mobility

Although some of the reviewed studies examine, for instance, intention to switch from car to bicycle (e.g., Ma et al., 2019) and the impact of MSS station location relative to public transport and other points of interest on MSS adoption (e.g., Faghih-Imani et al., 2017; Rixey, 2013), the study of MSS user behaviour within the overall urban mobility context is rare. As urban mobility becomes more connected and intermodal, analysing how MSS user behaviour is shaped within integrated Mobility-as-a-Service (MaaS) systems becomes imperative. MaaS platforms are digital systems that integrate several complementary transport modes (including trains, trams, metro, buses, taxis, shared-bikes and scooters...), aiming to offer users a "one-stop-shop" interface with flexible and tailored solutions. This allows users to plan, book and pay for a combination of transport modes, with the ultimate goal of achieving a seamless door-to-door travel experience (Cruz and Sarmento, 2020; Kamargianni et al., 2016). Given the importance of micromobility to fulfil the first and last mile of urban journeys, MSS is an essential piece if the MaaS puzzle (Macioszek et al., 2020). The technological integration of MSS systems and interfaces into MaaS (including booking, ticketing and payment), as well as the physical coordination on the ground among the different transport modes (e.g., timetables, pricing bundles, location of stations to create multimodal hubs), may affect the convenience and effectiveness of combining multiple transport modes, and hence users' willingness to use those alternatives to private cars. These issues may be crucial in achieving greener, more sustainable urban mobility, thereby deserving closer study.

4.2. Extending geographical coverage and considering culture

Although considering grey literature could widen the geographical coverage, our review shows that more than 57% of research is conducted in the context of Chinese and US MSS. Thus, more research is needed to extend our understanding of MSS and their users' behaviours in different countries and cultures. Studying MSS user attitudes and behaviours in new regions could provide helpful insights and information for operators intending to enter virgin markets.

Additionally, the cultural dimension is known to influence private use of micromobility vehicles, cycling behaviour and the implementation of transport policies in general (e.g., Aldred and Jungnickel, 2014). Although MSS studies consider samples from diverse countries and cultures, the potential effect of cultural factors on MSS user behaviour is conspicuously absent. Using established frameworks, like Hofstede's cultural dimensions (Hofstede, 1994; Hofstede and Minkov, 2010) or the GLOBE Project (Javidan and Dastmalchian, 2009) are promising avenues.

4.3. Researching emotional influences and outcomes of MSS use

A few studies discuss the role of emotions at the level of private biking and mountain-biking experiences (e.g., Hetland et al., 2019). Emotions are ubiquitous and are at the core of consumer experience (Bagozzi et al., 1999). However, MSS related literature is largely ignoring emotional factors (Bejarano et al., 2017). Emotions can be considered and have been approached, both as a determinant and as an outcome of the experiential behaviour (Palmer, 2010). None of the articles reviewed here considers the prospective effect of users' emotional states on their MSS experience, and the emotional benefits of using MSS is only addressed in one study (Choi and Choi, 2020). Thus, future research may look at emotions, both positive and negative, and explore their potential effects not only on the experience, but also as a result of the experience or even as having a mediating role in the relationship between different determinants and user behavioural responses such as loyalty (Ou and Verhoef, 2017).

4.4. Exploring new factors to improve promotional tools

Most of the existing literature tackles factors that help facilitate MSS implementation. As MSS becomes more pervasive, with operators and even different MSS types multiplying worldwide, competition intensifies among MSS services, and with other transportation modes. Current operators are mostly aware of the factors featured in Figure 3. What they increasingly need to know is what would make their specific business more attractive to users. Future studies could therefore consider the effect of aspects like vehicle appearance and design on user reactions towards MSS. Although a handful of studies consider the

appearance of MSS vehicles (e.g., Liu, 2020; Xiao and Wang, 2020), this was done superficially. Studies detailing features that can be used in promotional tools, like colour, logo, and unique design, are needed. Moreover, attractiveness factors like price were mostly studied for their positive or negative effect on MSS user behaviour (e.g., Chen and Chancellor, 2020). Future studies have to delve deeper, for example, comparing different pricing strategies and plans so that more targeted promotional practices can be developed.

4.5. Considering environmental beliefs and behaviours in the MSS context

The review shows that sustainability and green factors associated to individuals' attitudes and beliefs are explored as determinants of MSS behaviour in 37 studies (18.32%). This category of factors is highly relevant considering the role of MSS to sustainable transportation (Cerutti et al., 2019; Eccarius and Lu, 2020; Ngan and Khoi, 2019). However, it would be interesting to distinguish behaviour driven by genuine pro-environmental motivations from "green to be seen" attitudes (Brick et al., 2017, p. 226). Genuine environmental concerns, such as biospheric values, have been consistently shown to influence green behaviours (Katz-Gerro et al., 2017), whereas some people may engage in sustainable behaviours only because they are visible to others, signalling valued identities. As a socially visible object, shared bicycles may help project such environmentally friendly identities (Brick et al., 2017). Therefore, studies improving our understanding of the influence of sustainable and green motivations on MSS use would be welcome.

Aside from distinguishing motives, it is important to link MSS use to long-term commitment to sustainable mobility and other types of sustainable behaviour. Some of the articles reviewed found green and environmental intentions and green loyalty to result from MSS use, that itself derived from other determinants such as convenience and ease of use, social and health factors, but also hedonic and perceived value (e.g., Chen, 2019; Huang et al., 2019; Ngan and Khoi, 2019; Chen, 2016a; 2016b; Chen and Lu, 2016). Future studies could further explore, irrespective of motivations, a possible green contagion or positive spillover effect (Nilsson et al., 2017) of using of MSS, as a sustainable transport mode, on other sustainable behaviours, and even to other people, particularly if MSS users are opinion leaders (Geiger et al., 2019).

