Micromobility

Subjects: Transportation

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Micromobility is a widely used term for low speed modes of transport based on the use of electric-powered personal micro vehicles, such as e-scooters. E-bikes can be included in this definition as they have been in the USA, even if in some countries, such as Italy, micromobility usually refers to small electric devices, thus excluding e-bikes.

Keywords: shared mobility ; transport planning ; e-scooters

1. Introduction

The use of micromobility vehicles, mostly for short trips, is fostered via new shared mobility services, such as bike sharing or e-scooter sharing [1][2]. Since the use of the latter has been spreading recently all around the world, there are still many open issues in terms of suitable infrastructure, demand analysis and safety evaluations. The wide spatio–temporal availability of these services, made possible by mobile applications that easily match real time demand and supply, favors the use of micromobility in combination with other modes of transport, such as fixed and demand-responsive transit. Thus fostering a shift from a car dependent mobility model towards a Mobility as a Service (MaaS) approach, implying multimodal and seamless door-to-door trips [3][4][5][6]. Integrating micromobility with public transport could also enlarge its catchment area, increase its accessibility, and reduce congestion phenomena and pollution, thus making cities more liveable [7].

The outbreak of the COVID-19 pandemic has certainly further increased the potential for micromobility; in the first phase after the lockdown, due to social distancing restrictions, people had to compete to access to transit services, which had considerably reduced their capacity, especially in terms of available seats. In this respect, micromobility can be considered an option to discourage an immoderate use of cars and a valid alternative for those who do not own a private vehicle; in this way, this new type of mobility can contribute both to sustainability and to social inclusion [8][9].

Despite its great potential, the use and regulation of micromobility varies a lot between different parts of the world with a multitude of different operators performing the service in the same cities [10]. E-scooters have been a reality in the cities of the United States for several years [1]. In Europe, they have recently become part of everyday life and are increasingly being used for systematic trips and for tourism purposes. As an example, in Italy, the debate around the use of e-scooters as a new transport mode had been very lively, until their official regularisation in early 2020 (https://www.themayor.eu/en/problem-solved-italy-equates-e-scooters-to-bicycles - accessed on 12 October 2021). The standard provides the same traffic rules for e-scooters as for bicycles, in order to avoid the use of the vehicles on the sidewalk in proximity to pedestrians.

Given the very recent introduction of these new services in cities, there are still few data relating to this phenomenon to analyse. Besides this, policy makers should be able to govern the transition towards micromobility and MaaS, adapting cities and encouraging sustainable intermodal trips.

A recent study showed the need to plan and redesign urban spaces to accommodate this emerging mode of transport [11]. However, at present there are no studies aimed at planning and designing networks for micromobility. This paper presents a methodology for a preliminary evaluation of the suitability for use by e-scooters of portions of existing transport networks in urban areas. This topic has been under studied in the current literature, which is mainly focused on cycling infrastructures (e.g., Hull and O'Holleran [12]). However, the differences between bicycles and e-scooters point to the need for defining *ad-hoc* criteria to assign priority and assess safe e-scooter infrastructures [13]. In this respect, the report by Ernst & Young on micromobility, "Micromobility: Moving cities into a sustainable future" [14], formulates seven recommendations for policy makers to foster micromobility. In particular, it suggests supporting safety efforts and investing in alternative mobility infrastructures. Similarly, the POLIS report, "Macro Managing Micro Mobility" [15], suggests focusing on infrastructures as one of the key strategic issues. Spatial analyses are useful for this purpose. They allow one to take into consideration multiple heterogenous criteria regarding land use characteristics, and the potential demand and supply and to combine them to derive emergent networks. This approach has been used by Giuffrida et al. [16] for bicycle network design and by Fazio et al. [17] for bike station locations and design.

