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Restart: A Route Planner to Encourage the Use of Public Transport Services in a Pandemic Context

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Abstract

Public transport services play an important role in the mobility of the population in urban centers, allowing a decrease in the number of private vehicles in circulation and contributing to a more sustainable mobility. However, the emergence of the COVID-19 pandemic had a serious impact on the mobility habits of the population, with a substantial reduction in the number of public transport passengers due to the fear of contagion, which raises questions about the future sustainability of cities. Thus, it is essential to restore the confidence of travelers to feel safe and comfortable using public transport services. Taking advantage of the widespread use of mobile technologies, this article intends to propose a route planning system for public transport that meets the needs of passengers in terms of safety and comfort. After a systematic review of the existing literature and a series of focus group sessions, a prototype of the system was developed, and subsequently evaluated by potential users through usability tests. The results obtained are a good indicator of the system's functionality and ease of use. This assessment allowed us to corroborate the potential that the proposed route planning system has in promoting the use of public transport services as a means of mobility.

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1. Introduction

When it comes to urban development and improving the population's quality of life, urban mobility gains prominence. In recent years, private vehicles have become the main means of transportation to satisfy the movement needs of citizens (Baena-Toquero et al., 2014; Department for Transport Great Britain, 2019), leading to a traffic...
increase in city centers. In order to cope with the harmful effects of this practice, great efforts have been made to increase the modal shift, from private vehicles to public transport services (Dell'Asin et al., 2015).

However, the evolution of the COVID-19 pandemic, and its rapid spread throughout the world, has profound effects on the population’s lifestyle, especially concerning their mobility habits. As cities began to get out of the imposed blocks and the population resumed the activities that had been interrupted by the pandemic, changes have been observed in their mobility behaviors, with a decrease in the number of public transport trips throughout the world (Astroza et al., 2020). For example, this reduction was over 70% in the cases of India and the United Kingdom, and over 80% in the case of Italy (Tirachini and Cats, 2020). This sharp reduction in the use of public transport raised several questions about the future sustainability of mobility in cities. However, people's return to public transport services will only happen whenever they feel safe using them again (Marion Terrill, 2020).

The promotion of public transportation by making information available to travelers supports their perceptions of personal safety and comfort while traveling, playing these factors a vital role in the acceptance of the use of public transportation as a means of mobility (Pangbourne and Beecroft, 2015). The provision of information to travelers through route planning systems aims to help travelers find the best route to travel between a certain origin and destination (Herzog et al., 2017). The main factors taken into account by route planners in determining the best route are time, distance and cost (Baena-Toquero et al., 2014). However, considering the current pandemic situation, it is important that route planners meet the current needs of passengers, accounting for safety and comfort requirements, thus contributing to the restoration of confidence in using public transport services.

This paper aims to fill this gap by proposing a route planner that promote safety and comfort when using public transport services. It begins by presenting a literature review to understand the factors that influence perceptions of safety and comfort when travelling by public transport. Then, the development of the proposed solution was based on a User Centered Design approach combined with a Spiral Model methodology, with focus group sessions being organized to understand the needs of citizens, and usability tests were carried out to evaluate the developed prototype.

2. Related work

2.1. Safety and comfort when using public transport

Safety in the use of public transport can be described by the combination of 3 factors: safety against crime, safety against accidents and trust (Joewono and Kubota, 2006; Beecroft and Pangbourne, 2015). Protection against crimes is responsible for issues related to freedom from threats from other people, such as situations of violence, theft, or terrorism. Accident safety refers to the issues of impacts, whether related to injuries related to infrastructures or accidents with vehicles. Trust is responsible for personal affective issues, they are related to objective questions about an individual's knowledge and experience about how to travel on public transport and to subjective issues, such as the ability and self-confidence to make that same trip (Beecroft and Pangbourne, 2015). Individual factors also play an important role in defining the perception of personal security (Fyhri and Backer-Grondahl, 2012). The characteristics of the areas where individuals access public transport vehicles and the walking times to get to them have a significant relationship with the perception of safety in the use of public transport as the long periods of access can expose travelers to the vulnerability of the external environment, which can bring them feelings of insecurity (Shiwakoti et al., 2019).

Comfort on public transport travel is increasingly seen as crucial to the quality of service provided by transport systems. Studies reveal that agglomeration is the factor that most affects comfort during a trip, however, there are other important factors, such as air quality, temperature, odor and ambient noise (Wang and Zacharias, 2020).