4.6. Addressing the intention-behaviour gap

Results indicate that, when studying the factors that affect MSS behaviour, there is a focus on some specific forms of user behaviour, mainly, intention to use; MSS usage and usage patterns; and satisfaction and loyalty. Little research has considered, however, intention and actual behaviour together (Cai et al., 2019). This combined analysis is important, inasmuch as there are concerns that intentions do not always predict behaviour (Ajzen, 2015) in several different areas, such as ethical behaviours (e.g., Hassan et al., 2016); pro-environmental consumer behaviour adoption (e.g., Grimmer and Miles, 2017); and maintenance of physical exercise (e.g., Rhodes and de Bruijn, 2013; Sniehotta et al., 2005). Therefore, it would be relevant both as a theoretical contribution to the intention-behaviour gap and for MSS business practice that research: (i) examine and measure such intention-behaviour gap (Sheeran and Webb, 2016) in the context of MSS adoption, and (ii) explore the reasons for its existence to identify mitigating measures.

4.7. Examining negative MSS behaviours

The majority of studies examine factors affecting positive behaviours, such MSS usage (e.g., Nickkar et al., 2019; Zeng et al., 2020), frequency of use (e.g., Chen and Huang, 2020; Reilly et al., 2020); and travel length (e.g., Salih-Elamin and Al-Deek, 2020; Wang and Lindsey, 2019). Conversely, very little research considers the factors affecting other behaviours such as uncivilized actions, which were seldom addressed and focus attitudes only (Jia et al., 2018). There are several negative user behaviours that deserve closer analysis. For example, some research suggests that humans are egoistic and need regulation concerning collaborative consumption (Hartl et al., 2016). Trying to uncover the motives for such behaviours and what kind of regulatory measures or positive incentives are effective in reducing MSS misuse could contribute to mitigate a practical problem that MSS operators face. This also opens research opportunities within social marketing studies.

4.8. Including negative assessments of MSS use

On a different perspective, negative assessments of MSS use, such as complaints (Xin et al., 2018), dissatisfaction (Kim and Hong, 2020), and avoidance behaviour (Rabassa et al.,

2020) are also infrequent in the review. Although studies addressing satisfaction can provide useful clues concerning dissatisfaction, none of the studies consider, for instance, users' negative Word-of-Mouth (WoM). Understanding determinants of WoM can help MSS operators build more robust marketing strategies that consider the power of referral. WoM seems to be crucial for MSS brand image, but this was discussed only once, by Xiao and Wang (2020). As relevant as positive behaviours towards MSS are, research must also endeavour to understand the determinants of negative behaviour like dissatisfaction, avoidance, negative WoM, and boycott. Understanding the critical failures in MSS service that trigger destructive behaviours would allow operators to avoid or control unpleasant user experiences and better meet users' expectations.

4.9. Expanding studies on SSS

Only six of the articles reviewed (2.96%) study the context of SSS. One of them compares temporal determinants of BSS and SSS user behaviours (Younes et al., 2020). The paucity of research on SSS can be explained by how recent the emergence of scooter-sharing is (2017). However, SSS business is expected to grow and expand rapidly all over the world (CBInsights, 2020), justifying specific investigation to identify the determinants of SSS users' behaviour, as well as to examine similarities and differences between SSS and BSS usage.

4.10. Consolidating the use of theoretical frameworks

Less than a quarter (21.18%) of the studies reviewed rely on theory to develop their research framework, with TPB and TAM dominating (see Table 5). Other theories are employed only once, or twice in the case of Diffusion of Innovation Theory (Schoner et al., 2016; Therrien et al., 2014) and Norm Activation Theory (Huang et al., 2019; Kim et al., 2017). The field would therefore gain by a stronger theoretical grounding, not only by relying more on theory to guide empirical work, but also by consolidating the diverse approaches listed in Table 5. Several theories can help frame the discussion around the research opportunities we identify above. For example, Differential Emotions Theory (Izard, 1977) can play a fundamental role in revealing the effect of MSS use on users' positive and negative emotions, while Appraisal Theories of Emotions (Lazarus, 1991a,

1991b) can contribute to understand how users' emotional states influence their attitude and behaviours. The Theory of Green Purchase Behaviour (Han, 2020), in turn, can provide grounds to explain users' environmentally responsible behaviour and understand how awareness of environmental consequences affects MSS usage behaviour.

4.11. Employing new research designs

About 96.5% of the included studies have favoured a quantitative approach to examine the determinants of MSS user behaviour. Although appropriate and expedient to highlight factors that have the most influence on user behaviour, they have limitations. Almost two thirds of the studies reviewed (59.69%) base their analysis on data collected from self-reported surveys, relying on the respondents' ability to remember their behaviour retrospectively or to be aware of adequately self-report beliefs, attitudes and behavioural intentions. However, self-report is subject to a variety of biases (e.g., consistency, social desirability, leniency, acquiesces or mood state) that introduce systematic measurement error, affecting the validity of the conclusions (Podsakoff et al., 2003). Frequently, contradictory results are left unexplained or are only superficially tackled. For example, convenience and facilitating conditions are found to predict bikesharing usage intention in some studies (e.g., Wu et al., 2019) but not in others (e.g., Ding et al., 2019). Using more qualitative or mixed-method techniques allows for more in-depth investigation of specific behavioural influencing factors helping to clear inconsistencies among studies. Moreover, qualitative research can help uncover new hitherto ignored factors with relevant influence on MSS user behaviour. Furthermore, methods that capture physiological and neurological signals can be the starting point to explore the unconscious mechanisms of user behaviour (Bell et al., 2018) and key emotions associated with the MSS experience. Longitudinal studies would add the ability to track behaviour change of MSS users over time, namely regarding the above-mentioned effect on other future pro-environmental behaviours.

5. Conclusion

The proliferation of MSS businesses around the world and the magnitude of literature accompanying this trend called for mapping and summarising all academic research

contributions about the determinants of MSS user behaviour, in order to find gaps and provide directions for future research. This systematic review of the existing literature includes 203 articles published between 2011 and August 2020 and discusses the relationship between various influencing factors and several forms of MSS user behaviour, predominantly MSS usage intention, usage and frequency of use, and user behavioural responses such as satisfaction and loyalty.

