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Exploring the factors affecting bike-sharing demand: evidence from student perceptions, usage patterns and adoption barriers

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Abstract

Shared mobility is an innovative transportation strategy defined as the shared use of a vehicle, bicycle or other mode which enables users to gain short-term access to transportation modes on an as-needed basis. Bike-sharing systems have rapidly expanded around the world with important implications for urban areas. Considering the benefits regarding cycling and implications deriving from bike-sharing services implementation, this paper presents an in-depth analysis to investigate a variety of determinants, barriers and motivation that can influence the willingness to cycling and join bike-sharing. The study focuses on a specific target group represented by university students and their preferences have been collected through a structured questionnaire in applying the Likert Scale. A statistical analysis has been realized based on a chi-squared test, deriving the difference between expected and observed frequencies for several combinations of the analyzed attributes. First results highlight the differences between the impact of economic, environmental and social factors for students cycling and provide useful suggestion to define the way for a well-thought-out design of a bike-sharing transport service.

Keywords: Sharing mobility; Bike-sharing services; Sustainable mobility; Willingness to cycling; Likert scale; Chi-squared test

1. Introduction

The term shared mobility refers to a variety of transportation modes that are shared on an as-needed basis (Shaheen et al., 2020). It includes various forms of carsharing, bike-sharing, scooter sharing, ridesharing (carpooling and

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vanpooling), transportation network companies (TNCs), and micro-transit. Over the last decade, the international discourse on sustainable transport has been bursting with supposed best practices like bike-sharing, a system of short-term bicycle rental popular in cities across the globe. Today over 500 cities proudly host a bike-share, and that figure grows annually (Wood, 2020; Pucher and Hagen, 2014), increasing the positive environmental, social, and transportation-related impacts of these services. As young and presumably healthy adults, students have the physical capacity to cycle; allegedly, they should have more knowledge, motivation, and awareness about shared solutions and sustainability issues. On the other hand, they usually have fewer financial resources than employed people, this being only one crucial issue that could contribute to their more frequent use of bicycles (Pogacar et. al., 2020). Furthermore, the characteristics of these young bike-sharing users represent an important aspect to investigate, taking into consideration that they may differ from city to city (Efthymiou and Antoniou, 2016). Thus, the variability of bike-sharing users' travel patterns and the factors that determine their decision to join, maintains the research interest around this subject high. Based on this premise, focusing on a specific target group consisting of university students, this paper extends the current literature and contributes in this direction by proposing an in-depth analysis to investigate a variety of determinants, barriers and motivation that can influence the willingness to cycling and join bike-sharing.

2. The spread of bike sharing

The bike sharing system is currently one of the most widespread and popular shared and sustainable mobility systems, especially after the Covid-19 pandemic. Many countries have promoted the use of bikes and slow mobility (i.e walking), in order to guarantee daily trips without using private vehicles, especially for distances of less than 1 km. In order to guarantee social distancing, the Local Administrations have encouraged the promotion of cycling infrastructure and services through the creation of temporary lanes also called "pop up", i.e. infrastructure to be implemented in a short time and at the same time they aimed at improving the design and redevelopment of areas with increased space for cycling. In general, the factors that most influence the choice of the service are closely related to the travel distance between origin/destination, the presence and location of parking for bicycle, the type of provided service, the weather conditions and especially to the type of infrastructure and its maintenance (Scott and Ciuro, 2019). In the design phase, studies confirm that the planning, implementation and maintenance of shared spaces for forms of slow mobility, such as pedestrians and cyclists, can be evaluated taking into account several aspects, both infrastructural and both linked to subjective perception, through the estimation of aggregated indices for an overall view (Ignaccolo et al. 2018, 2020). The perceptions are differently as the age and gender of road users varies and there is also an influence on the perceived Level Of Service (LOS) (Nikiforiadis and Basbas, 2019; Nikiforiadis et al., 2020, Kazemzadeh et al., 2020). The oversizing of cycle lanes can have a significant impact on the pedestrian's perception related to the infrastructure, even in scenarios with low cycling flows. The presence of vertical/horizontal signs or kerbs or advanced space line (ASL) can increase the safety of the cyclists during their travel (Rencelj et al., 2019). This criticality can be reduced if the design of cycling infrastructure follows an integrated approach such as that pursued by I-BIM modelling (Campisi et al., 2020) and considering not only plan and design approach but also costs and safety (BCI and BLOS index) (Klobucar and Fricker, 2007). In addition to infrastructure incentives, nations and local governments are promoting bicycle sharing services. Like in Europe, bike sharing in Italy is to all intents and purposes an established reality, making it the EU with the highest diffusion in terms of number of active services. In 2018 the Italian bike sharing recorded a fleet growth of + 147%.

