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Shared micro-mobility and travel satisfaction: A case study of three European countries

Abstract

Many scholars have examined the determinants of individuals' satisfaction levels with daily travel, including the environmental, personal, and travel attributes. The choice of transport mode in daily travel is found to play a significant role in determining satisfaction with daily travel. However, so far, little is understood about what the adoption of shared micro-mobilities (e.g., shared bikes, e-bikes and e-scooters) brings to individuals' satisfaction with daily travel. Similar studies are essential to understand the wellbeing implications of shared micro-mobility and guide its future development. This paper investigated the changes in individuals' daily travel satisfaction following the adoption of shared micro-mobility by regression analyses based on online questionnaire survey data in three European countries (the Netherlands, Sweden, and the United Kingdom). The results showed that the adoption of shared micro-mobility services helps increase the users' daily travel satisfaction in general. The travel satisfaction increase resulting from shared micro-mobility use depends on both the trip features (trip purpose and mode substitution) and user characteristics. It is greater for male, younger, and low-income respondents than for their counterparts. Nevertheless, shared micro-mobility users still report a similar daily travel satisfaction level with non-users. Our study revealed the potential of shared micro-mobility services in promoting daily travel satisfaction and provided policy insights for how to maximize their wellbeing implications.

Keywords: travel satisfaction, shared micro-mobility, travel attitude, transport equity, Europe

1. Introduction

Subjective wellbeing has been widely used as a measure of people's evaluations of their lives, which consists of moods (positive and negative feelings), life satisfaction, and satisfaction with different life domains, such as living, work, and social relations (Diener et al., 1999; Kahneman et al., 1999). As a specific domain satisfaction, travel satisfaction assesses people's affective and cognitive judgements of travel. This concept has attracted significant attention by transport researchers in the past decade and been applied at different scales, including a specific trip (i.e., trip satisfaction), a certain type of trips (e.g., commuting satisfaction), and overall daily travel patterns (i.e., daily travel satisfaction) (Ettema et al., 2010; De Vos and Witlox, 2017; Gao et al., 2017; Ye and Titheridge, 2017; Liu et al., 2022; Huang and Ma, 2026). A few scholars focus on the role of travel satisfaction in travel decisions, suggesting that travel satisfaction can capture the experienced utility of travel by certain mode (Bergstad et al., 2011; Abou-Zeid & Ben-Akiva, 2013), thus influence future mode choice (De Vos, 2019; Guan et al., 2024a). Some others investigate the close relations between commuting satisfaction/daily travel satisfaction and life satisfaction, and reveal the contribution of travel satisfaction in promoting long-term subjective wellbeing (De Vos and Witlox, 2017; Olsson et al., 2020; Yin et al. 2021; Gao et al., 2022; Hu et al., 2022; Dong et al., 2024; Li et al., 2024; Maheshwari et al., 2024). Therefore, improved travel satisfaction should be one of the objectives in developing transport system. Given this, many other studies have examined the determinants of daily travel satisfaction (e.g., Cao and Ettema, 2014; St-Louis et al., 2014; Waygood et al., 2019; Mao et al., 2022; Guan and Wang, 2024). Among them, an important question is how daily travel satisfaction is associated with the modes used in daily life, including private cars, public transport, walking, and cycling.

The recent introduction of new mobility services, such as shared micro-mobility (**SMM**; e.g., shared bikes/e-bikes/e-scooters), has updated urban transport system and people's travel modes used in lives. However, what shared micro-mobility brings to the users' daily travel satisfaction is still less investigated. The lack of similar research results in an incomplete understanding on the association between travel mode choice and travel satisfaction, especially in the context of rapid development of shared mobility services (Chen et al., 2020). Such knowledge is essential to understand the wellbeing implications of SMM, the ignorance of which may lead to a biased evaluation of the cost-effectiveness of SMM development in relevant policy design. Besides, research about the SMM use impact on daily travel satisfaction can also help identify strategies to maximize its potential wellbeing benefits, thus facilitate its wide adoption and promote more sustainable travel patterns ultimately (Abou-Zeid & Ben-Akiva, 2013; Guan et al., 2024a).

The impact of shared micro-mobility on daily travel satisfaction could be mixed. On one hand, thanks to the location tracking (GPS) and digitalized payment systems, the users can search, unlock, and pay for shared micro-vehicles using the mobile application. Such intrinsic features of shared micro-mobility make it a flexible and efficient transport mode, especially for short-distance trips (Chen et al., 2022a). Besides, shared micro-mobility services can benefit the user experience of public transport as a first/last mile solution (Hirsch et al., 2019). For both reasons, the use of SMM may improve the user's satisfaction with daily travel. On the other hand, shared micro-mobility use may also bring some co-disbenefits in daily travels. For example, when individuals take it as a first-mile solution to access transit stations, they may sometimes have negative travel experiences due to issues like digital barriers, safety concerns, long walking time to the vehicle, and the uncertainty about the availability and parking of vehicles (Meng and Brown, 2021). These co-disbenefits of shared micro-mobility use may weaken its benefit to daily travel satisfaction. However, despite the potential wellbeing impacts of SMM, relevant research mostly focuses on the user profile (Dill and McNeil, 2021) and its environmental (e.g., Nikiforiadis et al., 2021) and equity effects (e.g., Guan et al., 2024b). Few studies (if any) have examined the impact of SMM use on daily travel satisfaction, and therefore reveal its wellbeing implications (Chen et al., 2020).

To fill this gap, this paper aims to shed light on the wellbeing impact of shared micro-mobility use by investigating its effect on daily travel satisfaction based on online questionnaire survey data in three European cities, including Utrecht (Netherlands), Malmö (Sweden), and Greater Manchester (United Kingdom). We selected these three cities because they represent different mobility cultures and provide different kinds of shared micro-mobility services, which can help us to capture the travel satisfaction impact of SMM use more comprehensively. To better understand the role of shared micro-mobility in travel satisfaction, we examined: 1) how daily travel satisfaction differs between SMM users and non-users? 2) how SMM use changes daily travel satisfaction? 3) which factors affecting such daily travel satisfaction change? The results help clarify the effect of shared micro-mobility use on daily travel satisfaction and reveal its wellbeing implications.

2. Literature review

Since this study aims to examine how shared micro-mobility use affects daily travel satisfaction, our review starts from papers on the determinants of travel satisfaction, then summarizes the relevant studies on shared micro-mobility, and finally justifies how shared micro-mobility use may affect travel satisfaction via different ways based on the reviewed research. Given that travelers develop their overall daily travel satisfaction based on their repeated experiences of various daily trips, daily travel satisfaction could be viewed as an aggregation of trip-level satisfaction (Ettema et al., 2010; De Vos and Witlox, 2017). Factors of satisfaction with certain trip(s) may more or less contribute to daily travel satisfaction indirectly. Therefore, although this study focuses on daily travel satisfaction, we review articles on both trip satisfaction and daily travel satisfaction to provide a full picture of potential influential factors of the latter.

2.1 Research on travel satisfaction

2.1.1 Determinants of satisfaction with certain trip(s)

Many studies have investigated the determinants of satisfaction with one specific trip or a certain type of trips, such as trip attributes. Researchers have found that public transport riders tend to have the lowest trip satisfaction, followed by car users, while active mode users had the highest level of trip satisfaction (St-Louis et al., 2014; Mao et al., 2016; Ye and Titheridge, 2017; De Vos et al., 2021). Trips by active modes (e.g., walking or cycling) have been found to bring positive emotions during travel by stimulating the secretion of endorphins and providing opportunities to enjoy the scenery and engage in social interaction (Gatersleben and Uzzell, 2007; De Vos and Witlox, 2017; De Kruijf et al., 2019). The combination of modes in trip (trip complexity) also affects the satisfaction with trips. For instance, it has been found that bikeshare users are less satisfactory with their bikeshare trips if it's used together with public transit (Chen et al., 2022a). Travel duration is normally negatively associated with satisfaction with certain trip(s) because long travel time leads to more fatigue and less enthusiasm in travel (Morris and Guerra, 2015; Higgins et al., 2018; De Vos et al., 2019; Gerber et al., 2020; Sun et al., 2022; Deng et al., 2023). Trip purpose also impacts trip satisfaction. Studies have found that travelers are more satisfied with recreation trips than trips for other activities (Mokhtarian and Salomon, 2001; Ory and Mokhtarian, 2005; Ettema et al., 2013; Zhu and Fan, 2018; Chen et al., 2022). Besides, the seasonal and weather conditions affect the satisfaction with trips by different modes as well (e.g., Willis et al., 2013). For example, high temperature leads to a higher trip satisfaction for transit travelers, while sunshine results in a lower trip satisfaction for cyclists and pedestrians (Ettema et al., 2017).