Research on MSS user behaviour is dominated by Chinese and American samples and contexts. The supremacy of quantitative approach and lack of qualitative and mixed-method studies is noted. Less than a quarter of the articles reviewed rely on theory – largely TPB and TAM – to guide their studies, while more than 75% draw their assumptions from findings of previous studies.

The review identified 25 main factors associated with MSS user behaviour, which we grouped into three: (i) temporal, spatial and weather-related factors; (ii) system-related factors, and (iii) user-related factors. Most of these factors were often investigated in different contexts, different MSS types or different geographical locations. Although this is a relatively large number of factors, it was surprising – considering the growth of MSS – that several important factors are still neglected in the literature, specifically, cultural, emotional and brand-related factors. These can be levered to contend with MSS competitors and other transit services. Moreover, the literature was largely attentive to specific user behaviours and responses like MSS intention and usage behaviour, and user satisfaction, while disregarding several important forms of behaviour like WoM and negative behaviours and responses.

This review contributes to the literature in numerous ways. It is timely, integrating the research evidence amassed in recent years, along the growing MSS business. It maps the studies on factors influencing MSS user behaviour and proposes an integrative arrangement. The ensuing discussion provides researchers in the field with a set of promising avenues for future research, including: studying MSS behaviours within integrated urban mobility, extending geographical coverage and considering culture, researching emotional influences and outcomes of MSS use, exploring new factors to improve promotional tools, considering environmental beliefs and behaviours in the MSS

context, addressing the intention-behaviour gap, examining negative MSS behaviours, including negative assessments of MSS use, expanding studies on SSS, consolidating the use of theoretical frameworks, and employing new research designs. Finally, it makes a contribution to practice by providing MSS operators with a catalogue of influencing factors that play a crucial role in attracting public transit users, helping to guide their strategies and leverage their activities.

The choices made in any systematic literature review inevitably carry limitations. In our case, we exclude non-English, non-indexed (in WoS or Scopus), and non-journal publications such as books, book reviews and chapters, dissertations, editorial notes, conference outcomes, and other grey literature. Some relevant, especially more recent work, may therefore be missing.

Likewise, the choice of keywords, coding, factor categorization, and interpretation of the data are, naturally, subject to the authors' own biases. Investigator triangulation was nevertheless followed (Flick, 2004), and the final themes presented in the paper result from the interaction among five researchers.

Moreover, the different research methodologies and types of data used in the included studies result in substantial statistical heterogeneity between samples, which precludes the performance of a meta-analysis of this material. Similarly, the diversity of countries and cultures studied compromises the generalizability of results. This systematic literature review presents a more organised and consolidated view of this fragmented body of research, proposing a framework where future studies may position themselves.

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Figures

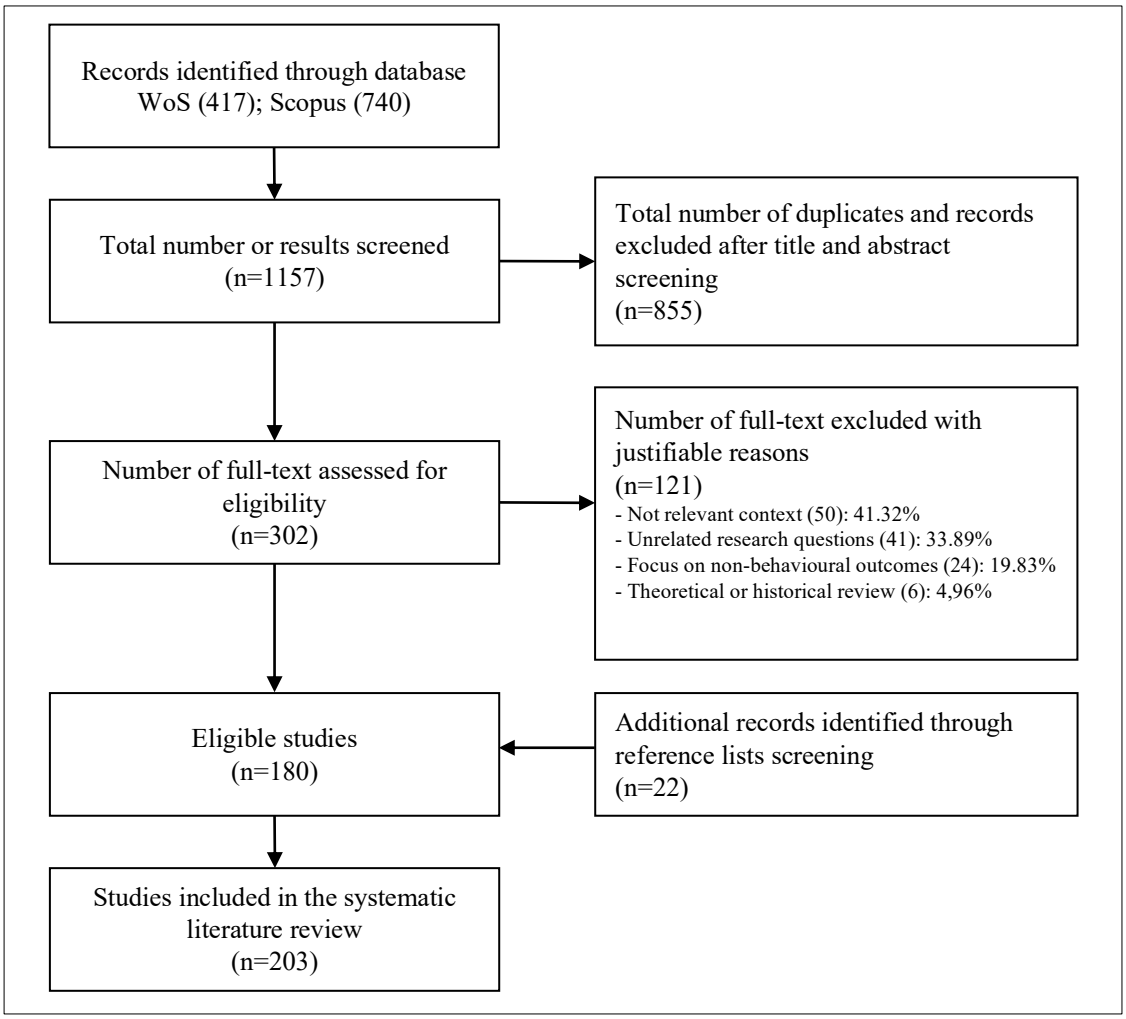

Figure 1. PRISMA flowchart characterizing the search process
Source: Adapted from Stevenson, Hartmeyer and Bentsen (2017)

