



Towards a Multi-modal Transportation Scenario: An Analysis About Elderly Needs

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Abstract. For the elderly the use of public transportation services represents a central need, not only from an economic point of view, especially for the most disadvantages social classes, but also from a social perspective, since it creates social relations. However the elderly have several needs in their travel experience, deriving mainly from their psychophysical problems. In this scenario, to improve the travel experience of the elderly it is necessary to adopt an inclusive design approach, in which the different categories of people are considered as a resource for a more accommodating design.

In this paper, the authors present a research on the design of multi-modal transport services with a focus on the interactions of the elderly with the digital services provided by the transport companies. Starting from the analysis of academic studies in this specific field, the authors present the results of an empirical survey. It has been conducted with the aim to identify the elderly needs, to define the elements that can improve their travel experience and to define those characteristics that allow to create more usable, accessible and sustainable interactive services. From this survey different types of needs emerge. They can be considered as requirements and consequent system features for potential digital services based on the elderly needs.

Keywords: Public transport services · Elderly · Inclusive design approach

1 Introduction

The present study is part of a larger research about the smart city suitability to elderly needs, especially in the use of public transport services.

More specifically, it constitutes the following step of a previous study [1] oriented to examine the design of public transport services fitting different user categories, with a focus on the interactions between elderly and digital services. Starting from that theoretic analysis, the authors have conducted an empirical research about elderly needs in public transport by referring to a larger travel experience scenario.

As emerged by the previous study, better services can be implemented by adopting inclusive design approaches. In particular, thanks to the adoption of inclusive design processes, the different categories of people are considered as a resource for a more accommodating design and the designers are encouraged to realize solutions that really

are easy to use for all citizens. In this way, taking into account the user experience of elderly for creating transport services suited for all can bring effective benefits even for the others travellers, as they can experience the same problems as permanent or temporary issues at some point in their life.

Moreover, it is due to consider that there are different physical or digital impediments that can arise during the various phases of the interaction between people and transport services that can cause the social exclusion of the most vulnerable groups in terms of access to the services available within the city. For example, the difficulty in using digital devices, or in hearing and understanding audio infomobility announcement, but also in transporting heavy or bulky objects (such as a suitcase or a stroller), etc. Then, it is important to include the needs of different segments of the population in the design of services, so as to reduce social inequalities in terms of access to those services. Indeed, in this way the whole society can benefit of a more vibrant and varied urban environment made liveable and accessible thanks to effective, efficient and pleasant city services.

Starting from this premise, the empirical study presented into this paper puts a particular focus on the elderly needs in public transportation services, as it appears fundamental in order to assure a better quality of life for the entire city. This becomes especially evident if considering the shift of city transportation services towards a multi-modal and “mobility as a service” (MaaS) scenario [2]. According to the insights derived from the previous theoretic study, the issues to consider in designing an adequate travel experience for elderly are the usability and accessibility of digital services, the active involvement of the elderly in the design process, the focus on the whole travel experience (not only on a single step of it) and on the design of solutions that fit different users needs, without stigmatizing or discriminating anyone. Starting from these insights, in this paper the authors present the results of the empirical study about elderly needs in public transport services within a multi-modal transportation scenario. The study has directly involved elderly during the design process, in order to create more usable, accessible and sustainable travel experiences.

In detail, in the first section the authors describe the main factors that influence the elderly use of mobility services, especially of the public transport services. In the second one they identify the elderly needs related to the travel context by gathering them from the academic studies on the topic. In the third section they describe the methodological approach and the main results of the empirical survey. Then, the effects on the design of a multi-modal transportation solution suiting a wide range of travellers, included elderly, are discussed in section four. Finally, in the conclusion the authors state further steps for the creation of inclusive travel services.