In accordance with National Observatory of Sharing Mobility, Italy has seen the spread of bike sharing services in 265 cities (90% of which are provincial capitals) and this has meant that Italy has had the highest spread in Europe in terms of active services. The distribution in the different regions is characterised by Northern Italy with a 59% share, followed by Southern Italy with a 28% share and finally the Centre with a 13% share.

In terms of type of service provided (station-based SB or free-floating FF) there are some differences. According to (Bolassa, 2018), it is possible to observe that the SB service is used for medium-long distances and the FF service is more used for short trips. The number of bikes rented with station-based service remains higher than with the FF service and also the total number of kilometres travelled with the SB service is higher than with FF (about 50% more). The number of users who use bicycles for travel purposes in the last two years has also increased thanks to the spread of e-bikes with assisted pedalling that meet the less well-trained, allowing them to easily tackle slopes and longer routes. These data are important for the planning, drafting and approval of Sustainable Urban Mobility Plans (from Italian Piani Urbani della Mobilità Sostenibile - PUMS) (Torrisi et al. 2020). These urban planning tools are promoted

by the European Commission, which has issued guidelines on accessibility, sustainability, safety and sharing. Cycle paths, cycle stations and bike-sharing are central to this planning, considering the benefits of cycling, especially in terms of reducing environmental pollution, noise and decongestion. Especially in urban areas, characterized by and high levels of motorization rate and traffic congestion, which lead to an over-saturation of road capacity and with consequent travel time unreliability phenomena, both for private and public transport (Torrisi et al, 2017a, 2017b), the development of forms of shared mobility could represent a solution towards sustainability. The implementation of this form of shared mobility brings with it considerable environmental benefits, linked to less car use and, therefore, decreasing air pollution. It also allows the use by all social classes because the costs of the service are much lower than the costs of purchasing and maintaining the vehicles. The most recent alternative that promises to reduce these effects considering the Mobility as a Service (MaaS) concept (Canale et al., 2019) and the use of ITS technologies for real-time traffic monitoring and estimation and through smartphone-based geolocation by users (Torrisi et al., 2018a, 2018b). However, due to the increasing novelty of these systems, only a few the investigations have already employed them (Brakewood et al.,2017, Wargelin et al., 2012; Oliveira et al., 2011; Cottrill et al., 2013; Kopp et al., 2015, Cruz et al., 2020).

3. Materials and methods

3.1. Survey design

There are several studies in the literature that have addressed the analysis of bike-sharing propensity, using different procedures of acquiring user demand data (Chevalier and Chalermagne, 2019; Pawlowski et al., 2014; Swiers et al., 2017). The proposed study sees the involvement of a similar sample (comprising students of the University of Catania and University of Enna Kore), with the aim of investigating not only their transport attitude but also the correlation among the infrastructure details and the their propensity to use bike sharing service.