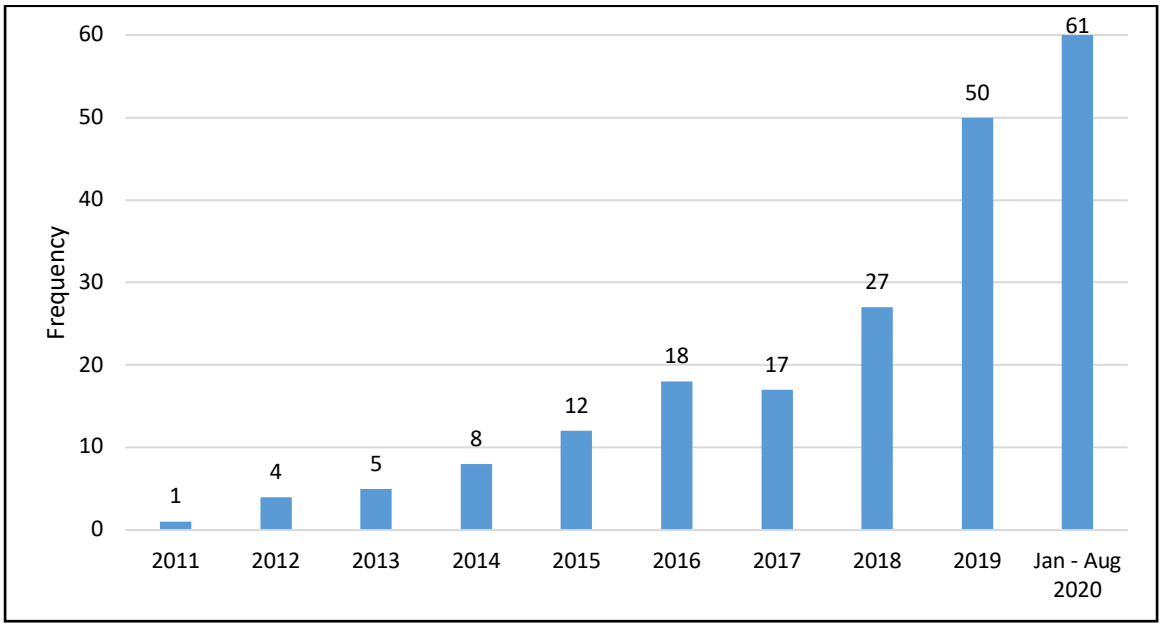

Figure 2. Number of articles published between 2011 and August 2020

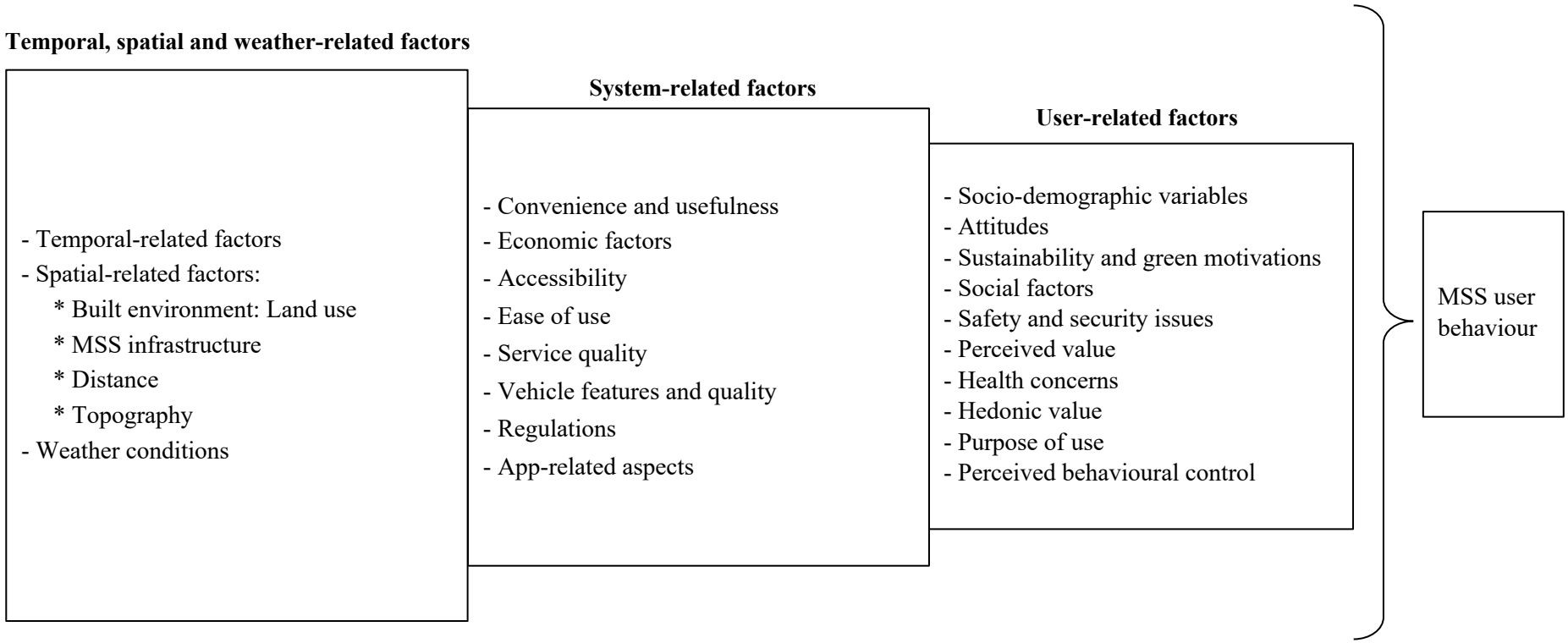

Figure 3. Factors influencing MSS user behaviour

Tables

Table 1. Main keywords used in the comprehensive literature search

"Two wheeler* mobility system" OR "Two-wheeler* mobility system" OR "Bike shar*" OR "Bike-shar*" OR "Bikeshar*" OR "Bicycle shar*" OR "Bicycle-shar*" OR "Bicycleshar*" OR "Scooter shar*" OR "Scooter-shar*" OR "Scootershar*" OR "Micromobilit* shar*" OR "Shared Bicycle" OR "Shared Bike*" OR "Shared electric bike*" OR "Shared e-bike*" OR "Shared scooter*" OR "Shared electric scooter*" OR "Shared e-scooter" OR "Shared micromobilit*" OR "Public Bicycle*" OR "Public Bik*" OR "Public Scooter".

Table 2. Article distribution by journal and time of publication

Journal	Number of articles	%	2011	2012	2013	2014	2015	2016	2017	2018	2019	Jan - Aug 2020
Sustainability	20	9.85%					1	1	1	3	7	7
Transportation Research Part A	19	9.36%					1	4	3	3	3	5
Journal of Transport Geography	14	6.90%				4	1	1	1	2	4	1
International Journal of Sustainable Transportation	11	5.42%					2	1	2	2	1	3
Transportation Research Record	10	4.93%	1	1	1	1	1	1	1	1	2	
Journal of Cleaner Production	7	3.45%									3	4
Plos One	6	2.96%			1		1		1		1	2
Sustainable Cities and Society	6	2.96%							2	1	2	1
Transportation	6	2.96%				1	1	1	1			2
Transportation Research Part D	5	2.46%									2	3
Transportation Research Part F	5	2.46%		1					1	2	1	
Case Studies on Transport Policy	4	1.97%									2	2
Transport Policy	4	1.97%			1	1		1		1		
Transportation Research Part C	4	1.97%		1			1	1			1	
Travel Behaviour and Society	4	1.97%									2	2
International Journal of Environmental Research and Public Health	3	1.48%						1			1	1
International Review for Spatial Planning and Sustainable Development	3	1.48%					1				1	1