2 Elderly Needs in the Use of Transport Services

With ageing, older people change their mobility habits. In fact, the use of public transportation services becomes a fundamental way for participating in social activities and for maintaining relationships, especially for the most disadvantaged social classes [3]. However, elderly make fewer trips than other categories of travellers, as by retiring

they have less need to move daily. Moreover, since their needs change, they are led to change their usual means of transport, too.

These aspects are confirmed by the research conducted by ISTAT, i.e. the Italian National Institute of Statistics, in the 65–74 age group [4]. From these data emerge how, with ageing, the people's preferences towards the use of trains and buses increase, even if they use them sporadically during the year. These data also suggest that elderly people do a more occasional use of means of transport, especially of the suburban ones compared to the urban ones. In this sense, elderly people are less familiar with the exploration of unknown places. So, it can be assumed that they need more information for organizing a trip and for effectively moving towards their destinations. In details, the data collected by ISTAT in 2017 showed that the 55.4% of people belonging to the 65–74 age group is satisfied of the trains services and the 51.4% of the buses services. On the other hand, the main factors that cause the dissatisfaction of elderly people are the cleanliness, especially for the trains (only the 38.6% is satisfied) and the lack of comfort during waiting times at stops, especially for buses (only the 45.4% is satisfied). In effect, these two factors can be both connected to the need of elderly for comfort during the travel, that seems to have an important impact on the use of public transport means. In this sense, also the delivery of more and better information can help to make the travel more comfortable, as it permit to the elderly people to better orient themselves and feel more safe.

As a consequence, by improving this aspect, it will be easier for elderly to reach their destinations and access to different transport services. In the end, this leads to an overall improvement of the whole travel experience.

3 Related Works

Most of the elderly needs derives from their psychophysical problems and the resulting restricted mobility. But there are specific issues that influence their behaviours in the different contexts of their life. In details, the main academic research areas about mobility for the elderly concern essentially two aspects: on the one hand the factors, especially the critical conditions, that influence the behaviour of the elderly, and on the other hand the interactive systems properly suiting the elderly's informative needs. Both these research lines are interested in the role of technology as a means to simplify the elderly experience with the public transport. This is evident especially for the second one. Regarding the first one, the focus is mainly on the categorization of the variables that influence the elderly behaviours. For example, Sungyop e Ulfarsson [5] propose a model consisting of five groups of variables: personal, family, neighborhood, travel, information. With the same purpose, Haustein [6] identifies some subcategories of this age group, proposing a segmentation based on living condition, level of disability, financial resources, and social relationships. In details, from each of these subcategory he derives specific needs that characterize the different target groups. The main aim of these researchers is often to highlight the critical aspects of the public transport system that reduce the user-friendliness of the means and disincentive their use. In this regard, Holley-Moore and Creighton [7] draw the attention to the excessive number of tickets that the elderly must preserve in the multimodal journeys. In effect,

also the features of the means of transport often are not suited to the the physical condition of elderly travellers. In this sense, Broome, McKenna, Fleming and Worrall [8] point out how the unsuitability of a bus can penalize elderly people having health problems or disability. In details, they identify three specific variables from which it is possible to find specific disadvantages that combine the decline of people's psychophysical abilities with the inappropriateness of the bus: personal factors that concern the specific traveller, contextual factors that include the aim to be achieved, and the relational factors that put in connection the personal issues with the surrounding environment.

Consistent with all these matters, the second aforementioned research area refer to the informative needs which affect the elderly experience with the public means of transport. Most of the studies in this field consider this specific category of needs in respect of the different stages of a trip. For instance, Farag and Lyon [9] analyze the various information needs related to the planning of the travel. According to their study, the seniors research information especially through a face-to-face interaction. Indeed, the use of connected devices is not so frequent in the trip planning, because most of the elderly is not at ease with the use of technologies. In fact, their most recurring interaction in this sense is requesting assistance through the customer support telephone number. It is also because the direct interaction with a human operator reassured the elderly people, despite the difficulties to correctly listen to the information (since hearing problems) and to memorize it. With reference to the information about the departure times of the means of transport, Farag and Lyon [9] highlight how the consultation of printed timetables can result easier for elderly, even if doubts remain about their accuracy. Such information is especially needed to consent to the elderly to better orienting themselves in unknown urban spaces, where significant cognitive accessibility problems are likely to emerge. In this sense, giving them recurring feedback about the compliance with the planned itinerary can reduce their anxiety while travelling [10].

