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Abstract

This paper is based on a research project carried out in the Metropolitan Area of Milan, which looks at cities of the future as highly populated by long-living active people and characterized by innovative technological facilities. The project is conducted based on a multidisciplinary research approach with the goal of studying how to enhance the elderly's walking activities in urban environments. The whole process has applied the system thinking approach to actively engage participants (senior citizens) and stakeholders in all the research steps. Findings have revealed the presence and absence of hardware and software of urban environments in terms of walkability for the elderly. The research concludes with a reflective definition of walkability parameters emphasizing the soft aspect and a systemic design guideline for future development.

Introduction

Both scholars and practitioners are studying the future of cities, being more attractive, competitive, inclusive and resilient. Challenges highlight the fact that both the hardware and the software of cities have to be taken into consideration when policymakers, designers, urban planners, architects and other relevant roles are going to plan the future of our cities, as we are going to discuss in this paper. The research aims at better understanding what elderly people perceive as criticalities or valuable elements while walking/crossing in the city and at improving the situation by means of practical interventions on the comfort, safety and attractiveness of urban environments. This study will focus on the co-creation of urban spaces, which will act as a "social center" of the neighborhoods that increase the possibility and the willingness of elderly citizens to participate in social activities and have social interactions. Existing checklists and guidelines for the design of age-friendly cities do not often take into account the needs of sociality among the elderly, which is instead the truly intrinsic motivation for them to navigate the city. The investigation of innovative design solutions for the outdoor urban areas will foster the walkability and accessibility of the environments, more significantly, will induce spontaneous aggregation and appropriation of public spaces by elderly citizens. This will be promoted by conducting a human-centred approach for creating new meaning of age-friendly cities. The results of the project will provide knowledge, data and experiences useful for city managers and policy makers involved in the design of innovative and technological solutions (ICT, IoT) for the management of mobility in future smart and sustainable cities, characterized by the presence of active long-living inhabitants interacting with multiple technology-based services.

Literature review

Age-friendly cities

City, as one of the most complicated social systems, is the habitat for a variety of people. The planning of cities' future has to take into consideration the satisfaction of different needs and provide equal

solutions to all. The population ageing is one of the major trends at the global level with great implications for cities. In OECD countries, the population of citizens over 65 years old reached 17.8% in 2010 and is expected to rise to 25.1% in 2050 (OECD, 2015). Looking specifically at cities in the period 2001-2011, the number of elderly increased by 23.8% in OECD metropolitan areas, 5 percentage points more than what it increased in non-metropolitan areas (OECD, 2015).

Policymakers have to be aware and able to address the consequences of the ageing process affecting especially cities; indeed, elderly people are mainly located in the hinterlands and suburbs than in cities centres. Among the challenges due to the ageing of the population identified by OECD, we selected, for the discussion presented in this paper, mainly two:

- Infrastructure and urban form need to be redesigned to increase the attractiveness of and well-being in cities;
- Social isolation resulting from a reduced social network.

The concept of Age-friendly City (WHO, 2007) is established as a framework where Active Ageing, the promotion of physical activity of ageing people, is recognized as a priority for public health actions. Therefore, a holistic and systemic approach is required when ageing is taken into consideration in the development of cities' futures. Agenda 2030 and the Sustainable Development Goals, the World Humanitarian Summit and the New Urban Agenda (Habitat III) are highlighting the call for inclusive urbanization and among the priorities identified, they include the engagement of older people in planning activities and decision making processes (Jones, 2016).

The hardware and the software of walkable cities

The term "walkability", as the main element upon developing an age-friendly city, is identified as crucial for cities' smart growth and sustainability (Glicksman, Ring, Kleban, & Hoffman, 2013). Its definition might seem intuitive; however, there are a few scientific definitions. We report here those which better describe our approach to this concept:

- INFRASTRUCTURAL (HARDWARE): is the extent to which the built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network (Southworth, 2005)
- ACTION ORIENTED: walkability is defined as the measure of the overall walking and living conditions in an area, in particular, as the extent to which the built environment is friendly to the presence of people walking, living, shopping, visiting, enjoying, or spending time in an area (Stantec Consulting Ltd., 2009)[1]
- DESIRES and EXPECTATIONS: Walkability can thus be understood as a ''match'' between residents' desires and expectations for types of destinations, their willingness to walk a given distance and the quality of the required path (Manaugh and El-Geneidy, 2011)

