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POST-PANDEMIC CITY AND LIGHT SHARING MOBILITY: A COMPARATIVE ANALYSIS OF BUDAPEST, LISBON, ROME, WARSAW AND VILNIUS

1. THE CONTRIBUTION OF BIKE AND E-SCOOTER SHARING SYSTEMS TO SUSTAINABLE MOBILITY. – Bike sharing systems have become a common feature of the modern urban landscape in many European cities (Shaheen *et al.* 2010; McKenzie, 2019), and recently a bewildering variety of mostly battery-powered vehicles – such as electric scooters – have been scattered all over the sidewalks of major urban centres, providing residents and visitors with a new mode of light and sustainable personal transportation.

Scientific studies on bike-sharing systems (hereafter BSSs) list a number of impacts – potential and actual, positive and negative – some of which can be extended to e-scooter sharing services (hereafter ESSs) for which, due to their recent advent, empirical studies and research are still limited.

Among the major positive impacts of these networks, the most documented are: economic benefits from reduced car use and/or abandonment (Otero *et al.*, 2018; Ricci, 2015), health and quality of life benefits (Otero *et al.*, 2018; Qiu and He, 2018), positive environmental externalities including reduced greenhouse gas emissions (Qiu and He, 2018; Shaheen *et al.*, 2010; Zhang and Mi, 2018), improved urban efficiency (Ricci, 2015), reduced vehicular traffic (Fishman *et al.*, 2015), the latter also documented during the pandemic period (Teixeira and Lopes 2020, Teixeira *et al.* 2022). However, with regard to possible social impacts (e.g. equity and inclusion), some authors claim that the benefits of light sharing mobility services are unevenly distributed among the city's users, as the main categories of users are typically male, young, and with above-average socio-economic status (Ricci, 2015). Moreover, even when considered in the context of urban planning processes, the distribution of the offer of sharing mobility systems is strongly unbalanced in favour of central and/or tourist areas, which are already better served by local public transport, and the pricing policies of these services rarely provide discounts for disadvantaged user categories (Caggiani *et al.*, 2020).

Endorsed by the local governments of many European cities to reduce carbon emissions, to encourage pro-environmental behaviour, and more generally to meet the environmental objectives of the 2030 Agenda, light and shared mobility systems seem to have the potential to outline “potential new pathways to sustainability” (Heinrichs, 2013) and combine the growing demands for networked and multi-modal urban mobility with environmental challenges.

Bike and electric scooter sharing systems can in fact be used for proximity trips (the so-called last-mile solutions) where public transport does not or cannot arrive, and can represent a valuable tool for public administrations that want to discourage the use of private cars, promote the use of light and sustainable mobility systems, and enhance intermodality (Shaheen *et al.*, 2020) by promoting the design of the “15-minute city” (Moreno, 2021).

As discussed by Sanna and co-authors (forthcoming 2022), the global Covid-19 pandemic that started in March 2020 had a significant impact on the freedom of movement of individuals, marking a setback for the use of light-sharing mobility systems that have – at least temporarily and differing between various urban contexts – lost a considerable share of users in favour of private transport. During the peak of the pandemic, one of the key public health measures adopted worldwide to slow the spread of the virus was the restriction of movement. Nevertheless, the effects of such measures on urban mobility have not been identical for all means of transportation: while the use of private cars has increased, all other methods of transport have decreased in usage numbers, with public transport experiencing the greatest decline. However, in some cities (e.g., Budapest), cycling – and bike sharing in particular – experienced the lowest decrease out of all available means of transport (Bucsky, 2020), showing a trend towards individual transportation where affordable.



The outbreak of Covid-19 also prompted central and local governments to adopt policies that favour smaller individual transport (e.g., construction, renovation, and extension of existing cycle paths; economic incentives and/or subsidies for bicycle and e-scooter purchases, etc.) (Diogo *et al.* 2021), some of which may not just be transitory measures but that could generate permanent changes in how urban travellers traverse their cities, and how cities are planned and built in the future.