Technologies located on board or near the bus stop greatly affect the elderly travel experience. Holley-Moore and Creighton [7] underline the importance of having information systems on board. They pay particular attention to the benefits of visual and acoustic information, especially for those who have orientation and sensory problems.

However, in order to be effectively useful, technological devices on board must be designed by putting special attention to meet the elderly travellers' needs, especially if these devices are the only available information source. In this regard, according to the Universal Design approach [11], elements such as volume of the sensors, display dimensions, physical characteristics of the devices, etc. should take into account elderly needs, in order not to cause them troubles. In fact, as stated by Hjorthol [12], the difficulties they could encounter can provoke fear and nervousness moments, produced by the lower perception of control over the context, especially when they are on board. At this regard, Bekiaris, Panou and Mousadakou [13] conducted a study which emphasizes the importance to consider the aspects related to the accessibility of these systems. These authors affirm that in designing digital devices, such as interactive totems or electronic information panels, more and more attention needs to be given to

several elements: lighting, weight, physical conformation of the device, interface (color, text character, etc.), sound and tactile feedbacks, voice users interaction, and location.

Also Waara and Stahl [14] conducted an analysis on these aspects, focusing on the informational needs of elderly before the trip. Among them, they report, for example, the need to receive information regarding the cost of the trip, the possibility to choose the seats and to select paths with a few sections on foot.

Finally, the state of the art shows that in the design of technological solutions, elderly needs must be considered both at the software (the usability of the interface) and hardware level (the device shape). Moreover, the provided considerations confirm that taking into consideration the needs of the elderly can also improve the user experience of all users.

4 The Empirical Survey

The aim of our empirical study was to focus on specific elderly needs in public transport services. This paragraph shows the methodological approach we followed and the main outcomes of the conducted study.

4.1 Methodological Approach

The empirical study was carried out through qualitative interviews. This choice is justified by the importance to explore in depth thoughts and needs of the respondents. In particular, we carried out seven interviews to participants with the following characteristics:

- aged over 65;
- having a middle/high school diploma;
- moving on short-medium distances at least once every three months, mainly to take part in specific events;
- having low familiarity with technologies.

One moderator and one observer took part in each interview. The latter consists in five sections:

- an introduction showing the aim of the research;
- shift habits analysis, focusing on motivations and frequency of moving;
- travel related aspects analysis, focusing on the services during the different stages of the travel;
- technologies employed during the different stages;
- identification of the main user needs.

The next paragraph, which summarizes the main outcomes of the empirical survey, will reflect this organization.

4.2 Survey Outcomes

This paragraph will focus on the most important elements emerged from the survey. It should not be considered as an exhaustive content, since specific and particular elements are not completely investigated. Its aim is to give a general overview on behaviours and approaches of elderly in the investigated fields related to the multi-modal transportation scenario. It has to be considered strictly connected to the discussion section, in which indications on how these results influence the design of technical solutions are identified.

Shift Habits

The economic convenience, the calm moving, and the exhaustiveness of information are the most important elements influencing the choice of the transportation means by the elderly.

Generally, elderly move towards known destinations (related to administrative practices or linked to leisure activities), making mainly short or medium-distance trips. They use public means of transportation, with a multi-modal scheme: the motivation is not only related to economic issues, but also to the possibility to carry out other activities during the trip. Individual means represent an alternative marginally taken into consideration, due to the concern for parking the car and for the possible lack of orientation. Moreover, none of the participants use sharing and sustainable means (e.g.: car sharing, bike sharing, bicycle, etc.). Finally, the choice to take a walking path depends on the physical problems of the participants: in the best cases, they also travel half a kilometer (even enjoying the offered view).