In many cases, walkability is defined as a measure and evaluation. Several indexes were built to measure the walkability of an urban area. In particular, we refer to Speck (2013) according to whom a walk has to satisfy four main conditions: it must be useful, safe, comfortable, and interesting. In a similar way Forsyth and Southworth (2008) define "walkable" as close, safe, barrier-free, full of pedestrian infrastructure and destinations, but also encouraging physical activity, upscale, leafy, or cosmopolitan.

[1] https://www.edmonton.ca/transportation/PDF/WalkabilityStrategy200909.pdf

Trying to combine different definitions, we can state that, an urban area to be defined walkable has to be:

- *Useful and close* refer to the availability of daily life services are located in a walkable distance;
- *Safe* means that pedestrians are protected and preferred over cars; also the perception of safety has to be taken into consideration, since is a very important attribute for an attractive city (Jacobs, 2006)
- *Comfortable*, barrier-free and full of pedestrian infrastructure indicate that urban streets are planned to be 'outdoor living rooms' (Speck, 2013)
- *Interesting*, full of pedestrian destinations means that sidewalks are lined by unique buildings with friendly faces and that signs of humanity abound" (Speck, 2013). As Jane Jacobs (2006) stated a good sidewalk is a stage for the daily intricate ballet of citizens and strangers where all their distinctive parts reinforce each other.

Gorrini and Bandini (2017), leading LONGEVICITY research project, which will be presented in detail in the following chapter, identified five indicators to be tested:

- Usefulness: urban areas should be designed to guarantee the presence of numerous and diverse public services for the elderly within a walkable distance from their place of residence (e.g., land-use mix; street connectivity; transport services; social and health care service; commercial activities).
- Comfort: urban areas should be designed to accommodate the comfort of the elderly while walking (e.g., pavement type; continuity on side-walks; installation of ramps for people with reduced mobility; urban furniture for resting; green areas with trees, benches, tables and fountains).
- Safety: urban areas should be designed to guarantee the safety of elderly pedestrians while walking and crossing (e.g., absence of barriers and pothole on side-walks; speed bumpers; traffic lights; illumination systems in proximity of the zebra crossing; legible horizontal and vertical signage).
- Attractiveness: urban areas should be designed to have a polycentric structure, with several and distinctive areas of attraction for the elderly inhabitants (e.g., points of interest, amenities, public spaces and events; quality of the architectural streetscape; vitality of the social context).
- Legibility: urban areas should be designed to be legible, memorable and navigable, in order to enable the elderly to easily locate themselves and navigate through the city (e.g., roads toponymy; legible road signs; place-based maps for indicating public services)

As Alfonzo (2005) stressed, it is important to be aware of the existence of a hierarchy of walking needs, which go from the most basic and personal, such as physical conditions, to higher-ordered and environmental, such as accessibility, safety, comfort, and pleasurabilty: " Thus, for example, if the need for safety is not met, a person would not consider his or her need for comfort or pleasurabilty when deciding whether to walk" (Alfonzo, 2005: 11). In addition to that, the scholar states that this hierarchy has to be placed in a socio-ecological framework, where also personal life circumstances play a role.
In this sense, a systemic and collaborative design approach is particularly relevant in the study of walkability.

Systemic and collaborative design approach

The concept of system has always been part of design discipline and relevant to the "artefact" that design is dealing with. With the emergence of new design domains, such as service design, strategic design, social design, the attention on systems at different scales and in different contexts has raised again. Some scholars have articulated system thinking as a design process (Ackoff, 1993), and others considered design as a systemic discipline (Nelson, 1994). Both of them include converging and diverging phases for seeking possible directions and solutions. Why does this matching of system thinking and design thinking work?