2.2. Habits of using public transport

Making transport choices requires the traveler to balance his travel decisions with the resources available. Travel decisions are influenced by the traveler’s personal resources, these include not only the availability of time and money, but also the amounts of physical, cognitive and affective effort that may be required (Stradling, 2002). Demographic characteristics, the purpose of the trip, as well as the spatial distribution of destinations are some of the factors that influence the choice of transport (Elias and Shiftan, 2012). Passengers choose public transport as a means of transport if it offers travel time that, within their needs, allows them to reach their destination, with or without resorting to
transfers, or hiking, or when there is no other transport alternative (Ceder, 2004). The main factors indicated by the population for not using public transport as a means of transport were very long travel time, the destination was not covered by public transport services, low frequency of service, long walking time to a public transport stop and the need for service exchanges (Shiwakoti et al., 2019).

2.3. Route planning on public transport

A route planning system is a powerful tool in assisting navigation in urban areas (Santos et al., 2018). One of the main premises adopted to suggest the best route are the factors of time, distance or cost, however, these may not be sufficient to satisfy the needs of travelers (Baena-Toquero et al., 2014), and may even present suggestions that affect certain users, such as staying in unsafe or highly polluted areas, resulting in negative experiences (Santos et al., 2018).

Route planners should consider the profile and needs of users, the different types of public transport available and the problems related to mobility in the areas where citizens travel (Baena-Toquero et al., 2014). Giving travelers more information can generate greater interest in the use of public transport and can help to look at mobility from another perspective. Values such as comfort, vehicle arrival time, weather conditions, delays, safety conditions are some examples of factors that must be considered when looking for the ideal route (Baena-Toquero et al., 2014).

The integration of different public transport services in the same route planner, allows users to obtain information about transferring between different modes of transport in a more comfortable, pleasant, and less stressful way. Each transport has its strengths and weaknesses, so the combination of the different modes offers the planner more flexible and efficient solutions (Ismail and Said, 2014). The availability of information in real time is also a valuable resource when providing information to users of route planners, making it possible to notify travelers of the actual situation of the public transport vehicle, making it possible, for example, to provide information on delays, changes in timetables or traffic conditions (Ceder, 2004; Baena-Toquero et al., 2014).

3. Research approach

The definition of the proposed route planning system was based on the User Centered Design process, which is a collection of methods focused on the assessment of user needs and goals, integrating the concepts of usability, user experience and accessibility (Gulliksen et al., 2003). This approach has been combined with a Spiral Model methodology in the software development lifecycle process (Boehm, 1988), which suggests an iterative process that allows progress to be repeatedly checked and evaluated.

In this way, the first stage consisted of conducting a set of discussion group sessions with public transport passengers. The understanding obtained from the literature review was reinforced by the results of the group sessions, leading to the definition of the requirements and functionalities of the system. This process was the starting point for the development of a prototype of the route planner's mobile application, using the Proto.io tool. To validate the concept and evaluate the developed prototype, usability tests with potential users were performed.

3.1. Focus group

To understand and identify the needs of public transport passengers and the factors that would lead the population to regain confidence in the use of public transport services, discussion group sessions were held with public transport passengers. In aggregate, two focus group sessions were held, via Zoom, bringing together a total of 7 participants, 4 in the first session and 3 in the second, each lasting approximately 60 minutes. The sessions were held after the second wave of the COVID-19 pandemic and participants were recruited by convenience. The sessions were recorded, with the consent of the participants, and analyzed according to qualitative methods (Charmaz, 2006). All participants were informed about the study's aims and signed an informed consent form. The discussion groups were combined with the application of a questionnaire, to obtain a sociodemographic characterization of the sample.

During the discussion sessions, participants were asked about the factors that contribute to their perception of comfort and safety when using public transport services, how the emergence of the COVID-19 pandemic affected their mobility habits and the factors that would lead them to regain confidence in the use of public transport. Finally,
participants were asked to express their opinion on the role of providing information in improving the travel experience and to identify what information they consider important to be made available to travelers.