Studies have suggested the significant impact of individual socio-economics on trip satisfaction. Income is generally found to be positively related to trip satisfaction (Mao et al., 2016; Ma et al., 2021; Shi et al., 2022; Guan et al., 2023), while the impacts of age (Mao et al., 2016), gender (De Vos et al., 2016; Handy and Thigpen, 2019), education level (Ye and Titheridge, 2017), and the ownership of private cars (De Vos et al., 2021) vary across spatial contexts. Built environment attributes affect trip satisfaction as well. The general finding is that compact development characterized by high density (De Vos et al., 2016; Mouratidis et al., 2019), better access to public transport services (Ettema et al., 2011), and high walkability (Kim et al., 2014; Majumdar et al., 2021) helps increase the residents' satisfaction with trips. A few studies found that the residential built environment can also affect satisfaction with commuting and leisure trips indirectly via travel mode choice (e.g., Mouratidis et al., 2019; Ye and Titheridge, 2019).

Trip satisfaction is also associated with travel attitudes (De Vos and Witlox, 2017). Scholars have widely found that individuals tend to be more satisfied with their trips if they travel by preferred (rather than disliked) transport modes (Abou-Zeid et al., 2012; St-Louis et al., 2014; Mokhtarian et al., 2015; De Vos et al., 2016; Ye and Titheridge, 2017; De Vos, 2018; Ye and Titheridge, 2019; De Vos et al., 2021; Wang et al., 2024). Some studies also indicated that an ideal travel duration shorter than the actual one affects satisfaction with commuting or leisure trips negatively (Humagain and Singleton, 2020; Ye et al., 2020; Ma et al., 2021).

2.2.2 Determinants of daily travel satisfaction

Most of the determinants of trip satisfaction matter in daily travel satisfaction as well. In line with studies on trip satisfaction, it has been found that decreased car use share (Bergstad et al., 2011) and increased travel time by transit (Wang et al., 2020) in daily travel reduce individuals' daily travel satisfaction level. Besides, travel amount shows a negative impact on daily travel satisfaction. Studies found that frequent users of private cars (Waygood et al., 2019; Li et al., 2022) or public transport (Cao and Ettema, 2014; Waygood et al., 2019; Olsson et al., 2020) are less satisfied with daily travel than those non-frequent users, and the total number of trips in daily life is negatively associated with daily travel satisfaction (Guan et al., 2023). Travel cost also affects daily travel satisfaction negatively. For example, Olsson et al. (2020) found that transit riders who viewed the ticket price as high reported a lower daily travel satisfaction than other transit riders in northern Europe.

A close relation between travelers' socio-economics and daily travel satisfaction has also been found in empirical studies (Cao and Ettema, 2014; Waygood et al., 2019; Kim, 2020; Wang et al., 2020; Li et al., 2022; Guan and Wang, 2024). Environmental attributes play a role in overall daily travel satisfaction as well. For example, based on a two-wave questionnaire survey from 2011 to 2013 in Beijing, China, Wang et al. (2020) found that improved built environment (i.e., better accessibility and physical design) and social environment (i.e., enhanced neighborhood safety and interactions) in the neighborhood contribute to the residential relocators' daily travel satisfaction. Though related evidence is still limited, travel attitude also matters in daily travel satisfaction. For instance, Guan and Wang (2024) found that the mismatch between commuting mode and travel mode attitude is negatively associated with daily travel satisfaction in general.

2.2 Shared micro-mobility and travel satisfaction

2.2.1 Studies on shared micro-mobility

As an emerging mobility service, shared micro-mobility has attracted great research attention. First, scholars have widely investigated the user profile and usage patterns of SMM services (Dill and McNeil, 2021), finding that SMM services are less accessed and used in marginalized areas and for transport disadvantaged groups, such as low-income, elderly, and minority groups (Mooney et al., 2019; Brown, 2021; Reck & Axhausen, 2021; Mouratidis, 2022; Giuffrida et al., 2023; Jin and Sui, 2024; Su et al., 2024). Besides, shared bikes and e-bikes are found to be mostly used for commuting purpose (e.g., Fishman et al., 2015; Shen et al., 2018; McKenzie, 2019), while shared e-scooters are predominantly adopted for recreation or shopping trips (e.g., Bai et al., 2021; McKenzie, 2019).

Second, another group of research identified the influential factors of shard micro-mobility use, including: 1) the built environments, such as transit access and cycling infrastructure (Bai & Jiao, 2020; Dzięcielski et al., 2024; Guan et al., 2024); 2) natural environment, like air quality and weather (Hosseinzadeh et al., 2021; Guzel et al., 2025); 3) level of services, such as access to SMM services (e.g., Sanders et al., 2020; Guo and Zhang, 2021) and price (e.g., Reck et al., 2021); 4) personal attributes, like socio-demographics (e.g., Reck & Axhausen, 2021; Gkavra et al., 2025), travel attitudes (e.g. Dill et al., 2022), and social norms (e.g. Chahine et al., 2024).

Third, some studies investigated the transport and social impacts of shared micro-mobility use, including: 1) accessibility. Several studies have indicated that SMM could enhance the users' accessibility (Qian and Niemeier, 2019). For instance, Chen et al. (2022b) collected data on the residents' perceived changes in accessibility to various activities because of adopting bikeshare in Beijing, China, and most respondents agreed that bikeshare use has made accessing activities easier for them. In line with this, it has been found that bikeshare reduce the users' travel time by providing alternatives for short car and public transit trips in congested streets (Bullock et al., 2017; Faghih-Imani et al., 2017). 2) mode choice. Shared micro-mobility use can raise the use of conventional cycling in daily travel (Goodman et al., 2014; Murphy and Usher, 2015). Although the speed and capacity limits constrain the ability of SMM to substitute private cars in long-distance trips (Barbour et al., 2019; Fukushige et al., 2021; Nikiforiadis et al., 2021; Sanders et al., 2022), studies have suggested that it could substitute less satisfactory transport modes like public transport to some extent (Fishman et al., 2014; Barbour et al., 2019; Nikiforiadis et al., 2021). 3) activity. It was found that SMM has strong spatial and temporal associations with the number of shopping and recreation trips (e.g., Bai et al., 2021). 4) health. Studies have revealed that SMM use is likely to promote healthier lifestyles through increased physical activity (Otero et al., 2018; Sanders et al., 2022) and reduced stress (Shaheen et al., 2014). 5) social inclusion. A few recent studies suggested that SMM use has the potential to reduce social exclusion by improving the users' mobility level (Guan et al., 2024b) and social capital (An et al., 2024).

2.2.2 The potential influences of SMM on daily travel satisfaction

The research findings on shared micro-mobility and daily travel satisfaction suggest a potential mixed relationship between them. SMM use may influence trip satisfaction directly, and the aggregated positive (or negative) emotions and cognitive assessments in multiple SMM trips would finally bring changes to daily travel satisfaction (De Vos and Witlox, 2017). On the one hand, individuals may experience higher satisfaction with trips by shared micro-mobility than with trips by other modes. Researchers have suggested that SMM brings enjoyment in travel because it is easily accessed, affordable, and convenient to use for most residents (Chen et al., 2022a). While conventional cycling trips tend to be associated with higher trip satisfaction (St-Louis et al., 2014), shared micro-mobility alleviate vehicle security and maintenance concerns during travel. Therefore, SMM may further improve trip satisfaction by reducing the emotional burdens. Besides, SMM can improve the satisfaction with transit trips by providing a first- and last-mile solution (Hirsch et al., 2019). The impact of SMM use on trip satisfaction may differ across different SMM services. For example, shared electric micro-vehicles (e.g., e-bikes/e-scooters/e-mopeds) may benefit trip satisfaction more greatly than shared bikes because of their higher travel speeds and less physical effort needed in use (Sanders et al., 2020).