The analysis has been conducted by developing a structured questionnaire survey divided into 4 section. The first part was related to socio-demographic data (e.g. age, gender, municipality of residence, attended faculty and possession of a car or other means of transport and driving licence). The questions related to this section were defined in a closed single answer manner. The second part investigated the travel behavior. The third one to analyze the infrastructural factor that influence the propensity of usage of bicycle, such as the presence of the bicycle path on the pavement or in the carriageway and the presence of dedicated parking spaces. These questions were answered on a Likert scale with values from 1 to 5). The last section was correlated to the propensity to join new forms of shared mobility, focusing on the factors that positively and negatively influence the use of the bike. In particular, factors related to the service such as price, travel time, reliability, safety, comfort, possibility to travel with people and/or luggage have been taken into account. In addition, factors related to the optimal functioning of the system, flexibility to avoid congestion, easily accessible parking, the perception of the service as a fashionable system and finally the lack of a private vehicle available have also been investigated.

3.2. Model development

Figure 1 schematizes the model development, characterized by three steps of analysis:

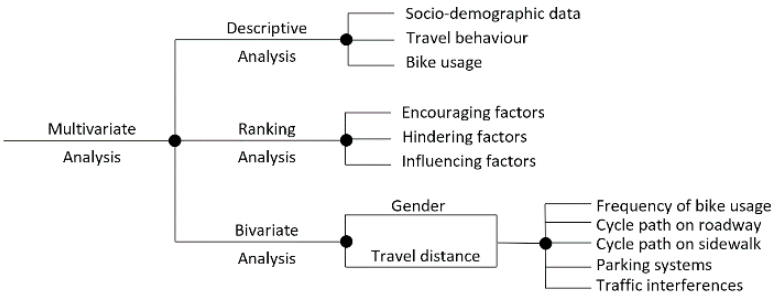

Fig. 1. Framework of the methodological steps of the analysis

The model was implemented considering the possible statistical correlations between different variables (i.e socio-demographic factors and travel behaviour) with respect to the characteristics of the infrastructure that influence the propensity to choose a shared service and the positive and negative aspects that generally influence the use of bicycles. For most of the questions on individual perception, a five-level Likert's scale has been used to gather the responses (1-not at all/2-slightly/3-moderately/4-strongly/5-definitely) (Likert, 1932, Louviere, 1999) and a statistical analysis based on chi-squared test has allowed to evaluate the difference between expected and observed frequencies for several combinations of the analyzed attributes.

4. Case study

The described methodological approach has been carried out in two different cities: Catania and Enna, both located in the southern part of Italy and characterized by the presence of a large number of university students. The two academical sites are located in the central-eastern part of Sicily and they are characterized by an orography of the terrain (especially Enna) which in some areas is not compatible or makes it inconvenient and difficult to use the bike. Furthermore, this is aggravated by the fact that there is a lack of reserved infrastructures (i.e. cycle paths) and dedicated services (i.e. racks and bike parking) and there are high levels of congestion that lead to the overcoming of road capacity and to significant interference with vehicular traffic. These aspects certainly represent a deterrent to the use of the bike. In 2017, 0.6% of the population registered in Sicily used the bicycle for home-work trips, while a percentage of 0.1% of children and students up to 34 years cycled to go to school or to university (Legambiente,2017). This percentage increased in 2019 with greater attention to the environment and health. As for the bike sharing service, it has been implemented for some years in the city of Catania through the service named “Bict”, managed by the Municipal Transport Company (from Italian Azienda Metropolitana Trasporti - AMT). In Enna, the bike sharing service will be activated starting from August 2020. In correspondence with the two university locations, the two areas show orographically differences as the University Campus of Catania is at 140 meters above the sea level, instead of Enna, located in a hilly/mountainous context at about 500 meters above the sea level. In both cases, the two university poles are located outside the historic center and adjacent to the motorway junctions (about 6-8 km away). Figure 2 shows some examples of the roads in the two cities. The road pavement is of a mixed type with stretches of ancient flagstone (from Italian “basolato”) with bad grip for the bikes. Furthermore, the infrastructures of the two cities have different slopes and widths of the roadway with an absence of cycle lanes for the city of Enna and the presence of cycle lanes in some parts of the city of Catania which, however, do not constitute real cycle routes. The urban planning tools of Enna and Catania provide for the creation and expansion of cycle lanes for a better connection between residential and university areas. Therefore, it is useful to understand which factors relating to infrastructure and service can influence the choice of bicycle use.