Participants are aged between 20 and 40 years. The majority (4 out of 7) reported that before the outbreak of the COVID-19 pandemic, they used public transport services daily, while the rest (3 out of 7) used it only frequently (1x a week). All participants reported using buses and light rail as a means of public transport and of these 3 also used trains. However, with the onset of the pandemic, their mobility habits have changed, and currently, 3 out of 7 participants use public transport services occasionally (1x per month), 2 in 7 use it rarely (1x per year), 1 in 7 use it with frequency (1x a week) and 1 in 7 does not use it. The means of transport used also changed, with 3 participants currently using the bus and 1 using the metro.

3.2. Usability testing

In order to evaluate the developed prototype and validate the proposed route planner concept, usability tests were carried out with potential users, aiming at analyzing the users' navigation in the prototype, understand their perception about the concept and to identify potential improvements. According to Virzi (Virzi, 1992), the performance of usability tests with at least 5 participants is, in most cases, sufficient to identify 80% of the usability problems of an interface. In this sense, six participants, aged between 20 and 30 years old, users of public transport services, participated in the usability tests. Half of these participants (3 out of 6) had already participated in the focus group sessions. Each of the test sessions lasted approximately 45 minutes. The screen where the tasks were performed was recorded, with the consent of the participants, for further analysis.

The usability tests were composed of a pre-test questionnaire, a post-task classification, and a post-test questionnaire. The pre-test questionnaire was used to characterize the sample and understand the mobility habits and their familiarity with smartphones. During the testing phase, participants were asked to perform 13 pre-defined tasks in the prototype, to assess its usability. Participants were encouraged to describe their reasoning out loud during its execution. At the end of each task, participants were asked to rate the ease of its execution, using a 5-point Likert scale, ranging from "very difficult" to "very easy". After completing all the tasks, the participants also answered a questionnaire composed of 7 open questions, to understand the general perception in relation to the prototype, the aspects they consider most valuable, the main problems detected, how they interpret the collaborative exchange information during the travels and their suggestions on possible improvements to the system. In this phase, the participants also classified 9 statements, on a 5-point scale from “Totally disagree” to “Totally agree”.

4. Proposed route planner solution

Taking advantage of the widespread use of mobile devices connected to ubiquitous communication networks, we propose a route planning platform, called Restart, materialized in the form of a mobile application, whose main objective is to promote the use of public transport services as a means of mobility.

4.1. Understanding the needs

Analysis of the content of the data generated in the sessions of the discussion groups allowed to perceive that all participants consider that the main factors that influence their perception of safety and comfort when traveling on public transport are related to noise, capacity, cleanliness, and ventilation of vehicles. The uncertainty regarding departure times, long waiting periods, traffic on the route and access routes to poorly lit stations are associated with negative experiences in the use of public transport services, being correlated with feelings of discomfort and insecurity.

The COVID-19 pandemic led to a change in the mobility habits of all participants in the discussion group. Most participants also stated that before the emergence of the COVID-19 pandemic, they did not consider other transport options besides public transport services, as it was cheaper and more convenient, however, given the current pandemic situation, and influenced by the fear of contagion, the majority of participants, 85.7%, mentioned that they started using other modes of transport such as private vehicles and private passenger transport services. Although the factors influencing the perception of comfort and safety have not changed much with the pandemic, they have gained greater importance, contributing to the choice of alternative means of transport to public transport.
Participants who report that they have stopped using public transport services, consider that the availability of travel information on public transport positively influences a modal transition in favor of these. Participants suggested ideas for information that should be made available to travelers, including information on the capacity, hygiene and ventilation of vehicles and information about the characteristics of the areas where the public transport stations are located, as well as the walking-time to these. Real-time information on the times of upcoming vehicle departures, the state of operation of lines and stations and the state of traffic on the route were considered to be extremely relevant information for travelers. Participants also state that they would like to be able to receive information about changes in the routes they travel on and warnings about the approach of vehicles to the stations where they are going to start their journey, thus being able to reduce waiting times at them.

4.2. Restart application

The development of the proposed system was based on the requirements elicitation of public transport passengers through knowledge from the literature and reinforced by the results of the sessions of discussion groups held. Therefore, the Restart application meets the current needs of passengers, taking into account safety and comfort requirements in route suggestions and going beyond conventional solutions.

The platform is based on wireless mobile communication technologies (3G, 4G and Wi-Fi) and location providers (GPS and network triangulation) embedded in its users' mobile devices. From the geo-referenced dynamic data provided by public transport operators and collected by the various sensors scattered on the network, the proposed platform provides information in real time, in a 30-minute time window, so that its users can plan their trips based on real data. As a way of increasing the relevance of the information made available and allowing updates on the network in a timely manner, users are included in a process of collaborative exchange of information with the system.