On the other hand, shared micro-mobility may also bring negative travel experiences due to reasons like the uncertainty about accessing and parking the shared micro-vehicles, the digital barriers in use (e.g., limited access to credit cards or smartphones), high rental cost, mandatory helmet legislation, safety concerns, and the sensitivity to bad weather (Bateman et al., 2021; Meng and Browm, 2021; Nikiforiadis et al., 2021). The unequal spatial distribution of shared micro-vehicles, as widely found by previous studies (Mooney et al., 2019; Bai and Jiao, 2021; Dill and McNeil, 2021), can raise concerns of uncertainty regarding accessing these services. Such uncertainty in use would disturb individuals' travel plans and result in more emotional cost in SMM trips (Chen et al., 2022a). And due to the speed limitation, SMM users may experience a longer travel time in daily life, which is typically negatively associated with daily travel satisfaction (Wang et al., 2020; De Vos et al., 2022a; Guan et al., 2023). All these issues may weaken the role of shared micro-mobility in increasing trip and daily travel satisfaction.

Besides the direct impact on trip satisfaction, SMM use may also affect daily travel satisfaction indirectly through other tunnels. First, SMM use can improve the convenience of daily travels by promoting the user's mobility (Guan et al., 2024b) and accessibility (Qian and Niemeier, 2019; Chen et al., 2022b) levels, especially for short trips and trip chaining, by providing additional flexible travel options in daily life (Bullock et al., 2017). Therefore, it is likely that SMM use makes the trips to access daily travel destinations more enjoyable and satisfactory. The cumulative satisfaction with trips in daily life will then improve the affective and cognitive evaluations of daily travel in general (Ettema et al., 2011; Wang et al., 2020). Second, shared micro-mobility use may also affect daily travel satisfaction via modal shift. As suggested by previous studies, shared micro-mobility use could substitute public transport and encourage more cycling trips (Murphy and Usher, 2015; Nikiforiadis et al., 2021). Such a change trend from motorized to non-motorized modes will likely bring an increase in daily travel satisfaction (St-Louis et al., 2014; Mao et al., 2016; De Vos et al., 2021). Third, given the close relations between SMM use and recreation trips (Bai et al., 2021), it is plausible that SMM use could also contribute to daily travel satisfaction by encouraging more satisfactory trips like recreation trips in daily life (Mokhtarian and Salomon, 2001; Zhu and Fan, 2018).

Although shared micro-mobility use may impact daily travel satisfaction via multiple ways, to our best knowledge, no research has investigated this issue explicitly. The most relevant papers are a few studies on the satisfaction with SMM services (or trips). For example, Aman et al. (2021) investigated the app store reviews of two major micro-mobility companies in the US operating e-scooters. They found that users' satisfaction with the shared e-scooter services was significantly impacted by safety (e.g., speed and riding lane) and app issues, while women riders were more satisfied and showed more positive sentiment than men. Besides, Chen et al. (2022a) examined factors affecting the satisfaction with bikeshare trips in Beijing, China. The research findings suggested that trips by dockless shared bikes are more satisfactory than those by car, public transport or private bikes. The users were more satisfied with bikeshare trips if they could access bikeshare more easily or use it as the primary mode rather than a first-/last-mile solution. Besides, Nikiforiadis et al. (2024) investigated the determinants of satisfaction with e-scooter trips, finding that leisure travelers are more satisfactory for their e-scooter trips when compared with non-leisure travelers.

In sum, despite the extensive literature on both travel satisfaction and shared micro-mobility, knowledge on their association is still limited. First, though a few studies have focused on the satisfaction with SMM services and trips, how SMM use influences the satisfaction with daily travel in general remains unclear. Second, no research has compared the impacts of different kinds of SMM services (e.g., shared bike vs. shared e-bike) on daily travel satisfaction, while they vary in terms of speed, expense, and physical effort required in use. Third, how the impact of SMM use on daily travel satisfaction varies across different spatial contexts and population groups has rarely been examined.

3. Conceptual framework

As mentioned, to provide a more in-depth understanding of the role of shared micro-mobility use in daily travel satisfaction, this study will examine three research questions: First, if SMM users and non-users differ in terms of daily travel satisfaction level? Second, how does the use of different kinds of SMM change daily travel satisfaction? Third, what are the factors affecting the travel satisfaction impact of SMM use?

To answer the first research question, we examine the associations between SMM use features (the type and frequency of SMM use) and current daily travel satisfaction. The results will tell if SMM use makes a difference in terms of current daily travel satisfaction. For the second research question, this study collects and analyzes the self-reported "change in daily travel satisfaction" because of using different kinds of SMM services (shared bikes, shared e-bikes, and shared e-scooters). For the third research question, we regress the environmental, personal and travel-related factors on the self-reported daily travel satisfaction change, since they were found to be important influential factors of travel satisfaction. Therefore, the model is examined for the users of different kinds of SMM separately. Figure 1 summarizes the factors examined in the model. It is hypothesized that daily travel satisfaction will increase if SMM substitutes less satisfactory modes like public transport (St-Louis et al., 2014; Mao et al., 2016; De Vos et al., 2021). We also include the purposes of SMM trips into the model to investigate if SMM affects daily travel satisfaction differently when it is used for different purposes. We assume that individuals who use SMM for recreation trips would be more likely to increase their daily travel satisfaction than SMM users who use it for other purposes, since recreational trips tend to be more satisfactory than other kinds of trips (Ory and Mokhtarian 2005; Zhu and Fan, 2018). Besides, individual socio-demographics and the residential built environment are also included as predictors, since they may affect SMM use and daily travel satisfaction simultaneously, and therefore their associations (Mouratidis et al., 2019; Li et al., 2022; Reck & Axhausen, 2021; Gkavra et al., 2025). Because the model is examined for different kinds of SMM separately, SMM use type/frequency are used to stratify the sample and not included in the model. The results of this model will highlight how SMM use changes daily travel satisfaction in different environmental, travel, and user contexts.

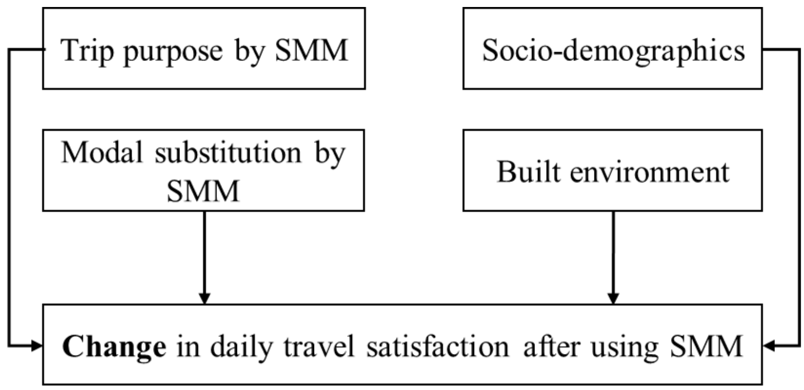

Figure 1. Conceptual model: daily travel satisfaction change (SMM user only)

This research contributes to existing literature in travel satisfaction from three aspects. First, it fulfills the theoretical framework on travel behavior and travel satisfaction by clarifying how travelers experience new forms of mobility like SMM services. Second, it expands the research framework of shared micro-mobility and travel satisfaction by analyzing the impact on daily travel satisfaction in general (rather than trip-level satisfaction), thus revealing the wellbeing implications of SMM better. Third, our study pioneers the analysis of the influential factors of SMM-resulted travel satisfaction change, thus captures the heterogeneity of SMM's wellbeing impact. The research findings could generate policy insights on the evaluation and optimization of shared micro-mobility's wellbeing benefits.