With the partial recovery of mass travel, the popularity of bike and e-scooter sharing systems seems to be renewed. This contribution presents the preliminary results of a comparative, survey-based study carried out during 2021 in five European capitals: Budapest, Lisbon, Rome, Vilnius, and Warsaw, with a specific focus on aspects of accessibility of the services and a brief analysis of the main reasons and motivations for non-use, expressed by a large proportion of respondents who took part in the online survey.

2. THE RESEARCH FRAMEWORK. – This contribution is part of the activities of the international research network “Cost-Action From Sharing to Caring: Examining Socio-Technical Aspects of the Collaborative Economy” through which a series of comparative analyses have been conducted, including direct questionnaires to users, on BSSs and ESSs usage habits in five European capitals, before and during the pandemic that started in 2020.

Following the main methodological indications provided by the scientific literature on the transport domain (Matyas and Kamargianni, 2019), the questionnaire was administered using a dedicated and multi-lingual online platform (Survey Monkey). This tool allows complex surveys to be designed dynamically and flexibly, has a low cost, and enables a wide audience of participants to be reached. At the same time, the main disadvantages of online surveys include the impossibility of representing a general population or conducting sample analyses. Furthermore, it is not possible to interview people without computer skills/knowledge or without access to the Internet. However, for the specific case of sharing mobility, this last aspect is not to be considered as an invalidating limitation of the survey since the main target group of BSSs and ESSs are users with smartphones and able to use their functions (as they are necessary for real time booking and electronic payment of sharing services).

The online questionnaire, in addition to outlining the socio-economic profile of the respondents, covered aspects related to the availability and potential accessibility of sharing services, transport habits before and during the pandemic, main motivations for using or not using the services, etc. The questionnaire was administered from April to June 2021 and distributed via social media (mainly neighbourhood, commuter and urban life Facebook groups) and mailing lists.

A total of 996 people responded to the survey. After a process of data cleaning and validation 797 observations were included in the convenience sample for analysis according to the city and gender distribution shown in Table 1. Rome is the city with the highest number of observations – about twice as many as the other capital cities. As far as gender distribution is concerned, it is almost equal in Warsaw, more unbalanced on the female gender in Rome and Vilnius and more on the male gender in Budapest.

Tab. 1 - Respondents per city (absolute values and percentage) and gender distribution (percentage)

City	Number of respondents	Respondents (% tot)	Female	Male	Other	Total
Budapest	133	16.69	45.1	54.1	0.8	100.0
Lisbon	129	16.19	40.3	58.1	1.6	100.0
Rome	281	35.26	53.0	46.6	0.4	100.0
Warsaw	128	16.06	48.4	50.8	0.8	100.0
Vilnius	126	15.81	59.5	40.5	0.0	100.0
Total	797	100.00				

Source: elaboration of the authors.

Most of the respondents have a “stable” relationship with the city. Of the 797 respondents, 88.3% “live temporarily or permanently” in the city, 7% visit it “at least once a week for study/work reasons”, 1.5% “at

least once a week for reasons other than the above”, 3% “less than once a week but more than once a year” and a residual 0.3% “at least once in the last year”.

As far as age is concerned, 30.36% of the respondents belong to the 37-46 age group, 25.35% to the 27-36 age group, 19.07% are between 47 and 57 years old, 13.80% belong to the 17-26 age group. All other age groups, from 16 years upwards, account for a residual 11.42%.

In terms of education, a large proportion of the respondents have a high level of education. 41.3% have a master’s degree, 29.5% a bachelor’s degree and 8.4% a PhD or postgraduate degree. Only 16.4% have secondary education, 3.2% have primary education and 1.3% preferred not to declare.

As far as income is concerned, when asked which statement best represented “the situation of the household with respect to the available income”, the picture that emerges is of a fair majority of medium-high incomes, with 34% of respondents declaring that they “live comfortably on their available income”, added to 23.6% who have an income that allows them to “meet their current expenses”. Only 15% have “great difficulty living on the available income” and 5.8% say they have “some difficulty living on available income”. Finally, 11.5% preferred not to answer.

