Aging and Interaction: Designing for Active Living Experiences

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Over the last century, the life expectancy of the worldwide population has been increasing due to significant improvements in housing and healthcare. As a result, the number of older people in the worldwide population will continue to grow rapidly. Considering this, the concept of active living is an important strategy that can enhance healthy lifestyles by staying mentally, socially and physically active during aging. In this concept, digital technology can be a great tool that can help people to pursue those benefits. However, it seems that older people are particularly susceptible to the negative effects of technology directly caused by poorly designed products and user interfaces. For these reasons, this paper wants to discuss age-related changes and characteristics that usually impact the user experience, in order to delineate background information of those problems and then propose design methods and practices that can help designers to develop accessible and age-friendly products and interfaces. We use the concept of Active Living to verify if and how the existing products on the market are fostering the values of an active lifestyle, promoting independence, empowerment, self-esteem and self-efficacy. We conclude by exploring new conceptual and methodological design guidelines through scenario-based design for inspiring future research in this field.

Keywords: Active Living, User-Centered Design, Human-Computer Interaction, User Experience, User Interface

1. Introduction

Population is gradually ageing with a global life expectancy that has increased by more than 6 years between 2000 and 2019, from 66.8 years in 2000 to 73.4 years in 2019 [1]. This phenomenon is coupled with a dramatic gap involving low-income countries, where life expectancy is 16 years lower than for people in high-income countries. Life expectancy, quality of life, equitable access to information technologies, do represent in our perspective intertwining assets of healthy ageing and active living.

As the population ages, important questions are coming into view [2]: *How might we better support seniors to lead active and independent lives in their homes, communities and neighborhoods? Can we make services and products for seniors easy to use and navigate?*

Ergonomics and interaction design for elderly people has been widely addressed at the theoretical and methodological level [3–5]; at the cognitive level, with an extensive production of reviews of the changes that aging makes to the human factors [6–9] and at the exploratory and research level dealing with projects on novel interaction paradigms and multiple devices [10]. The benefits of staying mentally, socially, and physically active as we age are well known [11]. Digital technology can help with that. But everything changes when products and services thought for the elderly are poorly designed. Especially since interacting with a computer is no longer about sitting in front of a desktop. Computers have become deeply engrained in nearly every activity of everyday life: "We carry them, wear them, and may even have them implanted within us" [12]. And it seems paradoxical how older adults can be particularly susceptible to the ill effects of unusable digital devices and user interfaces. While older people have not grown up with technology in the way that today's children have, most have had significant experience with it in their working lives and, later, in their personal lives [13].

Much of the research on age and technology use has been conducted from the perspective of usability, user experience, accessibility, and adoption. Such research projects are concerned with measures like frequency of use, performance, efficiency and accuracy [14–18]. In particular, several researches suggest that many older adults have difficulty using contemporary consumer products due to their complexity both in terms of functionality and interface design [19].

This chapter focuses on the experiential nature of the interaction with digital technology for ageing population. As other interaction design and human factors' specialists [2], we would like to continue to explore what are the characteristics of product design for the elderly and to understand how to enhance user experience for older adults. In particular the authors will focus on a purposeful & well thought-through design approach, shaped by participatory, user-centered and critical design traditions.

Even though the authors refer to designing interactions for elderly people this should not be taken as implying a uniform "elderly people" group [20]. Because of

the great heterogeneity of individual traits and diversity of life experiences according to the onset and progression of aging, the "older" group is the least uniform of the developmental stages. Age-related declines in cognitive and sensory-motor function occur slowly and at varying intensities from individual to individual. In other words, compared to the younger population, variability in older adults is significantly larger [21–23].

The definition of older people is now replaced by more articulated concepts, such as primary ageing (the changes due to ageing, without becoming ill), secondary ageing (characterized by the onset of chronic diseases, which affect the individual's adaptation to the environment) and tertiary ageing (the period immediately preceding the term of existence, characterized by a rapid decline of the skills of the individual) [11]. From the point of view of an interaction designer it is not age itself that is the issue but some of the effects of aging such as reduced vision, reduced manipulative ability, decreased autonomy and cognitive effects that lead to declines in memory, reasoning ability and speed of learning as well as the psychological correlates, like loss of self-efficacy.