4. Methodology

4.1 Data

Data used in this research were collected in an online questionnaire survey conducted from June to September 2022 in three European cities: Utrecht (Netherlands), Malmö (Sweden), and Greater Manchester (UK). The three cities differ in terms of mobility culture and shared micro-mobility services implemented. Like other Dutch cities, Utrecht is a cycle-oriented city with well-developed bicycle paths and nearly 50% of trips within the city were made by bicycle in 2021. In 2022, public transport rental bicycles (*OV-fiets*), shared e-bikes & e-mopeds (*Tier*), and shared e-cargo bikes (*Cargoroo*) were available in Utrecht. Malmö has a bike path network of 520 km, and cycling accounts for around 25% of the trips within the city. In 2022, shared e-scooters (*Lime*, *Tier*, and *VOI*) and both docked (*Malmöbybike*) and dockless bikeshare (*Donkey Republic*) were provided in the city of Malmö. Trips in Greater Manchester, however, are dominated by cars and public transport, while cycling level is very low (around 5%). In 2022, shared bikes/e-bikes (*the Bee Network Cycle Hire*) and shared e-scooters (*Lime*) were available in the city of Manchester and some other regions of Great Manchester (Salford and town of Trafford).

Since our research aims to investigate the wellbeing impact of shared micro-mobility, the questionnaire was distributed via local survey companies to residents in the areas where shared micro-mobility services were available, including the urban areas in three cities as well as some suburban neighborhoods in Great Manchester (Salford and town of Trafford). To keep the representativeness of our sample as much as possible, our surveys target the general population instead of solely shared micro-mobility users in these areas. The questionnaire (in both English and local language) requested information on the awareness and use frequency of different shared micro-mobility services, personal socio-demographics, access to different kinds of transport modes, and attitudes toward different SMM services. The first part of the postal code (i.e., first 3 digits in Malmö, 4 digits in Utrecht, and 2-4 digits in Manchester) at the residential location was also collected from each respondent to link the survey data with land use data. In total, we got 2110 completed questionnaires (please refer to An et al., 2023 for more detailed survey information). After cleaning the data, the final sample for this research included 1518 respondents, with 278 from Utrecht (Netherlands), 442 from Greater Manchester (UK), and 798 from Malmö (Sweden). Among them, there are 467 shared bike users (in all three cities), 261 shared e-bike users (in Utrecht and Malmö), and 409 shared e-scooter users (in Manchester and Malmö).

4.2 Measurements of variables

Our questionnaire included two kinds of travel satisfaction measures. All the respondents were asked to indicate their overall satisfaction level with daily travel at present on a 7-point Likert scale (from very low to very high). Further, to capture how SMM use changed the respondents' daily travel satisfaction, shared bike users were asked to indicate: "*Has the use of shared bikes impacted your satisfaction with daily travel*?", and the response was recorded on a 5-point Likert scale from much decreased to much increased. Similar questions were asked for shared e-bike and e-scooter users to collect the daily travel satisfaction change resulted from the use of different kinds of SMM services. By asking such a question instead of "travel satisfaction change before-and-after using SMM", our survey can exclude the impact of other factors (e.g., change in job hours) on travel satisfaction change, and capture the travel satisfaction change that SMM use itself brings to a greater extent.

SMM use was measured by the frequency of use of different kinds of SMM. The respondents were asked to report the frequency of using each kind of SMM services in their city in a 7-point scale: (1) (Almost) never; (2) 1–5 days a year; (3) 6–11 days a year; (4) 1–3 days a month; (5) 1–3 days a week; (6) 4–6 days a week; (7) Daily. The respondents who had used any kind of SMM services for **at least** "1–5 days a year" are considered SMM users, and those who had used the mode for at least 1–3 days a week are considered "frequent users".

For any kind of SMM users, we further asked the purpose(s) of SMM trips by the question: "*For what purpose(s) do you use (any of) shared micro-mobilities: 1) commuting; 2) recreation; 3) shopping; 4) to visiting friends or family members; 5) exercise; 6) to access other transport modes (e.g., bus stations or parking lots).*" Since this is a multiple-choice question, we created six dummy variables to capture the purposes of SMM trips. Mode substitution by SMM was captured by the question "*To what extent has the use of shared bikes/e-bikes/e-scooters changed the use of other forms of transport?*", with answers in a 5-point Likert scale from much decreased to much increased. We created a dummy on mode substitution for each of the seven non-shared modes, which equals one if SMM use has (much) decreased the use of such mode, and zero otherwise.

To investigate the heterogeneity among different population groups in terms of the role that SMM use plays in daily travel satisfaction, we included individual attributes in the models: age, gender, employment status, education level, driver's license, the presence of children, and household income level. To capture the potential influence of mobility issues, we also asked the respondents if he/she has "*a condition that substantially limits basic physical activities such as walking, climbing stairs, or carrying*", and added this variable into the models as "disability".

The residential built environment was collected by the first part of the postcode in each city. Population density and the distance from home (the central point of the residential neighborhood) to the city center were used to capture the urbanity level of the residential location. We also collected the spatial locations of train, bus, and tram stations, as well as cycling paths in the three cities from OpenStreetMap. By spatially joining the station locations with the postal code boundary in ArcGIS Pro, we created three variables on transport facilities: the distance from home to the nearest train station, the density of local public transport (bus/tram) stations, and the density of cycling paths.

Table 1 lists the sample profiles. Compared with the general population in the three cities, the respondents in our survey have a similar gender and income distribution. However, our sample is somewhat overrepresented by high-educated, employed, and younger adults, probably due to the online nature of our survey. Give that this study aims to investigate the relations between SMM use and travel satisfaction, rather than precisely measuring their distribution features in the population, the slightly biased sample should not be a critical issue.

Table 1 Sample profile

Variable name	**Explanation**	**Mean/% (Standard deviation)**			
		All sample (N = 1518)	**Utrecht** (N=278)	**Manchester** (N=442)	**Malmö** (N=798)
Daily travel satisfaction	From very low (1) to very high (7)	5.23 (1.42)	5.30 (1.33)	4.90 (1.47)	5.38 (1.40)
Socio-demographics					
Age	1: 18-29	24%	24%	36%	17%
	2: 30-39	29%	29%	30%	29%
	3: 40-49;	16%	12%	17%	16%
	4: 50-59;	13%	17%	10%	14%
	5: >=60	18%	18%	7%	23%
Male	1: Male; 0: Non-male	45%	46%	45%	44%
Employment	0: Unemployed	29%	26%	24%	33%
	1: Part-time employed;	6%	14%	6%	2%
	2: Full-time employed	65%	59%	69%	65%
Higher educated	1: Bachelor's or above; 0: Otherwise	55%	62%	52%	55%
Driver license	1: Has a driver's license; 0: Has no driver's license	83%	85%	76%	87%
Household with children	1: Live with children 0: Live without children	33%	27%	43%	29%
Household income	1: Low income	31%	44%	43%	20%
	2: Medium income	24%	21%	21%	26%
	3: High income	45%	35%	36%	54%

Disability	1: physical disabled (limits walking or riding); 0: No	9%	14%	10%	7%
Built environment (postal code level)					
Population density	Number of population (thousand/km^2)	4.79 (3.24)	7.26 (3.78)	4.17 (2.02)	4.28 (3.20)
Distance to the city center	Euclidean distance from the neighborhood spatial center to the city center (km)	4.82 (3.73)	4.41 (4.35)	6.68 (4.79)	3.93 (2.09)
Distance to the train station	Euclidean distance from the neighborhood spatial center to the nearest train station (km)	1.85 (1.07)	1.97 (1.66)	1.77 (1.13)	1.85 (0.72)
Transit density	Number of bus & tram stations per km^2	12.77 (7.37)	11.58 (6.52)	31.33 (23.61)	10.65 (5.57)
Cycle route density	The average length (km) of the cycle route per km^2	3.73 (2.28)	5.21 (2.11)	1.03 (0.67)	4.71 (1.52)
Shared micro-mobility use					
Shared bike	1: Frequent users	11%	12%	19%	6%
	2: Occasional users	19%	28%	23%	20%
	3: Non-users	70%	60%	58%	80%
Shared e-bike	1: Frequent users	7%	12%	15%	----
	2: Occasional users	10%	18%	24%	
	3: Non-users	83%	70%	61%	
Shared e-scooter	1: Frequent users	9%	----	16%	7%
	2: Occasional users	18%		22%	23%
	3: Non-users	73%		62%	70%

Note. Values in parentheses represent the standard deviations. Please see Table A1 for the descriptive statistics of variables for SMM user models.