Both approaches have shown their advantages when dealing with wicked and complex problems. System is a whole entity that cannot be divided into independent parts, and the behaviour of each element always has an effect on the whole system and on the interdependent elements (Ackoff, 1997). System thinking approach looks at the bigger picture and tries to connect dots, which could facilitate and formulate new relationships. Designers share a similar approach and mindset, moreover, it provides operative methods and tools.
Cross (2001, 2007) has explained in detail the "designerly way of knowing", illustrating the designers' unique way of knowledge contribution through reflections on practices. Compared with scientific and engineering, designers use abductive thinking logic to explore potential answers and solutions. A typical design process as identified by Kumar (2004) iteratively goes through research, analysis, synthesis and realization phases. There are different difficulties and challenges designers encounter in each step.

Societal problems are complex and caused by multiple and interconnected reasons over time, they can't not be totally solved with a solution. It is even difficult to articulate these societal problems, which are often ill-structured (Dorst, 2015), wicked and interdependent on each other. Here is where systemic design, combing system thinking and designerly ways of knowing, fits perfectly in this context as a lens to look into the issues. It basically starts with understanding the real situations through searching for and collecting data and information from the contexts and diverse actors. Designers have the ability to notice the weak but important data and information, moreover, to identify the hidden patterns and relations in order to make sense of that.

The change and evolution in design discipline not only lie in the features of problems, but also in how designers are building the strategies to solve problems. The wide application of co-design (Sanders & Stappers, 2008) is changing the roles of the designer, from a user-centred approach to collaborative creation with diverse actors. Following the concept of everyone is endowed with the ability to design (Manzini, 2015), design innovation process involved stakeholders in a co-creation process to contribute their talents and perspectives, especially for complex and societal issues. The human-centred approach will have a new meaning since the design process couldn't only focus on the targets (final users). Every actor is important and everyone is able to make change of the existing situation into a preferred one (Simon, 1968). Designers are those who should create easy access to tactically involve all.

The Longevicity project experience

In the multidisciplinary project LONGEVICITY[2], we have applied a design-led research approach to explore how to create a walkable neighborhood in the city for the elderly. This research project is founded by Fondazione Cariplo[3] within the Call Scientific Research 2017 "*Aging and social research:*

[2] https://sites.google.com/unimib.it/longevicity/home
[3] https://www.fondazionecariplo.it/en/index.html

people, places and relations". The project has started from 2018 and will be finalized by the end of 2020. The research team consists of both academics and practitioners from a range of different disciplines: department of information, system and communication of Milan-Bicocca university, design department of Politecnico di Milano; AUSER - the regional volunteer association for the elderly and Research Center for Advanced Science and Technology of The University of Tokyo.

On the basis of literature analyzed in the previous step, a design-led research process has been formulated, acting as a platform on which different stakeholders are able to discuss on the issue of walkability and to co-create possible ideas for improving the existing situations towards their preferred ones. The whole research process has been illustrated in figure1, in which, systemic design has been integrated at each step to keep in mind the complexity and interdependence of the parameters of evaluating walkability. And this approach considers the elderly principally as human-being, who have different rights rather than the limited functional ones.