The most frequently perceived problems during the trip are not only the ones related to the infrastructure (also connected to their physical condition, e.g.: the lack of comfortable seats), but also those related to the waiting times for public transport. These problems are considered more serious if satisfactory information on the arrival of the vehicles lacking or it is not updated.

During the trip planning, elderly find information through web channels (mainly on the website of the structure they will be visiting, but also on the websites of transport companies or through “cross-cutting” tools such as Google Maps) and paper tools (e.g.: paper maps). In case of long distance journeys, they prefer to rely on specialized agencies. However, during the trip they do not prefer acquire information from digital tools but by having a face to face contact (e.g.: with the crew or other passengers), which represents the main reference for the older passengers.

Travel Habits

In case of touristic journeys, information required by elderly does not refer only to the transportation means, but also to accommodation facilities and the specific points of interest to visit. Generally they are helped by travel agencies, which support them in searching and booking trip and structures and which provide them informative material and tickets. These activities are integrated with an autonomous research activity, which aims at evaluating the booked facilities, by going to the websites of the facilities or using evaluation services provided by other users (even if they do not have a high trust in other people).

Some people are totally autonomous in choosing and booking these services: they rely on the web channels, very often completing the reservation by making a phone call to the structures or by sending them an e-mail.

Before starting the journey, people find information related to the points of interest to be visited. In order to complete this task, they use paper guides, often integrated with information from travel websites and blogs, and pin information on a personal agenda or on a map. Usually the itinerary is not strictly defined, even if they think when and how to visit the various points of interest.

None of the participants shares photos, experiences, evaluations on the carried out trip after its conclusion; they simply save their materials on personal devices.

Use of Digital Technologies

The use of technologies by the elderly depends on the age: the greater the age, the lower their use. Generally, the use of digital technologies is more frequent during the trip planning phase, whereas during the trip the use of personal or non-personal digital technologies is low.

In the trip planning phase, elderly use desktop computers in order to find useful information, combining it with the material provided by travel agencies.

During the trip, elderly use devices available on their path (for example electronic displays and auditory technologies). People who own a mobile device, use it, for example to access mobile applications to orientate in the space, to get information on the points of interest or for entertainment goals.

Considering the payment methods, on the one hand, the older passengers declare to buy tickets only at the physical retailers, on the other hand the less elderly passengers take more various behaviours. In particular in case of short or medium distances, they buy tickets at the physical retailers near the place of departure; on the contrary in case of long distances (and probably of more than one ticket) the action is entrusted to another subject, by asking to a travel agency or a relative who will make the purchase online. So, generally elderly are not familiar with the online payment systems and a general distrust towards these systems emerges.

Finally, at the end of the trip most part of the respondents do not use digital tools, except for photo storage technologies (operation for which, the help of other people is required).

User Needs

During the trip planning, elderly would appreciate information related to the timing of the vehicles (e.g.: delays, arrival times, etc.) and unforeseen events (e.g.: strikes, traffic, works in progress, accidents, etc.) in order to better plan the itinerary and the departure time. For this reason, they would need to receive push notifications, to better deal with the journey (e.g.: a system that signals the stop to go down, the real time crowding of the means of transport, alternative routes, etc.). The older people need to know in advance the routes to be covered on foot, in order to better organize their moving.

The possibility to have a unique ticket which comprises all the means of transport is a central point since it give the elderly a perception of more security and control on the journey experience.

In the move phase, the elderly mainly need services that support their orientation towards the destination and that give the real time and updated information (for example explaining the motivation of possible delays). The face to face contact with the on board staff is a central need of the elderly, so it is important to design services that require people as an important touchpoint for this particular people category.