5. Results

5.1 Does daily travel satisfaction differ between SMM users and non-users?

To figure out the difference in daily travel satisfaction between SMM users and non-users, we conducted an independent sample t-test and an ANOVA test to examine the relations between SMM use and current daily travel satisfaction. Considering that the types of available SMM services were different among the three cities, we conducted the tests for each city separately. Table 2 compares the average daily travel satisfaction between users and non-users of each kind of SMM service in each city by an independent sample t-test. Overall, we found that on average, shared bike and e-bike users had a slightly higher daily travel satisfaction level than non-users, while shared e-scooter users had a slightly lower satisfaction level than non-users at the time of the survey. However, such differences are all non-significant in the t-test.

Table A2 further compares the daily travel satisfaction level between frequent users, occasional users, and non-users of SMM by ANOVA analysis. We found that, on average, frequent SMM users had a higher daily travel satisfaction level than occasional users. However, in all three European cities, the differences in daily travel satisfaction between these three groups were mostly non-significant. The only marginally significant result we found is for shared e-bikes in Manchester (p = 0.069).

The results of T/ANOVA tests suggested that SMM users did not have a higher daily travel satisfaction than non-users at the time of the survey. Although we found that shared e-bike use is positively linked with daily travel satisfaction level in Manchester, UK, given that these findings are based on cross-sectional data, we cannot conclude on the causal relations between SMM use and daily travel satisfaction, or the direction of such relations (i.e., if shared e-bike use leads to an increase in daily travel satisfaction, or if a higher daily travel satisfaction triggers the respondents to use them). To better clarify this issue, we further investigated how the users' daily travel satisfaction changed due to SMM adoption in the following sections.

5.2 Travel satisfaction change because of SMM adoption

To understand how the use of different SMM services change the users' daily travel satisfaction, we made a bar chat based on the answers to the three questions: 1) *Has the use of shared bike impacted your satisfaction with daily travel* (for shared bike users, left in Fig.2); 2) *Has the use of shared e-bike impacted your satisfaction with daily travel* (for shared e-bike users, middle in Fig.2); 3) *Has the use of shared e-scooter impacted your satisfaction with daily travel* (for shared e-scooter users, right in Fig.2). As shown in Fig.2, around half of the users reported that SMM use has no impact on daily travel satisfaction change (58% for shared bike users, 43% for shared e-bike users, and 57% for shared e-scooter users). Many more respondents reported an increase rather than a decrease in daily travel satisfaction after using SMM.

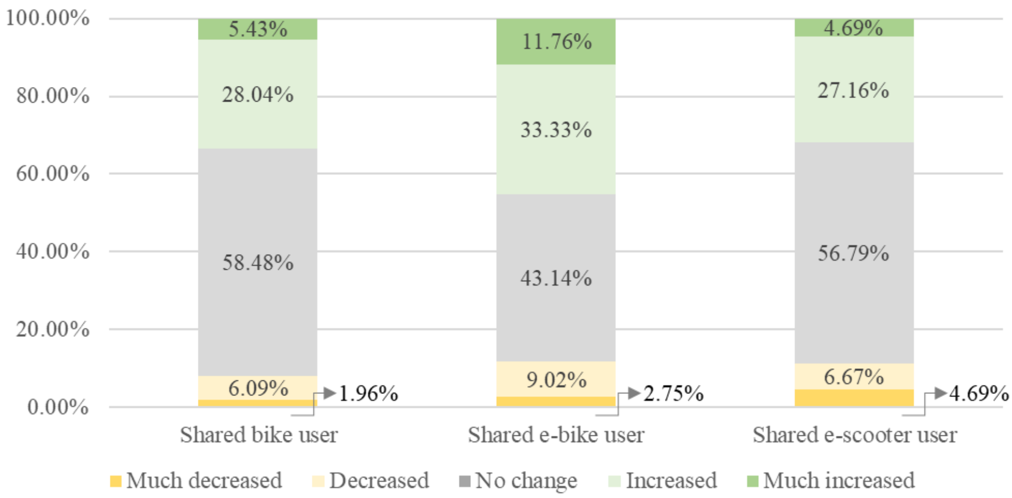

Figure 2. Self-reported change in daily travel satisfaction before and after using SMM

Among the three kinds of SMMs, shared e-bikes helped improve the users' daily travel satisfaction at most (45% of users reported a travel satisfaction increase) compared with shared bikes (33%) and e-scooters (32%). Only around 10% of users reported a decrease in daily travel satisfaction after the adoption of SMM (8% for shared bike users, 12% for shared e-bike users, and 11% for shared e-scooter users). Chi-square test suggests that the self-reported daily travel satisfaction change significantly differs across the three types of SMM used, X^2 (4, $N = 1120$) = 60.3, $p < 0.001$. Such descriptive evidence indicates that the use of shared micro-mobility could improve the user's daily travel satisfaction in general. This finding is not surprise since the use of SMM is mostly voluntary. The individuals are more likely to adopt SMM once they found that it could bring benefits to daily travels, such as improved travel satisfaction (Guan et al., 2024a). A more important question is exactly what affects such travel satisfaction change, and how to maximize the wellbeing benefits of SMM services from a policy perspective.

5.3 Determinants of the travel satisfaction change after using SMM

To investigate the factors affecting the travel satisfaction change resulting from SMM use, we examined regression models on the self-reported change in daily travel satisfaction. Because the dependent variable is specific to a certain type of SMM. We constructed a separate model for the users of each kind of SMM service, resulting in three models in total. The city dummies were controlled for in the models to address the potential context difference[1]. Given that the dependent variables are on an ordinal scale, we tried to fit ordinal regression models initially[2]. However, the proportional odds assumption was violated for most models. Therefore, we recoded the dependent variables into dichotomous variables (more satisfied vs. less satisfied/no change) and fitted binary logistic regression models instead. We checked the multicollinearity problem by running OLS models with the same variables in parallel. The indicator "Variance Inflation Factor (VIF)" is lower than the commonly accepted threshold of 5 (from 1.09 to 4.43), suggesting no serious multicollinearity problem (Mason et al., 2003). The models were then estimated by maximum likelihood (ML) method in SPSS version 28.0 respectively. Hosmer-Lemeshow test suggested that all the models fit the data well with p >0.05.

Table 3 shows the modelling results of binary logistic regression on the user's self-reported change in daily travel satisfaction because of using SMM (Model II). The reason of using SMM matters in the perceived change in daily travel satisfaction that SMM use brought. We found that for shared bike/e-bike users, adopting SMM for commuting trips increased the probability to report daily travel satisfaction increase for 71% and 82%, respectively. Meanwhile, adopting shared bikes/e-scooters for recreation trips increased the likelihood of experiencing daily travel satisfaction improvement after using them for around 60%. Regarding shared e-scooter users, adopting SMM as a first/last-mile solution is also associated with a 66% higher likelihood of reporting an increased daily travel satisfaction. However, SMM use for other reasons (shopping trips, social trips and exercise) were unrelated to the self-reported travel satisfaction change for all the SMM users.

In terms of mode substitution, shared bike users were 70% more likely to increase daily travel satisfaction if the use of shared bikes substituted walking, and 56% if substituted taxi. And for shared e-bike/e-scooter users who substituted local public transport, the probability to report an increased daily travel satisfaction is 2.54 and 2.74 times that of their counterparts who did not, while similar findings were not found for shared bikes. This result indicates that shared electric vehicles are considered better alternatives to local public transport than shared bikes, probably because of the higher travel speed and lower physical effort needed in use. Besides, for shared e-scooter users, car use reduction because of SMM use is also related with a 67% higher likelihood of reporting an increase in daily travel satisfaction.