Fig. 2. Examples of streets and connected infrastructures in the cities of (a) Enna; (b) Catania

The data collection campaign has been conducted during the period of December 2019 – February 2020 and 200 interviews (i.e. 100 randomly selected students for each University) have been collected with a paper questionnaire filled by individual interviews within a large consultation survey carried out in the University Campus of the two cities, by involving a sample with heterogeneous characteristics of travel pattern, so as leading to a good classified the beta tester. The average time for completing the entire questionnaire was around 12 minutes. With this short investigation time, the effects of fatigue causing a distortion of the response have been reduced to a minimum.

The sample has been consisted of undergraduate and postgraduate university students enrolled in different courses, gender equally distributed, of which 90% with an average age between 23 and 26 years and the remainder between 18 and 22 years old. A target of people with this specific age range has been selected assuming a greater propensity to

use green transport modes and reduced physical problems compared to, for example, the target of elderly people (over 70's). In addition, the sample was heterogeneous as it consisted of both residents of the two cities and commuters, who live in student residence rented houses, usually spending five days a week in the two locations analyzed.

5. Results and discussion

5.1. Descriptive analysis

From the first part of the questionnaire, investigating the socio-demographic information, it has been obtained that the almost of the sample has the driving license, i.e. 94% of respondents, while the only 3% does not have it, as observable from Figure 3a. A small part of the sample, i.e. the remaining 3%, declared to have a driving license for motorbike. From Figure 3b it can be noted that a high percentage, almost 50% of the sample owns a car, while in any case a further quarter of them (i.e. around 25%) still have the availability to use a car. As for two-wheeled vehicles, the 13% of students own a motorbike, 9% a bike and only 5% that they have no means.

In the second part of the questionnaire it has been investigated the travel behavior and habits. From the analysis it emerged that over 50% of the sample travels short distances (i.e. less than 5 km), while almost a quarter of the sample travels long distances (i.e. over 25 km); the rest is distributed over intermediate distances (i.e. between 5 and 25 km) (see Fig. 3c). In addition, it was examined with regard to the use of the bicycle: 44% of the sample does not use it, while all the others have declared that they have used the bicycle in the last year, albeit with different frequency, as shown in the Figure 3d. Specifically, the 33% rarely used this means of transport, whereas it can be said that a quarter of the sample used it more frequently. This may be interesting in regard to the assessment of influencing factors.

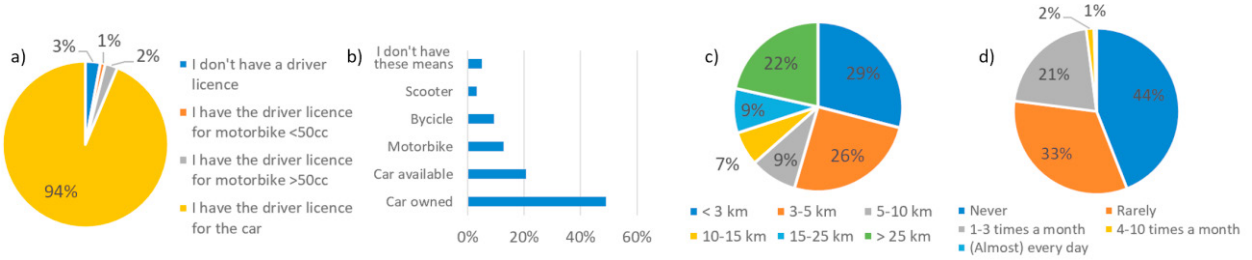

Fig. 3. Descriptive analysis results (a) Driver license; (b) Transport means ownership (c) Daily travelled distance; (d) Frequency of bike usage

5.2. Evaluation of influencing factors and students' perception

Through this investigation, it was possible to identify and analyze the factors deemed influencing in the propensity to join a bike sharing service. A preliminary classification has been made identifying encouraging and hindering factors linked to the use of the bike. Thus, by grouping these positive and negative aspects, weighted rankings associated with each of them have been obtained through the assessment of judgments by the interviewees, as reported in Table 1. In addition, in relation to bike sharing, five influencing factors have been selected, both exogenous and endogenous, in order to create a real ranking of priorities. The judgments have been expressed in applying Likert scale (i.e. 1 = not at all important, 2 = few important, 3 = indifferent, 4 = enough important, 5 = a lot important).