From the point of view of employment status, the prevailing categories include 38.6% of full-time employees without responsibility roles, 18.6% of managerial or executive employees, 14.3% of freelancers and 3.9% of entrepreneurs.

3. THE ACCESSIBILITY OF BSS AND ESS SERVICES. – With regard to the BSSs offer in the analysed cities, it should be noted that in 2021 Budapest, Lisbon and Vilnius had third generation systems, i.e. equipped with electronic stations and/or technological kiosks for vehicle pick-up and drop-off, while Warsaw had mixed third and fourth generation systems, the latter being dock-less (i.e. “free” bicycles equipped with electronic control units and GPS), while in Rome the service is entirely fourth generation. In addition, BSSs in Vilnius and Budapest consist of mechanical bicycles, in Lisbon and Warsaw the offer is mixed with both mechanical and electric bicycles, while the vehicles in Rome are exclusively electric.

As discuss by Sanna *et al.* (forthcoming 2022), from the point of view of the management of the service and the current number of vehicles (Table 2), while in Warsaw there is only one public operator for BSSs, in Budapest and Lisbon the service providers are both public and private, while in Vilnius and Rome the operators are exclusively private (multinational platforms such as Uber and Helbitz). This difference is, to a large extent, related to the choices made by municipalities in recent years; as documented by Diogo and co-authors (2021), in Portugal the service is operated by a municipal company that has received substantial public funding to the extent that some bikes are also used by the municipal police. Budapest’s main bike sharing company is also managed by the municipality and is part of the city’s public transport company.

Tab. 2 - Offer of bike and e-scooter sharing services in the five capital cities, nature of the service provider and vehicle fleet (estimates year 2021)

Typology	Budapest		Lisbon		Rome		Warsaw		Vilnius	
	PB	PR	PB	PR	PB	PR	PB	PR	PB	PR
N. of BSSs operators	1	1	1	2	0	2	1	0	0	1
Bicycle fleet	2,400	200-300	1,000	1,150	—	3,220	5,722	—	—	300
N. of ESSs operators	0	n.d.	0	2	0	4	1	4	0	n.d.
E-scooter fleet	—	n.d.	—	2,077	—	14,000	8,300	—	—	n.d.

Legend: PB = public, PR = private.

Source: authors’ elaboration on various sources¹.

¹ Data source for BSSs “The Meddin Bike-sharing World Map” online: www.bikesharingworldmap.com (last accessed 29/03/2022). Data on ESS services, after mapping the service providers present in each city, were found on the single online platforms (e.g., Bird, Dott, etc.).

As far as the offer of e-scooter sharing is concerned, the phenomenon is recent, and the available data is still very fragmented and changing. Europe's first ESS was launched in Lisbon in 2018; in Vilnius, Warsaw and Budapest in 2019 and in Rome only in the spring of 2020, at the height of the pandemic emergency. Regarding information about fleets, the available data are still partial, as of December 2021 Rome had 14,000 electric scooters, Lisbon 2,077 and Warsaw 8,300.

The geography of the distribution of BSSs and ESSs in the five capital cities shows common features and is deeply unbalanced between the centre and the urban periphery (Fig. 1).



Source: elaboration of the authors.

Fig. 1 - The distribution of bike-sharing services in the five studied capital cities

Nevertheless, the survey shows that respondents largely report having access to sharing services (Table 3). As far as BSSs are concerned, on average 61.9% of respondents find shared bicycles in the area where they live, a percentage that increases to 72.1% in the area where they work/study and to 73.5% in the area they visit for leisure, shopping, etc. Data are even higher by a few percentage points for the e-scooter sharing service.

Tab. 3 - Availability of BSSs and ESSs services according to respondents

Availability	Budapest (%) (n = 133)	Lisbon (%) (n = 129)	Rome (%) (n = 281)	Vilnius (%) (n = 126)	Warsaw (%) (n = 128)	Tot (%) (n = 797)
Bike-sharing service						
Area of residence	62.4	56.6	64.4	48.4	74.2	61.9
Work/study zone	73.7	74.4	71.9	69.8	71.1	72.1
Leisure/shopping	72.9	62.0	74.0	73.0	82.8	73.1
E-scooter sharing service						
Area of residence	74.4	55.8	65.5	59.5	64.8	64.4
Work/study zone	73.7	73.6	74.0	77.8	74.2	74.5
Leisure/shopping	77.4	59.7	77.6	81.0	74.2	74.7

Legend: Percentage of respondents with sharing services available near their area of residence, work/study zone or other frequent destinations (leisure, shopping, etc.).