The various passengers scattered throughout the public transport network have a unique view of events as they unfold, which can generate useful information for other travelers. Therefore, users of the Restart application are asked to contribute with information regarding aspects grouped in predefined categories on the transport network, namely related to safety and comfort characteristics, being subsequently awarded for the reliability of the information shared. When real-time data are not available or when the time window is longer than 30 minutes, published information from the service history is used. Some of the main features implemented in the proposed solution are presented in Fig. 1.

For the planning of a trip, the user must indicate the origin and destination, and can also choose safety and comfort criteria, such as the level of vehicle capacity on the route, if the trip involves changing vehicles, walking or poorly lit places and traffic along the route, as shown in the screen in Fig. 1a). After defining the trip parameters, the system presents different route options. The screen in Fig. 1b) shows an overview of the characteristics of one of the route suggestions for the trip, where the user can have a perception of the journey's route, the schedules and the characteristics of the safety and comfort of the vehicles to be used in the route. From the route suggestions presented, the user must choose the one that best suits his preferences and indicate that he wants to start his journey.

When checking in to a vehicle, the user is asked to provide information to the system. The sending of information allows travelers to share data related to aspects grouped in predefined categories about the vehicle they are in, being sent to the system with the user's spatio-temporal association. The screen in Fig. 1c) shows the different categories to which the traveler can contribute with information, including: levels of agglomeration, cleanliness and ventilation of the vehicle, driving skills of the driver and alerts or problems that affect the service.

During the journey, the user can follow the stations along the route, being warned, through an alert, when the alight station is approaching. When the user leaves the vehicle, the system must register the exit, which can again be done automatically or manually, such as checking in a vehicle.

The screen in Fig. 1d) shows the list of trips scheduled by the user. When the user plans a trip with a departure time different from the day/time of the day on which the planning is carried out, that trip is saved in the list of scheduled trips. In this screen the user can consult information about his scheduled routes, set alerts, and even change the requirements or the time of the same. When the departure time of one of the routes scheduled by the user approaches, he is notified, by means of notifications, so that he can start the trip and receive information of his entire route.

In the user profile, the user can configure his profile, being able to consult the points accumulated by the collaborative information exchange system and claim rewards. Finally, the system sends notifications about new relevant information while the mobile application is running in the background.
Fig. 1. Route planner system screens (a) definition of travel requirements; (b) view journey info; (c) submit vehicle information; (d) scheduled trips.

5. Evaluation results

The results of the evaluation of the Restart prototype show that most of the participants classified the tasks as easy to interact, presenting an average of 4.7 out of 5. Table 1 summarizes the results of the post-task questionnaire, showing for each task performed the average rate provided by the participants and the average time of completion of each task.

Table 1. Average time and average rate per task.

| Tasks                                      | Avg. Time (s) | Avg. Rate |
|--------------------------------------------|---------------|-----------|
| T1  Plan a journey to start right now      | 11.2          | 4.8       |
| T2  Define travel requirements             | 30.8          | 4.2       |
| T3  Choose the route for your trip from the route suggestions shows | 39.8 | 4.7 |
| T4  Choose the vehicle for the trip between the next departures | 13.8 | 4.5 |
| T5  Share system information about a station | 13.7          | 4.3       |
| T6  Share system information about a vehicle | 7.6           | 4.5       |
| T7  Share system information about a walk along the route | 7.7 | 4.5 |
| T8  Consult information about upcoming departures at a given station | 13.3 | 4.7 |
| T9  Query information about a given line  | 14.8          | 4.8       |
| T10 Check information about a given line | 5.1           | 5         |
| T11 Change the departure time for a scheduled trip | 11.7 | 4.5 |
| T12 Enable notification about the approach of the chosen vehicle for the planned trip to a certain station on the route | 6.2 | 4.7 |
| T13 Start a schedule trip                  | 2.7           | 4.7       |