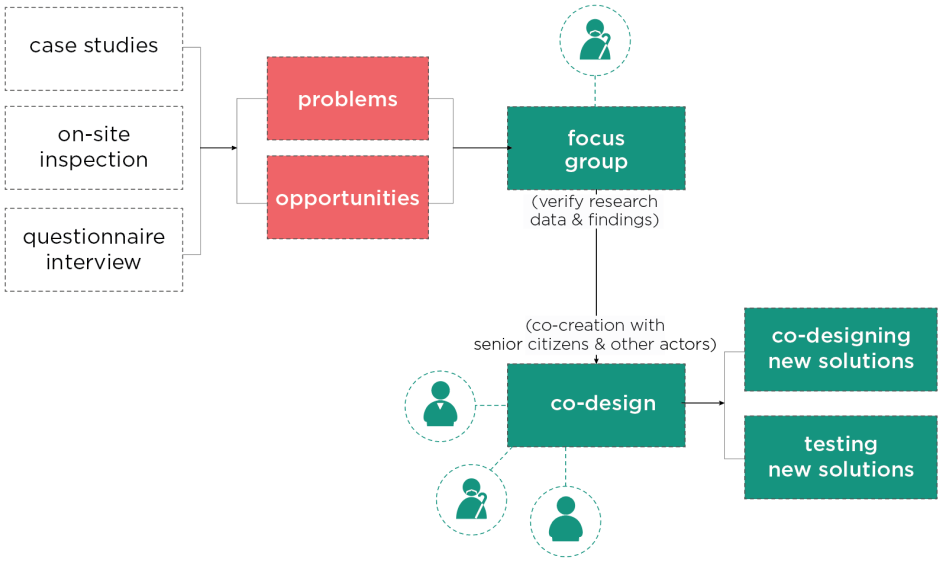

Figure 1. Research process of LONGEVICITY project (elaborated by authors).

The research methodology is based on the integration between quantitative data collection techniques and qualitative co-design methods. On one side, it is a combination of collecting data of pedestrian locomotion behavior (i.e. analysis) and the power of computer-based pedestrian simulations (i.e. synthesis). On the other side, a human-centred design approach guides different actors to collectively participate in the whole research process. The results obtained from the representational observation and the experimental investigation of pedestrian behavior give the basis for the following co-design phases, validation of computer-based simulation systems, testing the adherence of the simulation results on realistic behavioral dynamics. A GIS-based territorial analysis identified those areas in the city of Milan that are characterized by the highest presence of elderly inhabitants and by the poorest level of pedestrian safety. Senior participants will also be engaged in participatory design laboratories to express their needs and desires. A series of empirical studies will allow to: 1) assess the degree of walkability by means of questionnaires, interviews and focus groups; 2) co-creation sessions with all relevant actors to build more walkable scenarios; 3) testing and prototyping initial co-design solutions. The results of the project will provide a systemic view of walkability level of the neighborhoods; first-hand feedback, ideas and proposals for the future development; guidelines for co-design and co-management of age-friendly pedestrian mobility in future cities.

Case study was conducted to collect mainly second-hand research data for understanding situated design challenges and opportunities that are relevant to walkability. The case study was oriented to investigate and select innovative solutions to enhance the mobility of elderly pedestrians and to improve their (social) life. And four main categories/areas have been identified to guide case collection and analysis process:

- New concept of urban living for elderly (with a focus on "mobility")
- Smart aids for elderly (with a focus on technologies' impact)
- Active social life (community-based solutions)
- Explorative/visioning solutions (conceptual and experimental projects)

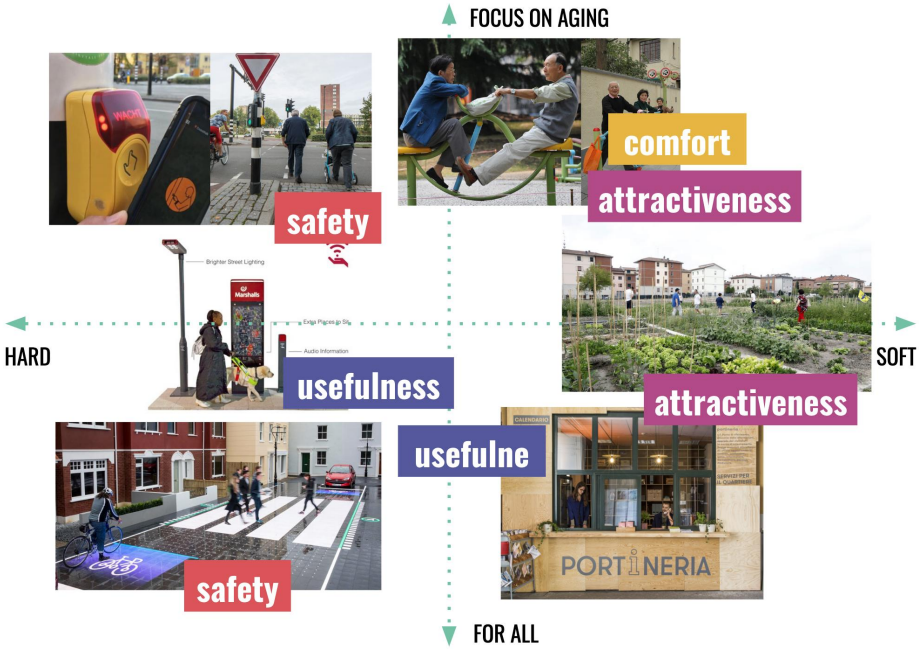

Figure 2. One result (map) of case study (elaborated by authors).