Socio-economic variables also matter in the self-reported change in daily travel satisfaction. For both shared e-bikes/e-scooters, the likelihood of elder respondents (50-59) to experience an increase in daily travel satisfaction after adoption is only 18% and 14% of that of the younger users (30-39), though the associations are only marginally significant ($p < 0.10$). One possible reason is that younger users can enjoy SMM more easily because of their, on average, better

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[1] For the models, a more ideal way is to build separate models by both the SMM type and city (i.e., 3+2+2=7 models). However, the sample size of SMM users is limited in our data and cannot support such a model design.
[2] The dependent variables for the tested ordinal logistic regression models were: change in travel satisfaction ---- less satisfied (1-2), no change (3), more satisfied (4-5).

physical strength. Although shared e-bikes/e-scooters are easy to ride with electric assistance, their use still requires physical effort to step on the pedals (or keep standing while riding). Moreover, SMM could be perceived as dangerous by older adults. High-educated people also experienced a 59% greater likelihood to increase daily travel satisfaction by using shared e-scooters than low-educated ones, probably because they faced fewer digital barriers in adoption. Compared with those unemployed, full-time employed respondents had a lower probability (only 56%) to report travel satisfaction increase after shared e-scooter use, while no difference between unemployed and part-time employed respondents were found. In addition, we found that the probability that male respondents improved daily travel satisfaction by using shared bikes it 1.6 times of that of females, and such group difference is even larger between those with (223%) and without (100%) a driver's license. Household income also matters in the travel satisfaction benefit of SMM use. As evidence, we found that compared with low-income users, high-income users have only 56% of likelihood to improve daily travel satisfaction by shared scooter usage. This is probably because shared e-scooters could be adopted as a complementary fast-speed mode of private cars, and thus reduce the economic burden in daily transport for low-income individuals.

The built environment has a limited impact on the daily travel satisfaction change after SMM use. The only significant effect we found is the positive link between the distance to the train station and the increase in daily travel satisfaction in the shared e-bike user model. This result indicates that shared e-bike users living far from train stations were 23% more likely to improve their satisfaction with daily travel by adopting shared e-bikes.

6. Discussion

Our research findings indicate that, in general, SMM use brings improvement in residents' daily travel satisfaction in the three European cities, but the benefit is still limited now. On one hand, while SMM users were more likely to report an increase (rather than a decrease) in daily travel satisfaction, a substantial proportion (55%-68%) of them still experienced no travel satisfaction increase from SMM adoption. On the other hand, even after using SMM, the users' current daily travel satisfaction is not significantly higher than that of non-users. These results may suggest that SMM users are likely to have had a relatively low daily travel satisfaction before, and they opted to utilize SMM services to enhance their daily travel satisfaction, although such enhancement may not fully compensate for their disadvantages in daily travel satisfaction.

The determinants of the increase in travel satisfaction vary across different SMM services. Shared e-scooter helps increase travel satisfaction more if it's used for recreation, but this is not the case for commuting, like shared bike/e-bike does. These results are in accord with previous findings that shared e-scooters are mostly used for fun (McKenzie, 2019; Bai et al., 2021), and likely indicate that individuals tend to use shared e-scooters for their intrinsic utility (e.g., a leisure trip) rather than derived utility (e.g., to access the workplace). Besides, compared with conventional shared bikes, shared electric vehicles have a great potential to increase daily travel satisfaction by covering long-distance trips. This is evidenced by the finding that modal change from public transport to SMM contributes to daily travel satisfaction for shared e-bikes/e-scooters only. Among the SMM services, shared e-scooter is the only mode showing the potential to benefit travel satisfaction by replacing private cars, probably thanks to its higher travel speed and much less physical effort needed in riding.

Table 2 Current daily travel satisfaction of SMM users and non-users (T-test)

Sample	Users		Non-users			
Full sample	***Mean***	***SD***	***Mean***	***SD***	***T*(1516)**	***p***
Shared bikes	5.25	1.33	5.22	1.46	0.40	0.69
Shared e-bikes	5.17	1.40	5.00	1.44	1.57	0.12
Shared e-scooters	5.16	1.40	5.24	1.47	-0.85	0.40
Utrecht, NL	***Mean***	***SD***	***Mean***	***SD***	***T*(276)**	***p***
Shared bike	5.41	1.22	5.23	1.40	1.10	0.27
Shared e-bike	5.45	1.33	5.24	1.32	1.21	0.23
Manchester, UK	***Mean***	***SD***	***Mean***	***SD***	***T*(440)**	***p***
Shared bike	4.98	1.44	4.85	1.49	0.97	0.33
Shared e-bike	5.03	1.42	4.82	1.50	1.49	0.14
Shared e-scooter	5.00	1.42	4.85	1.49	1.06	0.29
Malmö, Sweden	***Mean***	***SD***	***Mean***	***SD***	***T*(796)**	***p***
Shared bike	5.45	1.22	5.37	1.45	0.68	0.50
Shared e-scooter	5.28	1.34	5.43	1.42	-1.41	0.16

Note. P-value is from an independent sample T test; SD: Standard Deviation.

Table 3. Modelling results on the change of daily travel satisfaction after using SMM

	Shared bike user (N = 467)			**Shared e-bike user** (N = 261)			**Shared e-scooter user** (N = 409)		
Variables	**Beta**	**OR**	**95% CI**	**Beta**	**OR**	**95% CI**	**Beta**	**OR**	**95% CI**
Age (ref. 30-39)									
18-29	0.34	1.40	[0.80, 2.46]	-0.46	0.63	[0.31, 1.27]	-0.02	0.98	[0.55, 1.76]
40-50	0.12	1.12	[0.57, 2.22]	-0.42	0.66	[0.28, 1.57]	0.35	1.42	[0.67, 3.03]
50+	-1.00	0.37	[0.10, 1.39]	**-1.74***	**0.18**	**[0.03, 1.12]**	**-1.96***	**0.14**	**[0.01, 1.47]**
60+	0.18	1.20	[0.37, 3.93]	-1.43	0.24	[0.03, 1.98]	-0.13	0.88	[0.17, 4.52]
Male (ref. non-male)	**0.47****	**1.60**	**[1.01, 2.54]**	0.28	1.32	[0.73, 2.42]	0.17	1.19	[0.71, 1.99]
Household with children (yes)	-0.063	0.94	[0.56, 1.58]	-0.20	0.82	[0.44, 1.53]	0.44	1.55	[0.89, 2.69]
Employment (ref. unemployed)									
Part-time employed	-0.27	0.76	[0.26, 2.22]	0.96	2.60	[0.67, 10.15]	-0.05	0.95	[0.27, 3.31]
Full-time employed	-0.21	0.81	[0.42, 1.56]	-0.02	0.98	[0.40, 2.41]	**-0.58***	**0.56**	**[0.28, 1.10]**