Task T10 was perceived by the participants as the easiest task to perform, with all participants classifying it with a score of 5 out of 5. Task T2, was the task with the lowest rating, 4.2 out of 5. Participants justified this result with the difficulty of interpreting the icons used in the vehicle capacity, preferring to define this parameter based on the selection of the range of people inside the vehicle. Regarding the remaining requirements definition options, the participants considered that they fit their needs and that they were easy to understand. Despite the lower classification in terms of ease of use, the definition of travel requirements was considered by the participants as one of the most relevant features of the system. According to the results of the usability tests, all participants were able to perform the 13 tasks requested in full, with no errors found during their execution. The results obtained are a good indicator of the ease of use of the proposed system and the absence of major usability problems.
The availability of information in real time on different aspects of travel, including parameters associated with safety and comfort, was considered by the participants as a differentiating factor of this mobile application compared to others available on the market, and the main motivation for its use in the future. The possibility of receiving notifications about changes in the route, approaching vehicles to a certain station or to a point on the route, was considered one of the most relevant points. The travel scheduling functionality was also valued. The collaborative exchange of information between was understood as essential for travelers to be able to obtain information about the real state of the public transport network. The incentive mechanism, through the accumulation of points associated with the user profile, was considered by most participants a stimulus for collaboration. However, they considered that the value perceived by the availability of information in real time, obtained through the contributions of other travelers, would make them participate in the collaborative exchange of information even without the existence of associated rewards. During the testing session, participants contributed with important insights for improving the system, among which stand out the provision of information on travel prices and the connection with a mobile ticketing application. Participants also suggested the possibility of planning a trip for different days of the week and different.

All participants stated that using the proposed route planner would improve their travel experience on public transport services, giving them tools for safer and more comfortable travel choices and that the information provided meets their needs current. Finally, the results of the post-test questionnaire show that all participants found the system useful and intended to use this mobile application frequently (see Fig. 2). In addition, the usefulness of the system and the concept behind it became clear among the participants.

Fig. 2. Post-test questionnaire results.

6. Conclusion

This article proposes a route planning system that promotes safety and comfort in the use of public transport services. In the first phase, this work aimed to identify the needs of public transport passengers. As such, a review of existing literature and focus group sessions with public transport passengers were carried out. This step allowed us to understand and identify the main concerns of passengers when traveling on public transport and the factors that contribute to feeling safe and comfortable using them. The results show that the level of capacity, cleanliness, and ventilation of vehicles are the main factors influencing the perception of comfort in the use of public transport, while the perception of safety is mainly influenced by the characteristics of the access areas to public transport stations, by the level of capacity of the vehicles and the waiting time for their arrival.

Based on this understanding, a set of requirements and functionalities for the development of the proposed route planning system was defined. The solution presented is materialized in the form of a mobile application, called Restart, which offers its users resources for planning trips, consulting information about lines and stations, and scheduling trips. The system is based on wireless mobile communication technologies and location providers embedded in its users’ mobile devices and assumes a collaborative exchange of information between travelers and the system, as a way to increase the relevance of the information provided. In addition to the conventional criteria of time, cost and distance, the proposed system provides its users with information on the level of capacity, cleaning, sanitation and ventilation status of the vehicles, as well as traffic and incidents alerts on the route. In addition to information about the vehicles, information about the characteristics of the access roads to the stations is displayed. Making this information available
to the traveler helps them make informed travel decisions and choose safer and more comfortable routes, allowing users to tailor their journeys according to their preferences and needs.

The proposed solution was evaluated by potential users, through usability tests. The results obtained are a good indicator of the system's functionality and ease of use. The availability of real-time information on different aspects of the trip, including parameters associated with safety and comfort, was considered by the participants as a differentiating factor of this mobile application over others available on the market and the main motivation for its future use. Furthermore, the usefulness of the system and the concept behind it were clear to the participants. The results also show that the proposed solution addresses the main safety and comfort concerns of travelers when using public transport as a means of mobility during the current pandemic situation.

However, the exploratory nature of the study and the small sample used in focus group sessions can be seen as a limitation to the work presented. Despite this, the results obtained are a motivation to continue the work on this concept and a confirmation of the potential of this application and the influence it can have in promoting mobility using public transport services, thus, as future work, it is intended to improve the proposed solution based on the results of the assessment procedure and include the general population and transport specialists in the assessment of the system.