It can be seen from the results reported in table 1 that, in general, the encouraging factors have already been considered with lower weights since there is a lower propensity to use the bike. In fact, all these factors have obtained a score that remains below the value 3 (except one, i.e. *Bicycling helps me take care of my health*). In more detail, the factor that obtained the lowest score was the *Flexibility of departure time* and this is in any case due to the fact that the majority of the sample uses the car, already benefiting from this flexibility, thus noticing and little appreciating this advantage from the bike. The next factor in order of increasing priority was *My friends would ride a bicycle with me* because being barely used this means of transport, it is also unlikely to meet with others riding a bike. Then, almost in equal terms, there were the factors *I do not have a car, It allows me to save money* and *Availability of bike sharing system and bike rental*. In fact, in the case of not owning a car, both because of the terrain and the lack of infrastructure, the bike cannot be a real alternative to the car. As for the economic savings, not seeing the potential in the bike as an

alternative or complementary means, it is not automatically immediate to think that the bike could be used to save money. Finally, as far as bike sharing services are concerned, in Enna there are none; in Catania the bike sharing stations are not located in the key points of the city, and therefore the presence of this service is not very appreciated. With reference to the hindering factors, the negative aspects are manifold, more than the positive ones. They concern both the simple possession of the bike and both aspects related to infrastructure deficiencies and social factors. The most critical factor that emerged was the *Lack of infrastructure and safe cycle routes*, as often the connections with the bike are too long, and not having dedicated itineraries, one is not encouraged to use this means of transport. Following, there is *Sharing spaces with vehicular mobility* which generates insecurity, further strengthening the first factor just mentioned. The factors considered less discouraging concern subjective aspects, i.e. *Poor physical training* and *I have to carry something (backpack)* and even less *Afraid that someone will steal my bike.*
Finally, the influencing factors obtained higher weight values, as they have not been evaluated as encouraging, but simply influencing the propensity to use the bike and the bike sharing service. In particular, almost all of them obtained a weight above 4, or almost equal to 4 and this makes it clear that if these factors were attentive, the service worked well and the infrastructure was properly designed and maintained, then there would be a propensity to use the bike.

Table 1. Weights of encouraging and hindering factors for the use of the bike and influencing factors for bike sharing

Encouraging factors	**Weight$_{enc}$**	**Hindering factors**	**Weight$_{hin}$**	**Influencing factors**	**Weight$_{inf}$**
I do not have a car	2.80	I don't own a bicycle	3.09	The system works well	4.46
Availability of bike sharing and bike rental	2.79	Afraid that someone will steal my bike	2.81	Flexible mobility to avoid congestion situation	4.18
It allows me to save money	2.81	I have to carry something	3.15	Easily accessible parking	4.01
My friends would ride a bicycle with me	2.14	Lack of infrastructure and safe cycle routes	4.23	Not having a private vehicle available	3.96
Flexibility of departure time	1.84	Poor physical training	3.15	Trendy system	3.12
Bicycling helps me take care of my health	3.20	Sharing spaces with vehicular mobility	3.88		
		Traveling by bike takes too long	3.94		

5.3. Correlation analysis on usage patterns and adoption barriers

The correlation analysis allowed to assess the statistical dependency/independency of survey results, particularly related to the usage patterns (i.e. frequency of bike usage) and adoption barriers (i.e. infrastructural aspects), in order to understand which factors can influence the spread of a bike-sharing service in the study areas. Preliminary evaluations have been performed to evaluate how the location of the bicycle path on the sidewalk or in the carriageway and the presence of dedicated parking spaces influence the propensity of usage of bicycle. The outcomes of this first step analysis provided the base for the creation of frequency matrices and the completion of a bivariate analysis considering these infrastructural aspects in relation with two selected main variables, i.e. the gender and the travel distance (Table 2).