Higher educated (yes)	0.26	1.30	[0.78, 2.16]	-0.06	0.94	[0.50, 1.76]	**0.46***	**1.59**	**[0.93, 2.71]**
Driver license (yes)	**0.80****	**2.23**	**[1.12, 4.47]**	0.46	1.59	[0.60, 4.21]	-0.29	0.75	[0.35, 1.60]
Household income (ref. low)									
Medium	-0.09	0.91	[0.48, 1.74]	-0.60	0.55	[0.25, 1.24]	0.14	1.15	[0.57, 2.32]
High	-0.12	0.89	[0.51, 1.53]	-0.41	0.66	[0.34, 1.30]	**-0.58***	**0.56**	**[0.30, 1.06]**
Disability	0.45	1.58	[0.60, 4.19]	0.43	1.54	[0.54, 4.38]	0.31	0.59	[0.43, 4.29]
Country (ref. UK)									
Sweden	**-1.08****	**0.34**	**[0.13, 0.88]**	----	----	----	-0.12	0.89	[0.28, 2.83]
Netherlands	0.11	1.12	[0.46, 2.70]	0.14	1.15	[0.34, 3.84]	----	----	----
Population density	0.03	1.03	[0.93, 1.13]	-0.07	0.94	[0.82, 1.07]	0.03	1.03	[0.90, 1.17]
Transit density	-0.01	0.99	[0.95, 1.03]	0.02	1.02	[0.98, 1.06]	0.02	1.02	[0.98, 1.06]
Distance to the city center	-0.02	0.98	[0.91, 1.06]	-0.01	0.99	[0.91, 1.07]	-0.04	0.97	[0.88, 1.06]
Distance to train station	-0.07	0.94	[0.77, 1.14]	**0.21***	**1.23**	**[0.96, 1.57]**	0.08	1.09	[0.78, 1.51]
Cycle paths density	-0.07	0.94	[0.78, 1.12]	0.03	1.03	[0.81, 1.32]	-0.10	0.90	[0.68, 1.20]
SMM use for commuting (yes)	**0.54****	**1.71**	**[1.07, 2.76]**	**0.60****	**1.82**	**[1.03, 3.24]**	0.44	1.55	[0.92, 2.62]
SMM use for recreation (yes)	**0.47****	**1.60**	**[1.01, 2.53]**	0.20	1.22	[0.67, 2.21]	**0.48***	**1.62**	**[0.97, 2.70]**
SMM use for shopping (yes)	0.39	1.47	[0.93, 2.35]	-0.14	0.87	[0.48, 1.57]	0.19	1.21	[0.69, 2.13]
SMM use for social trips (yes)	0.35	1.42	[0.89, 2.24]	0.46	1.58	[0.89, 2.80]	-0.05	0.95	[0.57, 1.59]
SMM use for exercise (yes)	0.09	1.10	[0.66, 1.81]	0.20	1.22	[0.68, 2.20]	0.16	1.17	[0.65, 2.10]
SMM use for first/last mile (yes)	0.15	1.16	[0.67, 2.00]	0.03	1.03	[0.48, 2.20]	**0.51***	**1.66**	**[0.96, 2.88]**
Mode substitution by SMM									
Private car (yes)	0.43	1.54	[0.92, 2.57]	0.24	1.27	[0.64, 2.55]	**0.51***	**1.67**	**[0.94, 2.98]**
Regional PT (yes)	0.04	1.04	[0.57, 1.88]	-0.12	0.89	[0.39, 2.04]	-0.40	0.67	[0.33, 1.35]
Local PT (yes)	-0.18	0.83	[0.49, 1.41]	**0.93****	**2.54**	**[1.25, 5.16]**	**1.01*****	**2.75**	**[1.56, 4.84]**
Walking (yes)	**0.53***	**1.70**	**[0.99, 2.92]**	0.38	1.46	[0.72, 2.97]	0.25	1.29	[0.73, 2.26]
Private bike (yes)	-0.45	0.64	[0.34, 1.20]	0.19	1.21	[0.58, 2.54]	-0.16	0.86	[0.44, 1.67]
Private e-bike (yes)	-0.36	0.70	[0.33, 1.47]	-0.48	0.62	[0.27, 1.42]	-0.27	0.77	[0.37, 1.59]
Taxi (yes)	**0.45***	**1.56**	**[0.96, 2.55]**	-0.43	0.65	[0.31, 1.37]	0.45	1.57	[0.90, 2.73]
Constant	-2.03			-1.16			-1.46		
-2 Log likelihood	500.24			308.22			426.71		
Cox & Snell R Square	0.17			0.15			0.18		
Nagelkerke R Square	0.24			0.20			0.25		

OR = Odds Ratio, PT = Public Transport. * p<0.1; **p<0.05; ***p<0.01.

The contribution of SMM use to self-reported increases in travel satisfaction varies across socio-economic groups. Our research findings demonstrate the promising potential of SMM to broadly enhance daily travel satisfaction for younger and male groups. On one hand, previous research has shown that male and younger individuals are more likely to adopt SMM than their counterparts (Dill and McNeil, 2021). On the other hand, our research suggests that male and younger users are more likely to experience an increase in daily travel satisfaction after using SMM. For both reasons, the implementation of SMM services can greatly benefit these groups' travel satisfaction. On the contrary, though low-income groups also experienced a greater increase in daily travel satisfaction from using shared e-scooters than high-income individuals in Malmö, the potential of SMM services to improve their daily travel satisfaction may still be neutral. Since previous studies have found that low-income individuals normally have lower opportunities to access and use SMM than others (Israel et al., 2024), the inadequate access to SMM services could be a barrier for them to improve daily travel satisfaction by SMM adoption.

The European context is crucial for interpreting the well-being impacts of shared micro-mobility. European cities are typically characterized by compact urban form, relatively short trip distances, and extensive public transport systems. In such contexts, shared micro-mobility is more likely to function as a complementary mode - supporting walking and public transport - rather than as a large-scale substitute for private car use (Badia & Jenelius, 2023; Reck et al., 2022; Weschke et al., 2022). Consistent with this broader European evidence, our results show that improvements in daily travel satisfaction are most evident when shared micro-mobility is used for commuting, recreation, or first-/last-mile connections to public transport.

Policy implications

Our findings are relevant for policy. First, European cities have expressed growing concerns regarding the environmental and social implications of shared micro-mobility, including safety and health issues, conflicts in public space, and unintended substitution of walking and public transport (Milakis et al., 2020; Aba et al., 2024; Oeschger et al., 2020; Tice 2019). Our findings suggest that the well-being benefits of shared micro-mobility, measured by change in daily travel satisfaction, provide a complementary policy lens for navigating these debates. Though SMM services will not contribute to travel satisfaction for all individuals equally due to their low usage rate and group-varied travel satisfaction benefits, their implementation could be one of the potential strategies to improve wellbeing, especially younger, male, and low-income groups. Notably, the daily travel satisfaction increase from SMM use would also contribute to sustainability in the long run by encouraging more trips by SMM (De Vos, 2019; De Vos et al., 2022b; Guan et al., 2024a). Thus, planners should include wellbeing benefits into consideration when evaluating the cost-effectiveness of developing SMM services. Incorporating well-being indicators alongside safety, health, and sustainability metrics may help European cities identify contexts in which SMM could add value without exacerbating negative externalities.

Second, looking from the wellbeing perspective, shared e-mobilities should be implemented in European cities in addition to conventional shared bikes. While we found that shared bikes can improve residents' daily travel satisfaction as a more satisfactory alternative to walking, shared e-bikes demonstrated the greatest potential for increasing daily travel satisfaction among the three kinds of SMM services. One possible reason is shared e-bikes could cover longer-distance trips and satisfy daily travel needs better than shared bikes. This is in line with our finding that individuals tend to consider shared e-bikes (and e-scooters) as more satisfactory alternatives to local public transport.

Third, regarding the regions of SMM implementation, since commuting and recreation trips by SMM are more important in achieving the travel satisfaction benefit of SMM than other trips, providing SMM services in both residential areas (including low-income communities) and neighborhoods with work/recreation opportunities could be more effective to promote daily travel satisfaction by encouraging commuting/leisure trips by SMM services. Moreover, in areas far from train stations, the implementation of shared e-bikes could enhance daily travel satisfaction more effectively than shared bikes, likely due to their electric power advantage.

Fourth, from an equity perspective, our findings highlight the potential well-being benefit of SMM services for some transport-disadvantaged groups, like low-income people. Low-income individuals are typically transport disadvantaged groups with lower daily travel satisfaction (Verlinghieri and Schwanen, 2020; Ma et al., 2021; Shi et al., 2022; Guan et al., 2023), partially due to limited access to transport resources like private cars and SMM services. Previous European research also shows that SMM is disproportionately used by younger and highly educated populations, while disadvantaged groups like low-income people often face barriers related to access, affordability, or digital requirements (Böcker et al., 2020; Dill & McNeil, 2021; Mooney et al., 2019). Contrasting this background, we found that shared e-scooters, as a more satisfactory alternative to private cars, improve daily travel satisfaction of low-income individuals more greatly than others. Therefore, implementing shared e-scooters in low-income communities is likely to enhance the residents' mobility and travel satisfaction, and promote transport equity between different income groups simultaneously in European cities (Guzman, 2017; Israel et al., 2024).

Finally, for European cities pursuing sustainable and liveable mobility systems, these results indicate that SMM should be positioned primarily as a complementary component of integrated urban transport networks rather than as a standalone solution for car dependency. Although modal change from local public transport to shared e-bikes or e-scooters enhanced daily travel satisfaction in European cities, it should be noted that developing SMM itself could not fully satisfy daily travel needs due to its limitations in speed, capacity, and covering trips like shopping and escorting, especially in bad weathers. Integrated development of public transport and SMM facilities should be a more practical strategy, as we found that using shared e-scooters as a first-/last-mile solution significantly contributes to daily travel satisfaction. Policies that prioritize safe infrastructure, public transport integration, and context-sensitive regulation may allow cities to enhance user well-being while mitigating concerns related to safety, health, and public space conflicts (Abduljabbar et al., 2021; Oeschger et al., 2020; Tice, 2019). In this sense, shared micro-mobility can contribute to European transport policy goals not only through environmental performance, but also by improving the quality of daily travel experiences for selected groups and trip purposes.