The second research activity (territorial observations) was oriented to neutral evaluation of the features of physical environments, such as infrastructures, which have significant impacts on the quality of life of the whole population and in particular of senior citizens. On-site observations on two different districts of the Metropolitan area, selected also according to preliminary GIS analysis, helped us to better frame the design context of action and assess at a microscopic level the degree of walkability of a specific territorial area. According to the previous analyzed literature, an observation protocol[4] was developed, based on six main parameters: ***usefulness, comfort, safety, attractiveness, legibility***. Besides, we added another parameter - ***population***, in order to obtain information on typologies of populations present in those areas, their activities, and behaviors. This one was added from a system thinking perspective, which considered that "human activity" often has an important impact on the social issues. For each indicator, specific questions have been designed to get sufficient data to make walkability assessment.

The following activity (interviews) focused on carrying out data on the soft factors of a walkable city, such as quality of life perception (Hirsch et al., 2000), relationships and networks relevant to specific

[4] the protocol was attached in the appendix

contexts (Lui, Everingham, Warburton, Cuthill, & Bartlett, 2009; Scharlach, 2012). We conducted 22 interviews (11 in Sesto San Giovanni area, 11 Gorla-Crescenzago area). The interviewees were asked about personal information, leisure time, and to evaluate the neighborhoods taken into consideration in the project, according to the same indicators used to carry out the observations. Indeed, we wanted to compare the results of the above-mentioned parameters through which we evaluated the level of walkability of the area. In addition to that, we asked our interviewees to interact with a map of the selected area, where they were asked to indicate with different colors their walking paths highlighting also positive and negative elements which they usually encounter.

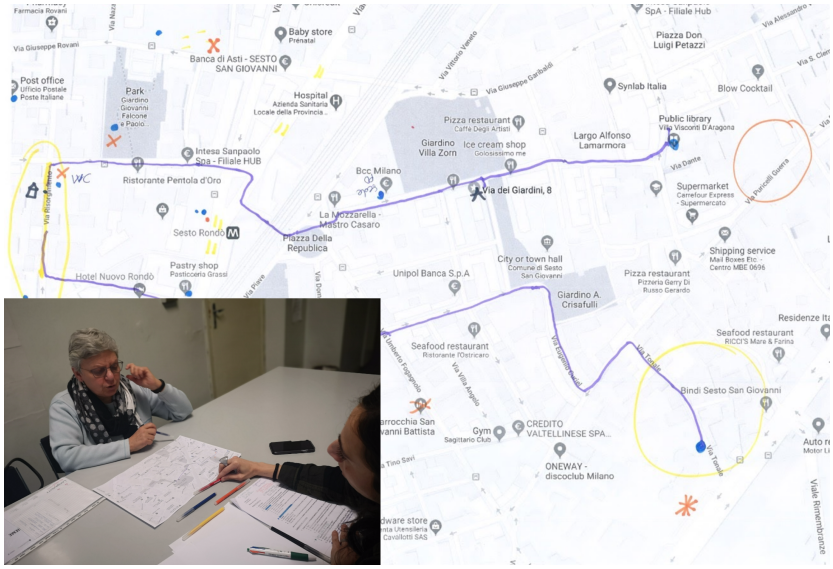

Figure 3. One example of an individual interview result.

Thanks to the data gathered during these activities, we were able to form and identify the problems and consequent design opportunities, driving the second part of the research, which is based on engagement and co-design activities to be carried out. The second part started with conducting a series of focus groups (in the form of workshop) with two groups of seniors, who have already participated in the interview activity together with some new participants . The focus group phase was aimed at generating qualitative perceptions on “walkability”, which will be analyzed in comparison with our previously identified indicators in observation phase. Besides, the focus group activity opens the conversation among all participants to discuss on discovered in the interview phase. Six parameters and previous findings have been used to design the research tools (figure 5.) for focus group activities.