Table 2. Bivariate analysis: Chi-square values and p-value.

	Gender correlations				**Travel distance correlations**			
Variables	**χ^2**	**p < .01**	**p < .05**	**p < .10**	**χ^2**	**p < .01**	**p < .05**	**p < .10**
Frequency of bike usage	3.2468	.3551	.3551	.3551	41.8333	Sign.	Sign.	Sign.
Cycle path on roadway	0.3093	.9582	.9582	.9582	26.7244	Sign.	Sign.	Sign.
Cycle path on sidewalk	3.3349	.3428	.3428	.3428	19.6578	.0738	.0738	Sign.
Presence of parking systems	11.4342	Sign.	Sign.	Sign.	24.146	.01943	Sign.	Sign.
Traffic interferences (flows and speeds)	2.7356	.4342	.4342	.4342	35.2461	Sign.	Sign.	Sign.

All the analyzed correlations with gender have been characterized by three degrees of freedom, because by calculating (number of rows-1)*(number of columns -1), the gender is a dichotomous variable (i.e. male and female), whereas the other correlated variables have been grouped into four categories depending on the level of influence (i.e. null, low, medium and high influence). It can be seen a strongly dependence between gender and frequency of bike usage and also with almost all variables concerning infrastructural aspects (except the presence of parking systems). In fact, as regard the location of cycle path, through the calculation of the frequency tables, it emerged that more than half of the sample considered that the presence of a reserved cycle path influences the propensity to use the bike in a medium-high way. Specifically, about 55% of the sample declared it is important that the cycle path is located on the sidewalk, and even 81% on the roadway, consistent with the last analyzed factor relating to traffic interferences.

The second group of correlations has been referred to the travel distance during daily trips. It has been considered five different categories depending on the distance: very low (i.e. < 3km); low (i.e. 3-5 km); medium (i.e. 5-15 km); high (i.e. 15-25 km); very high (i.e. > 25 km). Thus, in relation to this main variable the degrees of freedom are twelve. Higher χ^2 values have been obtained, allowing to identify the divergence between observed and estimated data under the independence hypothesis. In this case, the acquired variables showed in some cases an independence between them. The use of the bike is not strictly influenced by the travel distance, however many other factors (e.g. lack of infrastructures) make discouraging cycling even if the distance was short. Only the cases of cycle path on sidewalk and presence of parking systems for bicycles reveled a dependency relationship with the travel distance, both for $p < .01$. All the results obtained through the implementation of these correlations are in in accordance with the Miller and Siegmund (1982), considering the relation between multi-degree of freedom and p-value.

6. Conclusion

To determine high levels of cycling in several European and Italian cities it is developing an innovative approach to public space, redistributing the weights between the various transport components and combining with a human-cantered urban planning. Various post COVID-19 strategies have been promoted by European states to build cycle infrastructures and encourage the use of cycle mobility and micro mobility. The greater attention to social distance has encouraged people to use bikes. In this view, this research aimed at analysing the factors influencing the use of bicycle and the propensity to adhere bike sharing services, with a focus on a specific target group of university students. Results from the structured questionnaire allowed the derivation of individual and aggregated priority attributes and consequently to investigate the influence of different factors affecting bike-sharing demand from a sustainable perspective (economic, social and environmental viewpoints). Detailed analysis has been performed, by segmenting the sample and a chi-squared test has been calculated to analyse several combinations of attributes and their correlation considering different probability value *p*. Aggregated results of individual attributes show an almost total convergence on the fact that the lack of dedicated infrastructures negatively affect cycling and bike-sharing usage. On the other hand, a slight increased sensitivity to environmental and social aspects was highlighted. These findings can be used as an input for delivering first appropriate policy interventions in future urban transportation strategies looking to promote and reinforce bike-sharing usage and increase cycling uptake. The paper also offers valuable guidance to mobility providers about how bike sharing businesses can prosper long-term in an environment where shared mobility schemes constitute novel socio-technical interventions.