Transportation Letters	3	1.48%									2	1
Environmental Science and Pollution Research	2	0.99%									1	1
International Journal of Logistics Research and Applications	2	0.99%									2	
International Journal of Urban Sciences	2	0.99%					1			1		
Journal of Transport and Health	2	0.99%									1	1
Journal of Urban Planning and Development	2	0.99%						1		1		
Networks and Spatial Economics	2	0.99%						1				1
Other journals with 1 article published	57	28.08%		1	2	1	1	4	4	10	11	23
Total	**203**	**100%**	**1**	**4**	**5**	**8**	**12**	**18**	**17**	**27**	**50**	**61**
%			**0.49%**	**1.97%**	**2.46%**	**3.94%**	**5.91%**	**8.87%**	**8.37%**	**13.30%**	**24.63%**	**30.05%**

Table 3. Article distribution by country and time of publication

Country*	Number of articles	%	2011	2012	2013	2014	2015	2016	2017	2018	2019	Jan - Aug 2020
China	74	36.45%	1			1	3	5	4	10	21	29
USA	42	20.69%			2	2	2	4	5	4	11	12
Taiwan	15	7.39%					1	4	1	1	4	4
Spain	10	4.93%			1		1	2		2	1	3
Canada	8	3.94%		1	1	2		1	1		1	1
Australia	7	3.45%		1		2	1	1		1	1	
Greece	5	2.46%			1		1			1	2	
South Korea	5	2.46%					1		1	1		2
Brazil	3	1.48%									2	1
Iran	3	1.48%									2	1
Italy	3	1.48%								1	1	1
UK	3	1.48%		2		1						
France	2	0.99%							1	1		
Germany	2	0.99%								1	1	
Ireland	2	0.99%							1	1		
Poland	2	0.99%								1	1	
Singapore	2	0.99%								1		1
At the level of more than one country	3	1.48%					1	1	1			
Countries with only one published study**	12	5.91%					1		2	1	2	6
Total	**203**	**100%**	**1**	**4**	**5**	**8**	**12**	**18**	**17**	**27**	**50**	**61**
%			**0.49%**	**1.97%**	**2.46%**	**3.94%**	**5.91%**	**8.87%**	**8.37%**	**13.30%**	**24.63%**	**30.05%**

* The country does not refer to affiliations but indicates the place where empirical studies are conducted.

** Argentina, Austria, Colombia, Denmark, India, Malaysia, Mexico, the Netherlands, New Zealand, Slovenia, Switzerland, and Vietnam.