2. Research on e-scooters

The rapid spread of e-scooters has led to an open debate on their impact on users' travel habits, safety perception and use of public spaces. Furthermore, in most of the cases, the lack of *ad-hoc* legislation and infrastructure raises many concerns among citizens and public administrations [18][19][20]. There are many studies that have addressed this topic, focusing on different issues; some of these studies have focused on users' perception of using e-scooters. Tuncer et al. [2] carried out five weeks of fieldwork observations in Paris (France) to analyse users' experiences. They found out that users perceive e-scooters as a hybrid mode of transport capable of combining the characteristics of other modes of transport (i.e., vehicles, bikes and pedestrian mobility). James et al. [21] examined the pedestrian safety perception towards e-scooters. Through a survey, they inferred that pedestrians feel less safe around e-scooters than with bikes. In addition, they addressed the parking issue, finding that there are a percentage of users who improperly park e-scooters on sidewalks, obstructing the passage of pedestrians. Zhang et al. [20] focused on infrastructure preferences of e-scooter users. They performed a stated preference survey and estimated a recursive logit route choice model using GPS tracks collected on the Virginia Tech campus. Results underline the willingness of e-scooter users to travel in bikeways and multi-use paths. Gössling [19] compared ten cities in order to identify the major concerns related to the introduction of e-scooter services. The analysis demonstrated that, if not properly regulated, e-scooter services could create obstacles in terms of safety (i.e., speed limit), cluttering, inappropriate rider behaviour and vandalism. Campisi et al. [22] estimated an ordered logit model in order to identify users' characteristics that can influence the propensity of renting micromobility devices. The study was applied in Palermo (Italy) and the main results show that young people and students seem to be more prone to use this mode, while there is no gender difference. Another study, also conducted in Palermo, focused on the analysis of the performance level of e-scooters providing useful suggestions for authorities for the evaluation of strategies to foster personal mobility vehicles (PMVs) transport systems [23].

Other researchers analysed to what extent e-scooters fit into users' travel habits using spatial approaches. Jiao and Bai [24] conducted a spatial analysis with the aim of investigating the correlation between e-scooter travel patterns and land use. Results show that high-density areas, in terms of residents and points of interests, are those crossed by the highest number of e-scooter trips. This is one of the reasons why transport operators decided to invest in cities with high densities, neglecting the important role that micromobility may have as a last-mile solution in less dense areas with poor connections to mass rapid transit [25]. Bai and Jiao [26] made a comparison between Austin and Minneapolis (U.S.) by evaluating the spatio–temporal characteristics of the use of e-scooters. They found that in both cities the e-scooter usage was concentrated in downtown areas and university campuses. On the contrary, the temporal characteristics are differently distributed in the two cities. The work of McKenzie [27] also analysed the spatio–temporal usage of e-scooters by focusing on the differences between dockless e-scooters and dock-based bicycle services in Washington (U.S.). The results suggest that people prefer the bike-sharing service for commuting trips rather than e-scooters. The latter seem to be used mostly for leisure, recreation and tourism activities. As the authors claim, the reason for this difference can be the different periods that these services have been in operation. In this respect, users would entrust commuting trips to a service that has proven to be reliable for a longer time. Caspi et al. [28] proposed a spatial approach to examine e-scooter sharing trip patterns taking into consideration land use, built environment and demographic aspects. They used a dataset from an open data platform that provides the characteristics of e-scooter trips (e.g., departure and arrival times). Their results show that people use e-scooter services mainly in the centre of the city and in areas with bicycle infrastructures. Moran et al. [10] examined the geographical position of e-scooter service areas with the aim of determining the spatial variance of e-scooter positioning. The results show that operators restrict e-scooters to high-density neighbourhoods. The authors also underline the necessity of ensuring e-scooter services to outlying and poor neighbourhoods to struggle against social exclusion. In this respect, the study of Qian et al. [29], that developed a spatial-based methodology to quantify bike-sharing services for areas characterised by the presence of disadvantaged populations using the concept of "communities of concern" (CoCs), is notable.

Some recent studies dealt with other important issues regarding e-scooters. Yang et al. [30] presented a safety analysis identifying the pattern of crashes linked to the use of e-scooters. They collected accident data from 2017 to 2019, and, through a descriptive and cross tabulation analysis, they highlighted that children and elderly people are subjected to the greatest risk and that the severity of accidents worsens during the night. Sandoval et al. [31] propose a methodology to find the optimal location of e-scooter parking facilities based on what could be reasonably intended as destinations of e-scooter trips. Data are provided from shared urban mobility devices and are analysed through unsupervised machine learning algorithms to estimate the areas with a high number of trip destinations. He and Shin [32] elaborated a methodology based on three different e-scooter trips' datasets to predict the future e-scooter flows through a neural network algorithm. Masoud et al. [33] elaborated a mathematical model able to allocate e-scooters according to the minimisation of distance from chargers' locations. They simulated different scenarios in which the number of e-scooters and chargers vary with coordinates that are randomly generated.

To sum up, the literature related to micromobility and, in particular, e-scooter's usage is growing rapidly and is addressing many important issues.

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