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References

Brakewood, C., Ghahramani, N., Peters, J., Kwak, E., & Sion, J., 2017. Real-time riders: A first look at user interaction data from the back end of a transit and shared mobility smartphone app. Transportation Research Record, 2658(1), 56-63. https://doi.org/10.3141/2658-07

Bolassa 2018, https://www.rentorshare.net/bike-sharing-in-italia-tutti-i-numeri-del-2017/

Campisi T., Acampa G., Marino G., Tesoriere G., 2020. Cycling Master Plans in Italy: The I-BIM Feasibility Tool for Cost and Safety Assessments Sustainability , 12(11), 4723; https://doi.org/10.3390/su12114723

Canale, A., Tesoriere, G., & Campisi, T., 2019. The MAAS development as a mobility solution based on the individual needs of transport users. In AIP Conference Proceedings (Vol. 2186, No. 1, p. 160005). AIP Publishing LLC. https://doi.org/10.1063/1.5138073

Chevalier, A., Charlemagne, M., Xu, L. 2019. Bicycle acceptance on campus: Influence of the built environment and shared bikes, Transp. Res. Part D 76 (2019) 211e235, https://doi.org/10.1016/j.trd.2019.09.011.

Cruz, R., Bandeira, J., Vilaça, M., Rodrigues, M., Fernandes, J. M., & Coelho, M., 2020. Introducing new criteria to support cycling navigation and infrastructure planning in flat and hilly cities. *Transportation research procedia*, *47*, 75-82. https://doi.org/10.1016/j.trpro.2020.03.081

Efthymiou, D. and Antoniou, C., 2016. Modeling the propensity to join carsharing using hybrid choice models and mixed survey data, Transport Policy, 51, pp. 143-149. https://doi.org/10.1016/j.tranpol.2016.07.001

Ignaccolo, C., Giuffrida, N., & Torrisi, V., 2018. The queensway of New York city. A proposal for sustainable mobility in queens. Town and Infrastructure Planning for Safety and Urban Quality, 69–76. https://doi.org/10.1201/9781351173360-12

Ignaccolo, M., Inturri, G., Giuffrida, N., Le Pira, M., Torrisi, V., & Calabrò, G., 2020. A step towards walkable environments: spatial analysis of pedestrian compatibility in an urban context. European Transport \ Trasporti Europei, vol. 76 (6), p.1-12

Kazemzadeh, K., Camporeale, R., D'Agostino, C., Laureshyn, A., & Winslott Hiselius, L., 2020. Same questions, different answers? A hierarchical comparison of cyclists' perceptions of comfort: in-traffic vs. online approach. *Transportation Letters*, 1-9.

Klobucar, M. S., & Fricker, J. D., 2007. Network evaluation tool to improve real and perceived bicycle safety. Transportation Research Record, 2031(1), 25-33.

Likert, R., 1932. A technique for the measurement of attitudes. Arch. Psychol. 200, 1932, 140,55.

Louviere, J.J., Meyer, R.J., Bunch, D.S., Carson, R., Dellaert, B., Hanemann, W.M., Hensher, D., Irwin, J., 1999. Combining sources of preference data for modeling complex decision processes. Mark. Lett.10 (3), 205–217.Legambiente ,2017 http://www.legambientesicilia.it/

Nikiforiadis, A., & Basbas, S., 2019. Can pedestrians and cyclists share the same space? The case of a city with low cycling levels and experience. Sustainable cities and society, 46, 101453. https://doi.org/10.1016/j.scs.2019.101453

Nikiforiadis, A., Basbas, S., & Garyfalou, M. I., 2020. A methodology for the assessment of pedestrians-cyclists shared space level of service. Journal of Cleaner Production, 254, 120172. https://doi.org/10.1016/j.jclepro.2020.120172

Pawlowski, C.S., Tjørnhøj-Thomsen, T., Schipperijn, J., Troelsen, J., 2014. Barriers for recess physical activity (2014), BMC Public Health (2014) 14, 639, https://doi.org/10.1186/1471-2458-14-639.