7. Conclusions

This research provides new evidence on the impact of shared micro-mobility use (i.e. shared bikes, e-bikes and e-scooters) on satisfaction with daily travel. We found that compared with non-users, shared micro-mobility users have a similar daily travel satisfaction. In general, users tend to report that the adoption of shared micro-mobility services has contributed to an increase in their satisfaction with daily travel. The role that shared micro-mobility use plays in daily travel satisfaction depends on both its use features and the user's individual attributes. Shared micro-mobility helps improve daily travel satisfaction more if it is (also) used for commuting, recreation, and first/last mile trips than for other purposes. Shared bike users have a higher likelihood of reporting a travel satisfaction increase if shared bikes substitute taxi and walking, while shared e-bikes and e-scooters are more satisfactory alternative modes of public transit. Besides, we found that younger, male, and low-income groups tend to receive more travel satisfaction benefits from shared micro-mobility use than their counterparts. To maximize the benefit of shared micro-mobility on daily travel satisfaction, it is necessary to attract more users from such groups.

As an initial attempt to investigate the association between shared micro-mobility use and daily travel satisfaction, our study has several limitations and could be extended along the following directions. First, shared micro-mobility use is measured based on self-reported data, which may be influenced by recall bias. Future studies can use objective measurements (e.g., GPS tracking) to capture the individuals' use behavior more precisely. Second, while our study provides empirical evidence on how daily travel satisfaction changes after using shared micro-mobility, the self-reported satisfaction change may also suffer from memory bias. Future research should prioritize methodological approaches that allow for stronger causal inference regarding the well-being impact of shared micro-mobility. Longitudinal studies could help mitigate such bias by collecting travel satisfaction information before and after shared micro-mobility use, and disentangle whether improvements in daily travel satisfaction result from the adoption itself or from broader life-course changes such as residential relocation or job transitions. Qualitative methods (e.g., in-depth interviews) are also recommended to reveal the underlying reasons of the limited wellbeing benefits of shared micro-mobility use in more depth. Third, daily travel satisfaction is captured with a single question in our research. Future studies should better investigate the changes in different dimensions of daily travel satisfaction (e.g., affective vs. cognitive) with satisfaction with travel scale (Ettema et al., 2011), and how these changes are affected by shared micro-mobility use. Fourth, future studies could include more influential factors of shared micro-mobility use and travel satisfaction, like travel costs and weather, which are unfortunately lacked in this research due to data constraints. Besides, recent studies have suggested that travelers may compare their own travel (e.g., commuting time) with reference points (e.g., preferred, past, and peers' commuting time) in rating travel satisfaction (An et al., 2022; Guan et al. 2023; Guan and Wang, 2024; Wang et al., 2024). Future research could involve these reference points in models to understand the influence of shared micro-mobility use on travel satisfaction more comprehensively.

Finally, further policy-oriented research is needed to examine how local regulatory frameworks, spatial deployment strategies, and integration with public transport system shape the well-being effects of shared micro-mobility in European cities. In our study, we pooled the samples in three European cities in multivariate analyses due to the limited sample size. Future studies can try to examine the potential context heterogeneity of the wellbeing implication of shared micro-mobility if larger dataset is available. Besides, given that shared micro-mobility in Europe often substitutes walking and public transport rather than car travel, future studies should explicitly investigate the trade-offs between well-being gains, safety outcomes, public space use conflicts, as well as health impacts that from shared micro-mobility development (Badia & Jenelius, 2023; Milakis et al., 2020). Comparative research between European and other cities with different regulatory approaches are recommended, which could help clarify under which mobility and policy contexts shared micro-mobility enhances well-being for transport-disadvantaged groups while avoiding negative externalities, thereby supporting more equitable and sustainable urban mobility strategies (Dill & McNeil, 2021; Mooney et al., 2019).

Appendix

Table A1 Descriptive statistics of variables in SMM user models

Variables	Explanation	Mean/% (Standard Deviation)		
		Shared bike users (N=467)	*Shared e-bike users* (N=261)	*Shared e-scooter users* (N=409)
Travel satisfaction changes after using certain SMM	1: More satisfied; 0: Less satisfied or no change	34%	46%	31%
Socio-demographics				
Age	1: 18-29	38%	43%	40%
	2: 30-39	36%	37%	40%
	3: 40-49;	16%	15%	14%
	4: 50-59;	5%	3%	3%
	5: >=60	5%	2%	3%
Male	1: Male; 0: Non-male	52%	59%	54%
Employed	1: Employed; 0: Unemployed	82%	86%	80%
Higher educated	1: Bachelor or higher: 0: Otherwise	66%	64%	56%
Driver license	1: Has a driver's license; 0: Has no driver's license	84%	87%	88%
Household with children	1: Live with children 0: Live without children	39%	44%	37%
Household income	1: Low income	29%	34%	26%
	2: Medium income	23%	22%	24%
	3: High income	48%	44%	51%
Built environment (postal code level)				
Country dummies	United Kingdom	41%	67%	41%
	Sweden	35%	----	59%
	Netherlands	24%	33%	----
Population density	Number of population (thousand/km^2)	5.10 (3.24)	5.24 (3.08)	4.49 (2.80)
Transit density	Number of bus & tram stations per km^2	13.95 (8.05)	16.15 (9.44)	13.97 (8.55)
Distance to the city center	Euclidean distance from the neighborhood spatial center to the city center (km)	5.12 (4.42)	6.16 (5.31)	4.82 (3.82)
Distance to the train station	Euclidean distance from the neighborhood spatial center to the nearest train station (km)	1.91 (1.25)	1.92 (1.50)	1.82 (0.95)
Cycle paths density	The length (km) of the cycle route (/km^2)	3.32 (2.39)	2.36 (2.29)	3.30 (2.23)
Shared micro-mobility use features				
SMM trip purpose				
Commuting trips	1: Yes; 0: No	42%	44%	38%
Recreation trips	1: Yes; 0: No	55%	51%	58%
Shopping trips	1: Yes; 0: No	37%	47%	28%
Social trips	1: Yes; 0: No	42%	40%	41%
Exercise	1: Yes; 0: No	30%	36%	24%
First/last mile trips	1: Yes; 0: No	25%	19%	27%

Mode substitution by SMM				
Private car	1: Yes; 0: No	32%	31%	31%
Regional PT	1: Yes; 0: No	23%	26%	21%
Local PT	1: Yes; 0: No	34%	35%	35%
Walking	1: Yes; 0: No	25%	26%	28%
Private bike	1: Yes; 0: No	21%	26%	22%
Private e-bike	1: Yes; 0: No	13%	18%	15%
Taxi	1: Yes; 0: No	33%	29%	35%

Notes. PT = Public Transport. Values in parentheses represent the standard deviations.

Table A2 Current daily travel satisfaction of SMM users and non-users (ANOVA)

Sample	*Non-user*		*Occasional user*		*Frequent user*		
Full sample	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*F*(2, 1515)
Shared bike	5.22	1.46	5.25	1.33	5.26	1.34	0.08
Shared e-bike	5.00	1.44	5.08	1.41	5.30	1.38	1.98
Shared e-scooter	5.23	1.47	5.08	1.38	5.33	1.42	1.65
Utrecht, Netherlands	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*F*(2, 275)
Shared bike	5.23	1.39	5.38	1.25	5.45	1.15	0.63
Shared e-bike	5.24	1.32	5.51	1.33	5.35	1.35	0.87
Manchester, UK	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*F*(2, 439)
Shared bike	4.85	1.49	4.84	1.44	5.17	1.44	1.66
Shared e-bike	4.82	1.50	4.88	1.41	5.28	1.41	**2.68***
Shared e-scooter	4.85	1.49	4.87	1.35	5.17	1.51	1.38
Malmö, Sweden	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*F*(2, 795)
Shared bike	5.37	1.45	5.53	1.18	5.27	1.30	0.79
Shared e-scooter	5.43	1.42	5.19	1.39	5.53	1.27	2.30

SD: Standard Deviation; *p<0.1; **p<0.05; ***p<0.01.

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