Source: elaboration of the authors.

While there is a substantial perceived availability of light sharing mobility services, there is a low uptake. In particular, an in-depth analysis of the periods of subscription (or non-subscription) to bike-sharing services revealed that the majority of respondents (61.10%) did not subscribe to the service while 20.20% used it but only before the pandemic (March 2020) and then abandoned it. The remaining 13.55% of respondents used BSSs both before and during the pandemic and a residual 5.14% subscribed to the service “only recently, i.e., during the pandemic (after March 2020)”.

Similar responses were given for the e-scooter sharing service where the majority (higher than bike-sharing) of respondents (72.65%) never subscribed to the service while 14.43% used it but only before the pandemic (March 2020) and then abandoned it. The remaining 6.65% of respondents used e-scooter sharing both before and during the pandemic and 6.27% subscribed to the service “only recently, i.e., during the pandemic (after March 2020)”.

4. NONUSERS’ MOTIVATIONS. – Digging into the motivations of the nonusers it is interesting to examine why, despite the fact that the majority of respondents declared they could access e-scooter and bike-sharing services, they do not actually use them.

With regard to BSSs, when analysing the reasons for not using and/or not subscribing to the service, the respondents show conflicting opinions (Fig. 2). The main reasons on which respondents “strongly agree” are: (1) Other means of transportation are more convenient (26.5%), (2) Because of bad conditions on the roads/streets (potholes etc.) (20.8%), and (3) Because of the lack of a bike network” (21.2%). On the contrary, respondents “strongly disagree” with the top-3 motivations: (1) Personal reasons which do not allow me to ride (59.3%), (2) I am afraid of Covid-19 transmission” (57.8%), and (3) Lack of personal safety equipment” (37.0). Finally, they are fairly neutral and “neither agree nor disagree” on the following motivations: (1) It takes too long to check the bicycles in and out (50.2%), (2) The bikes are not good (e.g., too heavy, maintenance problems, not enough gearing/speed, uncomfortable)” (46.7%), and (3) Bike sharing is too expensive (43.6%), equal The bikes do not have enough cargo space to transport goods, kids, or pets (43.6%).



Source: elaboration of the authors.

Fig. 2 - Reasons for not subscribing the bike-sharing system

With regard to the e-scooter sharing, the reasons for non-using the system are less clear-cut and evident and essentially, the extreme positions of “strongly agree” are less numerous than the “agree” (Fig. 3). Nevertheless, most of the respondents agree or strongly agree on the following motivations: (1) Other means of transportation are more convenient” (agree 33%, strongly agree 39.9%), (2) I am concerned for my safety riding in traffic” (agree 29.9%, strongly agree 29.9%), and (3) Lack of personal safety equipment (e.g., helmet) traffic” (agree 21.8%, strongly agree 17.8%). Of a different opinion, therefore those who strongly disagreed with the following reasons do not consider them a motivation for non-use: (1) Personal reasons which do not allow me to ride (56%), (2) I am afraid of Covid-19 transmission (54.7%), and (3) Because of limitations in account creation” (30.9%). Finally, more neutral (“neither agree nor disagree”) responses have been associated with the following three main motivations: (1) It takes too long to check the e-scooters in and out (55.6%), (2) The e-scooters are not good (e.g., too heavy, maintenance problems, not enough gearing/speed, uncomfortable) (55.6%), and (3) E-scooter sharing is too expensive”.

5. CONCLUSIONS. – Respondents in the five European capital cities generally show a positive attitude towards light and sustainable urban mobility. Moreover, there is growing government interest in sustainable individual micro-mobility, demonstrated at both national and local level, and including sharing schemes, but it must work to overcome the dominance of car culture.