Table 4. Article distribution by methods used and time of publication

Approaches (No. of Articles - %)	Data collection method	Number of articles	%	2011	2012	2013	2014	2015	2016	2017	2018	2019	Jan - Aug 2020
Quantitative approach (196 – 96.55%)													
	Survey	117	59.69%	1	1	3	3	8	10	10	16	32	33
	Big data (Trip records)	70	35.71%		2	2	5	4	5	6	9	14	22
	Multi-source data	5	2.55%						2		1		2
	Other quantitative	4	2.04%								1	1	2
Qualitative approach (3 – 1.48%)													
	Interviews	1	33.33%							1			
	Focus groups	1	33.33%		1								
	Text mining	1	33.33%										1
Mixed method (4 – 1.97%)													
	Multi-source data	4	100%						1			3	
Total		**203**		**1**	**4**	**5**	**8**	**12**	**18**	**17**	**27**	**50**	**61**
%				**0.49%**	**1.97%**	**2.46%**	**3.94%**	**5.91%**	**8.87%**	**8.37%**	**13.30%**	**24.63%**	**30.05%**

Table 5. Main theories/models used

Theory/model used	Number of articles
Theory of Planned Behaviour	12
Technology Acceptance Model	7
Diffusion of Innovation Theory	2
Norm Activation Theory	2
Other theories appearing only in one study	23
Total number of articles that used specific theories/theoretical models	**43* (21.18% of included articles)**

* Three articles used two theories for theoretical foundations. Chen (2016a, 2016b) used both TPB and TAM. Ding et al. (2019) used both Customer Satisfaction Theory and Customer Engagement Theory.

Appendix A. Factors influencing MSS user behaviour and main outcomes in each included study

Study	Spatiotemporal and weather factors						System-Related Factors								User-Related Factors											Study outcomes
		Spatial-related factors																								
			Built environment																							
	Temporal-related factors	Land-use	MSS infrastucture	Distance	Topography	Weather conditions	Accessibility	Ease of use	Vehicle features and quality	App-related aspects	Service quality	Convenience and usefulness	Economic factors	Regulations	Purpose of use	Sustainability and green motivations	Social factors	Health concerns	Hedonic value	Safety and security issues	Attitude associated with using MSS	Attitude towards cycling and other transportation means	Perceived behavioural control	Perceived value	Socio-demographic variables	
Shaheen et al. (2011)	*			*							*		*									*				Bikesharing adoption
Bachand-Marleau et al. (2012)		*		*					*		*	*							*	*		*			*	Likelihood and frequency of using BSS
Fishman et al. (2012)					*	*	*													*						Public bicycle scheme use
Lathia et al. (2012)							*																			BSS usage
Ogilvie and Goodman (2012)																									*	BSS usage
Efthymiou et al. (2013)			*				*					*	*			*		*		*		*				Adoption of BSS
Fuller et al. (2013)		*																								Likelihood of cycling
Jurdak (2013)		*											*													BSS usage
Molina-García et al. (2013)		*		*			*										*			*		*				Behaviour towards BSS
Rixey (2013)		*	*	*		*																*			*	BSS ridership
Beecham and Wood (2014)																									*	Cycling behaviour
Corcoran et al. (2014)	*			*		*																				BSS usage patterns
Faghih-Imani et al. (2014)	*	*	*			*																				BSS usage
Fishman et al. (2014)				*								*														BSS usage
Gebhart and Noland (2014)						*																				Likelihood of using BSS + Duration of trips

Martin and Shaheen (2014)				*																						BSS usage
Therrien et al. (2014)																				*		*		*	*	Likelihood of using BSS
Zhao et al. (2014)							*						*												*	BSS daily use + Turnover rate
Bordagaray et al. (2015)											*															BSS usage
Faghih-Imani and Eluru (2015)		*	*	*																					*	BSS usage
Fishman et al. (2015)				*								*		*								*			*	Bike share membership
Hazen et al. (2015)											*	*												*		Intention to adopt BSS
Kaplan et al. (2015)								*														*				Bike rental intentions + Intention to cycle to multiple activities + Intention to cycle frequently
Lee et al. (2015)		*																							*	BSS usage to commute or to go to school
Milakis (2015)																*						*				Intention to use BSS
Pai and Pai (2015)												*				*						*			*	Intention to use BSS
Sarkar et al. (2015)	*			*																						BSS usage
Zhang et al. (2015)			*								*															User satisfaction + Use of BSS
Zhao et al. (2015)	*	*		*																					*	Bikesharing travel time and trip
Zhou (2015)	*	*		*																						BSS usage
Ahillen et al. (2016)	*	*		*																						BSS Ridership
Campbell et al. (2016)			*	*		*							*			*						*			*	Switching from an existing transportation mode to BSS or E-BSS
Chen (2016a)								*				*				*		*	*					*		Green loyalty to BSS
Chen (2016b)												*				*	*		*				*	*		Green loyalty to BSS
Chen and Lu (2016)								*				*				*					*					Green intentions for consumption of BS
Curto et al. (2016)		*		*								*												*		Willingness to use private bikes + Willingness to use BSS
Faghih-Imani and Eluru (2016a)		*	*		*	*																				BSS usage
Faghih-Imani and Eluru (2016b)	*	*		*		*																				BSS usage
Feng and Li (2016)		*	*																			*			*	Willingness to use BSS
Fernández-Heredia et al. (2016)												*										*		*		Intention to use BSS in university campus
Karki and Tao (2016)							*					*													*	BSS usage
Liao (2016)		*																							*	Public bicycle use
Mateo-Babiano et al. (2016)		*	*		*																					BSS usage
Noland et al. (2016)	*	*	*			*																*			*	BSS station usage
Schoner et al. (2016)				*																					*	System membership