Thus, in order to design for older people, it became relevant that designers empathize and sensitize themselves to the realities of elderly people [24], especially regarding what does "active living" mean for them and how they could establish and maintain "active living". This involves studying the literature on aging and active living; developing a vision on what is the main design scope; and understanding the rationale behind successful products and their design for older users. The objective of the chapter is to define a critical work on the domain and to propose a possible theoretical and methodological framework to support design studies and practices for the benefit of older people.

We will at first investigate Active Living as a concept with its own peculiar psychological aspects. Those factors will be then adopted as evaluation criteria to review the design of current products for older people. Last section of the chapter will provide support for an holistic approach to Active Living that would encompass the purely functional approach to design. Active Living will be in fact validated through scenario-based design [25, 26] and will allow us to identify conceptual and methodological design guidelines for inspiring future research in this field.

2. Active Living concept

2.1. Active Living in the literature

The World Health Organization defines active aging [27] as "the process of optimizing opportunities for health, participation, and security in order to enhance quality of life as people age including those who are frail, disabled, and in need of

care." As a policy framework, active aging allows people to realize their potential for physical, social, and mental well-being throughout the life course and to participate in society.

The state of well-being is a multifaceted phenomenon that refers to an individual's subjective feelings, and exploring perspectives of older adults on aging well is developing to be an important area of research [28]. Even though 'Active aging',' successful aging', 'healthy aging', 'positive aging', 'productive aging' and—in relation to technology— 'silver surfing', are just a few of the terms in use for naming this field [29]. Aging well is conceptualized using different contemporary theoretical frameworks in the last decades, including healthy aging, positive aging, productive aging, active aging, and successful aging [30].

This chapter will focus on the multidimensional approach and subjective definition to active living. In the last 50 years the importance of understanding the needs and wishes of older people has been extensively treated [31]. In considering planning for quality long-term care for older persons, Lawton defined the concept of quality of life (QoL) as "the multi-dimensional evaluation, by both intrapersonal and social-normative criteria, of the person-environment system of the individual" [32, 33] aiming at the improvement of older people in daily life activities and individual well-being [33–35]. Among QoL indicators there are Autonomy, Comfort, Relationship, Security.

The state of well-being is a multifaceted phenomenon in the older population which generally involves happiness, self-contentment, satisfying social relationships, and autonomy [36]. The sense of well-being refers to an individual's feelings, in this case, based on how older persons perceive the concept of well-being. The term "subjective well-being" is frequently used and strongly characterized by the interplay between individual characteristics and qualities of people's social environment [37].

We are proposing, in line with the "good aging" definition, a multidimensional concept, which is based on the meaningful integration of five main elements: (a) healthy nutrition, (b) daily physical exercise, (c) regular cognitive and mental activities, (d) maintaining social contacts inside and outside the family, and (e) keeping an active interest in society.

Such elements are tightly interwoven since maintaining good physical health and functioning plays an important role in facilitating mobility and enables older adults to perform more integrated functional tasks which include activities of daily living, fulfilment of social roles, and recreational activities. Furthermore good cognitive health is linked to social connectedness, independence, and life activities, and it might be preserved and enhanced by maintaining an intellectually engaged and physically active lifestyle [28, 38].

2.2. The Active Living concept

The Active Living concept, which we propose, has been investigated from both a scientific literature and a user research perspective in the international research project *RESILIEN-T, Technology driven self-management for building resilience among people with early stage cognitive impairment*, funded under AAL2018 that is currently being carried out in Italy, The Netherlands, Switzerland and Canada (RESILIEN-T) on aging and resilience. We hypothesize that crucial psychological aspects need to be taken into account to shape a meaningfully rich Active Living definition that does integrate factors such as cognition, functioning, and physical action.

In particular we want to highlight the need for older people to dynamically re-frame their condition and capabilities over time: they need to be aware of, and also to accept, the personal conditions they are making experience of, in terms of autonomy, use of tools, personal care, self-management.

For people. Active Living may be defined as living an active and meaningful life, in order to be able to maintain independence and self-efficacy in daily activities. By optimizing opportunities for participation in paths of health, safety, and socialization, which improves the quality of life and implements the potentials for physical and mental wellbeing [11]. Functional and objective conditions of people need to be considered in combination with their intimate and subjective experience, since the ability to act into the world is equally important to trust and self-esteem, acceptance and wish to share personal needs, limits and abilities. Therefore, as designers, rather than aiming to develop "innovative technologies that serve well-defined purposes" such as "optimal health and independence" [39], the approach we will take is in line with the "resourceful ageing" framework [10, 40] which focuses on empowering older people to age resourcefully.