Figure 4. Focus group activity (photos are taken by authors) .

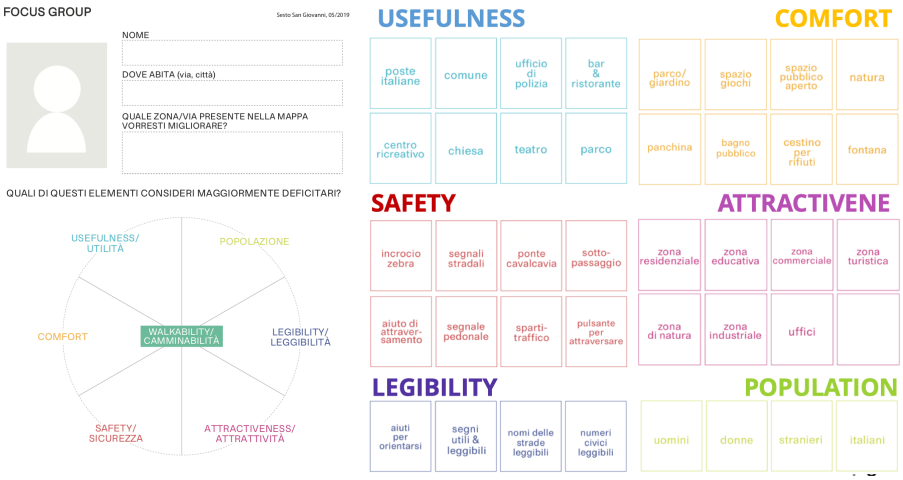

Figure 5. Research tools for focus group activity (designed by authors) .

For the last co-design phase, we are planning to work on two main possible directions of outputs based on the two different realities of the selected neighborhoods. This step will focus on co-creation of possible concepts and solutions that will answer the emerged questions in previous steps. This problem-solving activity will also consider the systemic changes that they might bring to other social issues beyond the improvement of walkability level in those areas.

Findings

In LONGEVICITY project, the status of walkability levels of two selected neighborhoods in Milan city has been presented through the six previously identified parameters. In this part, finding on each parameters will be detailed illustrated.

Firstly, two neighborhoods have shown quite satisfactory results on "**usefulness**". The elderly living in both areas are able to reach most of the presented public services, from general services to everyone (e.g. shops, bars and police office) to special services more relevant to the elderly (e.g. pharmacy and medicine center). This also shows that basically public services in Milan work and are distributed well, which enables elderly people to reach on foot without big problems. There are some specific services mentioned by the elderly during interview and focus group activities. For instance, the library has played a very important role in their daily lives. In one case, the library is still a "social center" for many elder people to meet together, to plan some events, or just to meet up with others in the neighborhood. The presence and maintenance of this library is significant and somehow irreplaceable. Another very interesting service has been mentioned by many elderly participants is the sport center, which we didn't include in our on-site observation protocol. Surprisingly, over 50% of the elderly people involved in our research project frequent sport class at least once a week, and many of them go to the classes together as a group activity.

The level of "**comfort**" in both areas is not very high. The elderly have mainly complained about the sidewalks, which are extremely narrow and not well maintained. They have explained different difficult situations they encountered and the inconvenience for walking. The missing of some connections and holes on the sidewalk could put the elderly in very dangerous positions. Another very crucial issue is the absence of urban furniture in the whole Milan city. The elderly people like to take a walk in their neighbourhood, however, they couldn't make a long one due to lack of benches, public restrooms and

access to some public spaces to rest. Besides, the street and environment in one of the selected areas are not very clean, which make people walk outside less than the other one. Compared with the previous parameter, “comfort” is not only about the “functional” aspect, but also how citizens, especially the elderly, make use of the city infrastructure.