Source: elaboration of the authors

Fig. 3 - Reasons for not subscribing the e-scooter sharing system

These services are often advertised as supporting a modal shift towards more sustainable transportation, and as tools for enabling more equity in mobility (etc.). However, their overall impact depends on how they are used and what kinds of trips they replace, who they serve, where, etc.

It is still unclear if most of these sharing schemes will survive once “normal” and/or post-pandemic life resumes, but there remain valuable conclusions to be drawn by comparing the differing approaches and outcomes of cycle and e-scooter sharing systems from multiple perspectives.

The survey suggests that despite their flourishing, bike and e-scooter sharing systems are characterised by uneven geographical distribution between city centre and periphery, are poorly integrated into the local public transport system, hardly reach low-income populations, and serve a narrow demographic band of male residents. There is evidence, moreover, that among the main reasons for not subscribing the BSSs and ESSs, utilitarian ones are decisive and “other means of transportation are more convenient” is indicated in both cases as a major reason. Equally, infrastructure conditions (bad conditions on the roads/streets and the lack of a dedicated network) are cited as crucial factors in non-use, which leads to concerns about personal safety taking precedence over any other contingent reasons such as fear of Covid infection.

As a conclusion, the growing proliferation of bike and scooter sharing services is giving rise to heated debates concerning both the regulation of the services (and their use) and the infrastructural conditions of the cities, the impact that the expansion of the vehicle fleet and, in some cases, of the areas served by sharing has on the use of public space, traffic, health (also considering current issues such as accidents), etc. Nevertheless, their potential to break car culture and change mobility patterns has not yet been fully explored, not least because the phenomenon is difficult to measure (given the absence of official statistics on vehicle fleets, users, mileage, etc.). At the political level “mobility as a service” (Mobility-as-a-Service MAAS) (Lukasiewicz *et al.* 2022), also promoted through sharing schemes, does not yet play a sufficiently prominent role in the urban agenda and is almost absent from the national mobility strategies of the countries examined. Therefore, although promoted as a sustainable means of transport functional to the design of “15-minute city” (Moreno, 2021) that focuses on environmental sustainability and energy transition, the contribution that these services can offer in terms of sustainability and environmental, spatial and social justice is still uncertain. For these reasons, it is of particular interest to continue theoretical and empirical research on light sharing mobility.

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SUMMARY: Promoted by many local governments to reduce the use of private vehicles and encourage pro-environmental behaviour, light-sharing mobility practices seem to have the potential to combine the demands of a networked and multi-modal urban mobility with the growing demand for environmental sustainability. This paper discusses the main outcomes of a survey-based, and comparative analysis carried out in 2021 on the use of bike and electric scooter sharing in Budapest, Lisbon, Rome, Warsaw and Vilnius. The aim is to reflect on the role and as yet unexpressed potential of light and sustainable mobility in support of urban planning that takes greater account of issues of environmental, spatial and social sustainability and justice.

RIASSUNTO: *Città post-pandemia e mobilità light sharing: un'analisi comparativa di Budapest, Lisbona, Roma, Varsavia e Vilnius.* Promossi da numerose amministrazioni locali per ridurre l'uso dei veicoli privati e favorire comportamenti pro-ambientali, le pratiche di *light sharing mobility* sembrano avere il potenziale di coniugare le istanze di una mobilità urbana reticolare e multi-modale con la crescente domanda di sostenibilità ambientale. Il presente contributo discute i principali esiti di una indagine comparativa e *survey-based* effettuata nel 2021 sull'uso di bike e monopattini elettrici sharing a Budapest, Lisbona, Roma, Varsavia e Vilnius. L'obiettivo è riflettere sul ruolo e sulle ancora inesprese potenzialità della mobilità leggera e sostenibile a sostegno di una pianificazione urbana che tenga maggiormente in considerazione i temi della sostenibilità e giustizia ambientale, spaziale e sociale

Key words: shared mobility, comparative analysis, Covid-19 pandemic

Parole chiave: mobilità condivisa, analisi comparativa, pandemia da Covid-19

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