Sun and Dai (2016)			*									*				*		*								User behaviour
Wang et al. (2016)		*	*	*			*																		*	BSS station usage
Yang and Long (2016)			*			*						*	*			*	*	*		*		*				Public participation willingness in BSS
Bejarano et al. (2017)													*			*			*	*						BSS usage
Caulfield et al. (2017)	*			*		*																*				Trip duration
El-Assi et al. (2017)		*				*																			*	Bike share ridership
Faghih-Imani et al. (2017)	*	*				*																				BSS usage
Gámez-Pérez et al. (2017)	*		*									*										*		*	*	Intention to use BSS
Godavarthy and Rahim Taleqani (2017)						*																				Willingness to use BSS in winter
Guo et al. (2017)	*	*	*					*				*	*			*						*			*	BSS usage + Satisfaction degree
Kim et al. (2017)													*			*		*				*				Willingness to pay + BSS usage
Lin et al. (2017)													*													BSS usage
Mattson and Godavarthy (2017)	*	*		*		*																				Bikes share use
Médard de Chardon et al. (2017)		*	*			*							*	*												BSS performance
Oates et al. (2017)																									*	Bikeshare use
Raux et al. (2017)				*																					*	Probability of being an annual member of BSS
Sun et al. (2017)			*				*													*						Usage of BSS
Wang et al. (2017)	*			*							*		*		*							*			*	Public bicycle choice behaviour
X. Zhang et al. (2017)												*					*		*							BSS users' subjective well-being
Y. Zhang et al. (2017)		*	*				*															*				Demand for BSS + BSS usage
Albiński et al. (2018)				*		*					*											*				Satisfaction + Number of booking
Bao et al. (2018)	*		*			*																			*	Bikeshare ridership
Cazabet et al. (2018)	*			*																						BSS usage
Chen and Lee (2018)		*							*			*		*			*			*						BSS performance
Cui (2018)																*		*		*		*			*	Participation willingness in shared bicycles
Du and Cheng (2018)	*			*			*					*	*		*				*			*			*	Travel patterns chosen
Estevan et al. (2018)		*		*			*										*					*			*	BSS usage
González et al. (2018)							*									*									*	Intention to use BSS
Hyland et al. (2018)	*	*		*		*																			*	BSS station usage
Jain et al. (2018)	*		*											*								*			*	BSS usage
Jia et al. (2018)							*			*							*									Intention to civilized use of BSS + Awareness towards uncivilized behaviour

																										+ Attitude towards uncivilized behaviour
Kaplan et al. (2018)								*							*		*	*						*		Intention to use conventional and electric BSS
Kim (2018)	*					*																				BSS usage
Li et al. (2018)											*	*	*	*				*							*	Usage of dockless BSS
Liu et al. (2018)												*						*	*					*		Tourists' experience satisfaction
Ma et al. (2018)								*				*					*		*			*			*	Trust attitude + Subjective well-being
Manzi and Saibene (2018)									*	*		*														Satisfaction
McBain and Caulfield (2018)	*	*		*																						Journey time variation
McNeil et al. (2018)							*						*									*			*	BSS usage
Nikitas (2018)	*		*			*	*					*	*			*		*		*		*				Acceptability of BSS + Expected usage patterns of BSS
Shen et al. (2018)	*	*	*	*		*	*																			Usage of dockless BSS
Wahab et al. (2018)							*					*	*						*	*						BSS usage
K. Wang et al. (2018)	*	*	*			*																*				BSS usage
Y. Wang et al. (2018)				*		*						*				*	*									Public bicycle adoption intention
Wu et al. (2018)		*					*															*				Usage patterns of BSS
Xin et al. (2018)	*		*	*			*				*	*		*						*						Cyclist satisfaction + complaints + loyalty
Yin et al. (2018)																*	*							*		Intention to use BSS
Abolhassani et al. (2019)							*					*	*							*						Willingness to pay for the BSS
Alcorn and Jiao (2019)		*																								BSS usage
An et al. (2019)	*	*	*		*	*																				BSS usage
Bakogiannis et al. (2019)			*				*	*										*		*		*				BSS usage
Barbour et al. (2019)																		*				*			*	BSS usage
Bieliński et al. (2019)		*				*																*			*	BSS performance
Cai et al. (2019)																	*				*		*	*		Intention for using BSS + Behaviour for using BSS
Cerutti et al. (2019)																*	*	*				*				BSS usage
Chen (2019)																*	*							*		Environmental trust of BSS + Environmental using intention of BSS
Chen and Chancellor (2019)																					*					Bikesharing leisure use
Chen et al. (2019)		*						*				*	*		*	*									*	BSS usage
Cheng et al. (2019)								*				*								*						Satisfaction + Continuance intention + Attitude

Chevalier et al. (2019)		*					*										*									Bicycle acceptance
Ding et al. (2019)											*	*						*		*						Satisfaction for BSS using + Enthusiasm for BSS using + Participation for BSS using + Social interaction for BSS using
Y. Du et al. (2019)	*	*	*	*																						Free-floating bike sharing usage
M. Du et al. (2019)				*									*		*							*			*	Travel behaviour
Duran-Rodas et al. (2019)		*																								BSS ridership
Festa and Forciniti (2019)	*														*										*	Willingness to use
Gao et al. (2019)								*				*					*			*						Behavioural intention to use BSS
He et al. (2019)	*	*	*			*																*			*	Electric Bikeshare ridership
Hess and Schubert (2019)			*				*	*	*			*				*				*		*			*	Adoption of e-cargo bike sharing
Huang et al. (2019)																*	*		*					*	*	Green intention
Jahanshahi et al. (2019)			*				*	*			*		*								*			*		Acceptance of BSS
Jia and Fu (2019)		*					*					*					*					*			*	Adopting cycling in commuting trips
Kaviti et al. (2019)															*										*	Selection between membership and casual trip + Pricing preferences of bikeshare users
Kutela and Teng (2019)	*					*																			*	Daily bikeshare trips
Li and Tang (2019)									*		*	*														Intention to use BSS
L. Li et al. (2019)							*						*									*				BSS usage amount
X. Li et al. (2019)																						*			*	BSS usage
Liu and Lin (2019)		*	*												*											Spatiotemporal patterns of public bicycle use
X. Ma et al. (2019)								*				*						*								Attitude towards FFBS + Willing to shift to FFBS
F. Ma et al. (2019)											*															BSS usage
S. Ma et al. (2019)			*	*	*			*	*			*	*			*						*				Choice of travel mode + Riding frequency + BSS usage
Maioli et al. (2019)											*									*						Satisfaction
Ngan and Khoi (2019)								*								*					*	*		*		Green intentions for consumption of BSS
Nickkar et al. (2019)	*	*		*																					*	Bikeshare ridership
Nikiforiadis et al. (2019)										*																BSS usage
Noland et al. (2019)		*																								BSS usage
Scott and Ciuro (2019)	*	*				*																				Bike share ridership
Serna et al. (2019)	*	*					*						*											*	*	Public BSS Adoption