Moving to the third parameter - **safety**, which is the most crucial element to consider when designing a walkable neighborhood for the elderly. The two selected areas are not performing well in guaranteeing safety. Many elderly people have shown their worries when crossing the road by using the zebra lines. And female elderly people have also communicated that they seldom go out during the night alone because of a low perception of safety in general (Sesto San Giovanni area). These problems discovered during our research are not separate but highly dependent. Especially in Gorla-Crescenzago, participants experienced robberies, which obviously provokes a low safety perception, in general. Different research methods have shown big differences on identifying the level of “safety”. Even though during onsite observation, the evaluation on safety is not scored very low. During interviews and focus group, the elderly participants have highlighted their inconvenience and the needs to get this issue improved/solved urgently.

Being **attractive** has a high impact on motivating the elderly to go outside walking in their neighborhoods - to make the grocery or to take a walk with friends in the park. Positively, there are several parks and squares where people could meet with others in each neighborhood. However, research has shown that there’s a lack of cultural and historic sites and locations. And they are not satisfied with the clearness of the neighborhood and they have repeated the importance of having clear and enjoyable sidewalks and public spaces. Generally they don’t consider their environments attractive. One interesting finding is that the elderly in both neighborhoods have shown their willingness to have a so-called creative center, where they could meet and do some creative activities or to attract some young generations. There are many uncovered local resources for elderly which are already existing but have not yet reacted.

The **legibility** level in both areas have gained quite positive feedback. This might be because the elderly are basically living in those neighborhoods for decades and they don’t need to read the names of the streets nor to find their way. They know very well where they are, where to go and how to reach there.

Last but not least parameter is “**population**” - referring to the people and their activities in that area. We have got a very different attitude and reactions from two areas. In one neighborhood (Sesto San Giovanni), the elderly are very welcoming to foreigners and immigrants, however, in the other one (Gorla-Crescenzago), many negative experiences and issues have been considered relevant to immigrants and unemployed people. Some participants have pointed out that the diversity of people, especially those who are doing nothing but hanging out on the street, in their areas make them feel less safe and less willing to go outside.

Based on the findings summarized in previous paragraphs, two reframed design challenges have been generated as the “input” for two co-creation workshops with the elderly, all project partners and students from both design department and department of information, system and communication. The first design challenge is pinpointing the possibilities to increase the elderly’s willingness to take a walk in the neighborhood, and the second one will focus on improving the elderly’s perception of safety when taking a walk outside, considering both infrastructure redesign and supportive services.

Discussion

The system thinking provides design-led research approach a more complete perspective to investigate and to form the future. And this perspective leads us to emphasize the research on exploring the *software* of a city (specifically, a neighborhood in the city) and the relationship between city's hardware and software. Therefore, it comes to the thinking that there are two dimensions of evaluation and to improve the city's walkability level: hardware - strategic urban planning to increase the comfort level, and basic infrastructure maintenance and upgrades to guarantee the walking safety; more importantly software - creating new events and opportunities to increase vitality of the neighborhood, which could be mainly applied to improve safety (the elderly's perception) and attractiveness. Working on the soft aspect of walkability requires a comprehensive consideration and organization of several parameters.

At the end, with the experience from LONGEVICITY project, this paper tries to summaries several systemic design guidelines to the last co-design session with stakeholders, potentially also to other similar projects and researches:

- Going **beyond** human-centred design. In a system, the service providers are as important as the final users. Conventional user-centred design highlights the importance of using empathy to better understand the users' needs and wants. However, in complex problems, there's not only one type of final users to take into consideration when developing the possible solutions. Moreover, every type of actor might change its role in different situations, a final user might act as a service provider when the contexts change. Therefore, a systematic and holistic perspective to treat every actor in the system as "human", the designers' responsibility is to better study their minds and to balance what could work best for all of them.
- Enabling actors and stakeholders to **collaborate** and **negotiate** in a "designed" context, in which data and information are available and accessible. Designers should create a platform and shared language for facilitating communication among all the stakeholders. The dialogue process will enable connection and understanding of each other, which will definitely help to reach a shared and collective future.
- Design for building **relationships**. From graphic and communication design, product design to design for service, spaces and strategies, the object that design deals with is always changing, but what is not changing is that designers are always trying to build relationships among human beings through physical objects. The relationship is much more complicated when design is moving towards the four level (Buchanan, 2019). How design for relationships could be applied in currently complex and social systems? We would say that using physical objects as triggers to make positive relationships happen.

Acknowledgement

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