5 Discussion of Results

On the basis of the survey outcomes, different kind of needs have been identified and converted into possible requirements and consequent system features for potential digital services. In this section some of these features identified as part of a design process addressed to the creation of an adequate travel experience for elderly are presented and discussed. The following is not an exhaustive list of all the possible features of a multi-modal solution for public transport suiting elderly needs. In fact, the ultimate aim of this paper is to highlight how the identified requirements can be integrated in an inclusive technical solution suiting a wide range of travellers, including elderly, for creating a better user experience with public transport in a multi-modal scenario.

In effect, most of the identified features meeting the elderly needs are suited also for other types of travellers, such as frequent-business travellers, occasional travellers, commuters, etc., regardless their age or psychophysical condition. Indeed, according to the previous study conducted by the authors [1], in the design of digital solutions there are some principles that should be considered in order to sustain the inclusiveness of the interactive system. They can be summarized into four kinds of objectives to fulfill in the design of a multi-modal travel solution: (1) Minimization of the effort in the different phases of the travel; (2) Personalization of the travel experience, with the aim of accommodating the different needs of the targets; (3) Implementation of a clear communication that allows travellers to easily understand all the steps of the interaction with the online and offline services delivered in the multi-modal transportation scenario; (4) Creation of a seamless travel experience, extended to multiple transport services and multiple information channels.

So, these general objectives are matched with the specific needs emerged by the empirical survey in order to identify an inclusive solution. In detail, in the following examples the focus is on the features that can be implemented on an interactive system supporting the information retrieval before, during and after the travel.

Minimization of the Effort in the Different Phases of the Travel

Before starting a new trip, there are several technical solutions that can minimize the effort required to reach a given destination.

In order to easily obtain the needed information and quickly visualize only the most interesting travel options, the user should be able to memorize (automatically or manually) on the interactive system the most frequent or preferred travel habits, i.e. the stops or routes taken more frequently. As this feature is tailored on the user habits and preferences, it is strictly connected also with the personalization of the travel experience. In general, it is possible to minimize the effort required to the traveller by

increasing the amount of useful information in possession of the user in advance to the travel. This permit the user to adapt the itinerary to his or her requirements. For example, especially for elderly people having physical problems related to age, knowing if the itinerary include a long walking or stairs is important in order to find the path accessible with the minimum effort.

More broadly, in any moment, the interactive system can also facilitate the traveller in the retrieval of useful information by suggesting points and services of interest directly or indirectly related to the travel, also on the basis of the context of the trip, that the user can add to his or her itinerary. A close feature concerns the sending of alerts (i.e. notifications and reminders) by the system about the scheduled travel agenda to allowing the traveller to relax and, simultaneously, be ready to act in time when requested, without missing anything about the travel, e.g. the right bus stop.

Lastly, the interactive system should offer as much support as possible during the most critical phases of the travel experience, for example during the purchase of tickets or the localisation of the requested bus stop. Moreover, in order to increase the inclusiveness of the solution, the use of simplified and intuitive interfaces, requiring only very needed information, should be preferred. This and other features addressed to assist the traveller during the journey make possible to avoid too stressful situations. This aspect is especially important when dealing with elderly or fragile people in general, as too risky situations might lead to the exclusion of these categories of travellers.

Personalization of the Travel Experience

In order to accommodate the travel options to the specific needs of the traveller, a technical solution should acquire and return to the user some essential information characterizing him or her experience. It is fundamental for this kind of services that the user can select the different options consistently with the personal wishes and the travel habits.

By integrating the personalization objective with the minimization of the effort, the system should also consider the most used or preferred travel options, i.e. the most used means of transport or bus stops, in order to return personalised itinerary and to visualize only the most interesting information. Generally the user can set specific parameters or filters to research and choose the more appropriate travel conditions. A very important parameter to consider when designing a solution suiting elderly need is the economic one, for example the possible discounts, promotions or economic facilitation applicable to a specific travel.

Other identified features are the possibility to view and combine the different transport modalities according to the user preferences and the possibility to select and reserve specific seats on the different means of transport.