Shao and Liang (2019)								*				*					*				*					Sustainability of the BSS: Continual use intention + Orderly parking intention + Care protection intention
Soltani et al. (2019)							*	*	*	*			*						*							User satisfaction
Sun et al. (2019)																	*				*		*	*		Civilized cycling intention + Civilized cycling behaviour
Wang and Lindsey (2019a)		*					*																			Trip frequency
Wang and Lindsey (2019b)																									*	Spatiotemporal patterns of public bicycle use + Use frequency + Trip duration
Y. H. Wu et al. (2019)		*		*									*													BSS usage
R. Wu et al. (2019)								*				*							*							BSS usage intention
Xin et al. (2019)																	*				*	*	*			BSS use intention + BSS use behaviour
Zhou and Zhang (2019)											*													*		Satisfaction + Loyalty
Zhou et al. (2019)						*																			*	Public bikesharing usage
Aguilera-García et al. (2020)															*						*	*			*	Adoption of SSS + Frequency of use of SSS
Aliari et al. (2020)	*	*		*		*	*																			Demand for campus bikeshare
Bai and Jiao (2020)	*	*		*																						BSS usage
Benedini et al. (2020)	*		*																							Cycling behaviour
Blanford and MGIS Geog 586 Students (2020)															*										*	Spatiotemporal patterns of public bicycle use
Caspi et al. (2020)		*		*																					*	Dockless shared e-scooter usage
Chen and Chancellor (2020)			*					*				*	*				*		*		*					Behavioural intention + BSS usage
Chen and Huang (2020)															*				*					*		Satisfaction + Loyalty
Yiyong Chen et al. (2020)		*	*													*										Riding density
Z. Chen et al. (2020)		*		*			*										*					*			*	BSS usage
M. Chen et al. (2020)				*									*		*							*			*	Frequency of use
Yujing Chen et al. (2020)													*													BSS user travel behaviour
Chi et al. (2020)														*			*							*		User sustainable behaviours
Choi and Choi (2020)												*				*			*	*				*		Sustainable management + Satisfaction + Continuous use
Eccarius and Lu (2020)								*								*	*				*		*	*		Usage intention
Ge et al. (2020)																	*					*				Attitude towards BSS + Intention to use BSS
Jahanshahi et al. (2020)								*				*	*				*			*						Behavioural intention + Use behaviour

Jamšek and Culiberg (2020)								*	*			*				*	*									BSS loyalty
Ji et al. (2020)	*	*		*																						Docked and Dockless BSS usage regularity
Jiao and Bai (2020)		*	*	*																					*	E-Scooter usage
Kapuku et al. (2020)	*		*																							Competitiveness of BSS
Kim and Hong (2020)	*			*			*		*	*		*					*									Customer satisfaction and dissatisfaction
Kim and Kim (2020)								*				*							*	*		*		*		Continuance intention toward BS Services
Kuo et al. (2020)							*					*														Intention to use docked BSS
Lin et al. (2020)	*					*																				BSS usage
Link et al. (2020)	*			*						*			*			*		*								Dockless + Docked BSS usage
Liu (2020)		*			*	*	*		*	*	*	*	*							*		*				User satisfaction
Q. Liu et al. (2020)	*	*	*	*																						BSS usage
Yong Liu et al. (2020)											*					*			*							Customer satisfaction + Loyalty
Yang Liu et al. (2020)	*	*	*	*																					*	Bikeshare usage frequency
Lo et al. (2020)														*												SSS usage
Ma, Ji et al.2020) (2020)	*	*																							*	BSS usage + FFBS usage
Ma et al. (2020b)	*			*					*	*		*	*			*		*		*		*			*	Willing to shift mode to bike sharing
Maas et al. (2020)		*		*																					*	BSS usage
Maranzano et al. (2020)																*										Satisfaction
Molinillo et al. (2020)	*																								*	BSS usage
Patel and Patel (2020)			*		*	*				*				*			*					*				Implementation of BSS
Qian et al. (2020)													*									*				Bikeshare usage
Rabassa et al. (2020)						*																				Avoidance behaviour
Reilly et al. (2020)													*					*				*			*	Becoming a frequent bike share user
Salih-Elamin and Al-Deek (2020)		*				*																				BSS travel time
Shao et al. (2020)											*	*														Satisfaction + Continuance intention
Shen and Chang (2020)																	*				*		*			Behavioural intention
Si et al. (2020)																*	*				*		*	*		Sustainable usage intention + Sustainable usage behaviour
Verma and Awasthi (2020)											*															Customer satisfaction
Z. Wang et al. (2020)	*	*		*																						BSS usage
R. Wang et al. (2020)		*														*										Cycling frequency around metro stations
Welch et al. (2020)		*											*			*										Likelihood of using BSS
Xiao and Wang (2020)									*			*	*				*								*	Bikesharing brand choice

Xu et al. (2020)			*			*											*					*	*			Intention to use FFBS + FFBS usage
Xu and Chow (2020)			*			*																				BSS ridership
Yang et al. (2020)		*		*																		*			*	BSS ridership
Ye et al. (2020)	*	*		*									*											*	*	BSS usage
Younes et al. (2020)	*					*							*													BSS usage + SSS usage
Zeng et al. (2020)	*	*		*																						Bikeshare usage
Zhanyou et al. (2020)								*			*	*									*					Satisfaction + Continued usage intention
T. Zhou et al. (2020)								*				*	*							*						Intention to use BSS
B. Zhou et al. (2020)							*				*			*		*		*		*						Satisfaction
Zhu and Diao (2020)	*	*		*																						BSS usage
Zhu et al. (2020)																*	*				*		*			Intentions to adopt bicycle sharing
R. Zhu et al. (2020)						*	*							*												Usage of FFBS and SSS