References
Astroza, S., Tirachini, A., Hurtubia, R., Carrasco, J., Guevara, A., Munizaga, M., Figueroa, M., Torres, V., 2020. Mobility Changes, Teleworking, and Remote Communication during the COVID-19 Pandemic in Chile. Transp. Find. https://doi.org/10.32866/001c.13489
Baena-Toquero, M.J., Muros-Cobos, J.L., Rodriguez-Valenzuela, S., Holgado-Terriza, J.A., 2014. Towards sustainability in multi-modal urban planners, in: 2014 International Conference on Connected Vehicles and Expo, ICCVE 2014 - Proceedings. Software Engineering Department, University of Granada, Granada, Spain, pp. 492–497. https://doi.org/10.1109/ICCVE.2014.7297595
Beecroft, M., Pangbourne, K., 2015. Future prospects for personal security in travel by public transport. Transp. Plan. Technol. 38, 131–148.
Boehm, B.W., 1988. A spiral model of software development and enhancement. Computer (Long. Beach. Calif). 21, 61–72.
Ceder, A., 2004. New urban public transportation systems: Initiatives, effectiveness, and challenges. J. Urban Plan. Dev. 130, 56–65.
Charmaz, K., 2006. Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis, in: Introducing Qualitative Methods.
Dell'Asin, G., Monzón, A., Lopez-Lambas, M.E., 2015. Key quality factors at urban interchanges. Proc. Inst. Civ. Eng. Transp. 168, 326–335.
Department for Transport Great Britain, 2019. Transport Statistics Great Britain 2019.
Elias, W., Shiftan, Y., 2012. The influence of individual’s risk perception and attitudes on travel behavior. Transp. Res. Part A Policy Pract. 46, 1241–1251. https://doi.org/10.1016/j.tra.2012.05.013
Fyhri, A., Backer-Grondahl, A., 2012. Personality and risk perception in transport. Accid. Anal. Prev. 49, 470–475.
Gulliksen, J., Gåransson, B., Boivie, I., Blomkvist, S., Persson, C., Cajander, Å., 2003. Key Principles for User-Centred Systems Design. Behav. IT 22, 397–409. https://doi.org/10.1080/01449290310001624329
Herzog, D., Massoud, H., Wörndl, W., 2017. RouteMe: A Mobile Recommender System for Personalized, Multi-Modal Route Planning.
Ismail, M.A., Said, M.N., 2014. Integration of geospatial multi-mode transportation systems in Kuala Lumpur, in: IOP Conference Series: Earth and Environmental Science. Department of Geoinformation, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor, Malaysia. https://doi.org/10.1088/1755-1315/20/1/012027
Joweno, T.B., Kubota, H., 2006. Safety and Security Improvement in Public Transportation Based on Public Perception in Developing Countries. IATSS Res. 30, 86–100. https://doi.org/10.1080/01449290310001624329
Marion Terrill, 2020. Shame about the cars, but Premier is right to be cautious about public transport [WWW Document]. Sydney Morning Her. URL https://www.smh.com.au/politics/nsw/shame-about-the-cars-but-premier-is-right-to-be-cautious-about-public-transport-20200518-p54txr.html (accessed 1.1.21).
Pangbourne, K., Beecroft, M., 2015. Personal security in travel by public transport: The role of traveller information and associated technologies. IET Intell. Transp. Syst. 9, 167–174. https://doi.org/10.1049/iet-its.2013.0166
Santos, F.A., Rodrigues, D.O., Silva, T.H., Loureiro, A.A.F., Pazzi, R.W., Villas, L.A., 2018. Context-Aware Vehicle Route Recommendation Platform: Exploring Open and Crowdsourced Data, in: IEEE International Conference on Communications. Institute of Computing, University of Campinas, Campinas, SP, Brazil. https://doi.org/10.1109/ICC.2018.8422972
Shiwakoti, N., Stasinopoulos, P., Vincic, P., Qian, W., Hafsar, R., 2019. Exploring how perceptive differences impact the current public transport usage and support for future public transport extension and usage: A case study of Melbourne’s tramline extension. Transp. Policy 84, 12–23.
Stradling, S.G., 2002. Transport user needs and marketing public transport. Proc. Inst. Civ. Eng. Munic. Eng. 151, 23–28.
Tirachini, A., Cats, O., 2020. COVID-19 and Public Transportation: Current Assessment, Prospects, and Research Needs. J. Public Transp. 22.
Virzi, R.A., 1992. Refining the Test Phase of Usability Evaluation: How Many Subjects Is Enough? Hum. Factors 34, 457–468.
Wang, B., Zacharias, J., 2020. Noise, odor and passenger density in perceived crowding in public transport. Transp. Res. Part A Policy Pract. 135, 215–223.