The personalization of the solution can be the result of a set of parameters configured by the user or the consequence of the acquisition of data by the system, e.g. about the most frequent uses of the interactive system by the user. In any case, the user should be able to define the level of personalization of the system and which data he or her wants to share with it.

Implementation of a Clear Communication

In order to avoid disorientation and facilitate the interaction with multiple online and offline services occurring during the travel experience, the traveller should have plenty of information in advance of the travel. For example, given specific spatial and temporal travel options (data/time and place of departure and arrival), the user should know: the itinerary to follow with the scheduled times; the means of transport and their on-board equipment (especially in the case of facilities for people with special needs, such as the presence of ramps or reserved seats or automatic doors); the location of transport hubs and the modality to safely access to the different transport services (e.g. validity of tickets, approved operators, facilities for people with special needs, health care services, safe location of self-service ticket kiosks, etc.); the total amount to be paid for the whole travel on the basis of the different fare types, along with the related payment options; the presence of architectural barriers and the related indications on alternative paths.

Another important requirement is the delivery in advance to the travel of information about permanent or temporary change of course or restrictions to the ordinary circulation of vehicles or service operations. Indeed, especially in the case of elderly or travellers with a limited knowledge of the surrounding context, it is better to avoid unexpected changes of plans. For this reason, the traveller needs also real-time informations, e.g. about the regularity of the service, and updates on his or her scheduled travel agenda.

As mentioned previously, by having a clear picture of the whole travel thanks to the possession of information clearly explaining all the different steps of the services, the user is able to minimize the efforts required during the travel.

Creation of a Seamless Travel Experience

Before, during and after the travel, it can be useful, especially for elderly to have a unique virtual space where to collect all the different elements concerning a specific travel, i.e. transport tickets, service cards, etc. Similarly, the traveller should have the possibility to integrate the useful information coming from his or her other accounts on a single platform.

In order to create a seamless experience, the interactive system should allow the user to find information about the location and the available services of the touchpoint diffused on the territory, such as ticket offices or interactive totems. Regarding this aspect of the user experience, the traveller should be able to interact with the multimodal-transportation services through different channels and devices, depending on the context. Moreover, the system should warn the user about the effective state of each touchpoint (e.g. opening times, presence of front office employees, etc.), in order to avoid to the user a worthless waste of time.

In conjunction with the minimization of the effort in the different phases of the travel, the personalization of the travel experience, and the implementation of a clear communication, this last objective permits to create a travel experience perceived as a whole. Indeed, the traveller can continuously interact with the different elements of the travel, before, during and after, moving from one place to another within a multi-modal transportation scenario as a seamless travel.

6 Conclusion

In this paper, the authors have discussed as the adoption of an inclusive design approach allows the creation of transportation services accessible to all categories of users, included the elderly. Further works aiming at reaching this purpose, should consider the application of research methodologies based on co-design. The latter are already been applied in the mobility field [15], since they allow to better understand needs and perceptions of users, involving them in creating solutions which they can use. In particular, the co-design process requires that designers, professional experts and potential users work together in creating a service which meets real needs and desires, by reducing the gap between designer objectives and user requirements. In fact, this represents an important weakness in the design process, since designers take often for granted some elements if the user point of view is not adequately taken into account.

The central aspect in co-design practice is adopting an iterative approach, by planning spaces and moments of interaction among these different stakeholders, that ensures a permanent user engagement and inclusion, also by continuously adapting the service features to the evolution of needs. This consideration is particularly true if we consider the peculiarity of the elderly, characterized by elements that rapidly evolve over time.

In the future works, the authors propose to apply co-design methodologies with the elderly that use multi-modal means of transportation. In fact, it is important making elderly aware of the potential of the application of this approach in improving their lives. In order to do that it is necessary to provide adequate explanations. A design model like this will increase the engagement and empathy of the elderly in expressing needs and ideas regarding their use of public transport.

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