Pogačar, K., Dežan, L., Lamot, M., & Renčelj, M., 2020. Determinants of Bicycle Use among Student Population: Exploratory Research of Social and Infrastructure Factors. Applied System Innovation, 3(1), 6. https://doi.org/10.3390/asi3010006.

Pucher, J.; Hagen, V. Walking and Cycling for Sustainable Cities. Built Environ. 2014, 18, 391–414. https://doi.org/10.2148/benv.36.4.391.

Renčelj, M., Campisi, T., Canale, A., & Tesoriere, G., 2019. The developing benefits of the advance space line (ASL) systems for planning safer traffic light intersections. In AIP Conference Proceedings (Vol. 2186, No. 1, p. 160007). AIP Publishing LLC. https://doi.org/10.1063/1.5138075

Scott, D. M., & Ciuro, C., 2019. What factors influence bike share ridership? An investigation of Hamilton, Ontario's bike share hubs. Travel behaviour and society, 16, 50-58. https://doi.org/10.1016/j.tbs.2019.04.003

Shaheen, S., Cohen, A., Chan, N., Bansal, A., 2020. Chapter 13 - Sharing strategies: carsharing, shared micromobility (bikesharing and scooter sharing), transportation network companies, microtransit, and other innovative mobility modes. Transportation, Land Use, and Environmental Planning, pp. 237-262. https://doi.org/10.1016/B978-0-12-815167-9.00013-X

Swiers, R.; Pritchard, C.; Gee, I., 2017. A cross sectional survey of attitudes, behaviours, barriers and motivators to cycling in University students. J. Transp. Health 2017, 6, 379–385. https://doi.org/10.1016/j.jth.2017.07.005

Torrisi, V., Ignaccolo, M., & Inturri, G., 2017a. Analysis of road urban transport network capacity through a dynamic assignment model: validation of different measurement methods. Transportation Research Procedia, 27, 1026–1033. https://doi.org/10.1016/j.trpro.2017.12.135

Torrisi, V., Ignaccolo, M., & Inturri, G., 2017b. Estimating travel time reliability in urban areas through a dynamic simulation model. Transportation Research Procedia, 27, 857–864. https://doi.org/10.1016/j.trpro.2017.12.134.

Torrisi, V., Ignaccolo, M., & Inturri, G., 2018a. Innovative Transport Systems to Promote Sustainable Mobility: Developing the Model Architecture of a Traffic Control and Supervisor System. Lecture Notes in Computer Science, 622–638. https://doi.org/10.1007/978-3-319-95168-3_42

Torrisi, V., Ignaccolo, M., & Inturri, G., 2018b. Toward a sustainable mobility through a dynamic real-time traffic monitoring, estimation and forecasting system: The RE.S.E.T. project. Town and Infrastructure Planning for Safety and Urban Quality - Proceedings of the 23rd International Conference on Living and Walking in Cities, LWC 2017, pp. 241–247. https://doi.org/10.1201/9781351173360-32

Torrisi V., Garau, C., Ignaccolo M., Inturri G., (in press) "Sustainable Urban Mobility Plans": key concepts and a critical revision on SUMPs guidelines" In: Gervasi O., Murgante B., Misra S., Garau C., Blecic I., Taniar D., Apduhan B. O., Rocha A. M. A. C., Tarantino E., Torre C. M., Karaca Y. (Eds.). Computational Science and Its Applications – ICCSA 2020. ICCSA 2020. Lecture Notes in Computer Science

Wood A., 2020. Tracing the absence of bike-share in Johannesburg: A case of policy mobilities and non-adoption. Journal of Transport Geography, vol. 83, 102659. https://doi.org/10.1016/j.jtrangeo.2020.102659.