We identified the following factors as main dimensions of older people experience: (a) empowerment, (b) perceived self-efficacy, (c) autonomy.

2.2.1 Empowerment

The notion of empowerment [41] is foundational in our approach since it does represent the overall scope of an intervention. The empowerment is a multidimensional concept constituted by several components including supporting older people to keep their current levels of mental functioning; by preventing possible decay in cognitive and social skills; by coping with adverse events and negative experiences; and by exploiting latent resources [11]. That is why, in order to empower older people to live independently, designers should make sure that older people can adapt and configure devices according to their personal circumstances in a way that their independence can be supported and be constantly renegotiated [10, 42]. Renegotiation of self-image may support the idea of iterative

empowerment pathways as structured, organized and goal-oriented paths for a healthy population integrating multiple levels of skill-support.

2.2.2 Perceived self-efficacy

Self-efficacy can be defined as a personal judgement of "how well one can execute courses of action required to deal with prospective situations" [43] and of own capabilities to produce designated level of performance. Perception of self-efficacy results from a reciprocal interaction between interpersonal factors, behavior, and the external environment. Self-efficacy is considered both as a predictor and as an outcome of social and physical interaction. Staying active is reportedly connected to self-efficacy since it implies good physical functioning and the ability to autonomously reach a goal. In general, individuals with high perceived self-efficacy are determined and show more effort across a broader range of tasks than people with a lower level of self-efficacy.

2.2.3 Autonomy

Staying independent was viewed as a major characteristic of aging well. Beyond the participants' living status (alone or with family), the importance of being independent was connected with the autonomous status of the older adults. A major concern that was frequently mentioned in the RESILIEN-T user research was not being or becoming a burden to others. In particular, along with the interactive discussions in all groups, target users involved in the user research reflected on the necessity of staying independent in performing their daily life activities including both personal and instrumental activities.

We have used the Active Living dimensions to verify if and how the existing products on the market are fostering the values of an active lifestyle, promoting independence, empowerment, self-esteem and self-efficacy.

3.   Products for elderly people: the-state-of-the-art

On the basis of the above considerations, the phenomenon of the aging population leads to many important social changes that are highlighting the necessity of finding new design solutions to support older people in living longer and healthier in their homes, communities and neighborhoods. In this perspective, rapid advances in technology are contributing to enhance the concept of Active Living since the development of assistive environments have the opportunity to offer a series of

benefits that can increase the older people's quality of life according to cognitive, physical and relational factors.

The Internet of Things and the development of recent technologies, such as sensor networks, Artificial Intelligence and Machine Learning algorithms, have great chances to improve the self-independence, autonomy, participation in social life and skills of the elderly. In particular these systems may be able to collect and integrate qualitative and quantitative data from multiple sources, and may extend the interaction modalities by utilizing tracking of daily routines and targeted suggestions, reminders or activities.

Unfortunately, nowadays, many products and services that are already available on the market do not fully satisfy such requirements because they can only partially cover the Active Living, or even demonstrate one single function. Moreover, these products often put end-users in a condition where they have no option but to passively undergo the operation of technology [42]. On the contrary, as examined before, the concept of Active Living lays on the multidimensionality of different human necessities, which, if well supported, are able to increase the quality of the elderly's health and independence.

For this reason, this section focuses on seven specific case studies because they share common characteristics – for instance all of them are screen-based multifunctional systems for senior care – that are capable of empowering older people under the concept of Active Living, specifically investigating particular interactions that can match with their main necessities and capabilities. The analyzed products are: **Pillo Health**, **ElliQ**, **Lumin**, **Compaan**, **GrandCare**, **Claris Continuum**, **Cutii**[1]. The main products' characteristics are focused on health monitoring, telepresence, physical and cognitive training and many other services that enable older people to keep themselves autonomous, active, healthy and socially connected.

Considering this, the analysis selected those projects because provide caregiving to older people through four meaningful features that have the original purpose of matching with the Active Living factors, meaning the empowerment, the perceived self-efficacy and the autonomy, that we already described in the previous section. The four factors that help to understand each project are: how the product take care of their users beyond the mere functional aspect of health monitoring; how they help users to stay connected with their relatives or friends; how the system is proactive in stimulating the users to stay healthy and active during the day; how the system is able to friendly dialogue with their user and create a social bond with them through its natural interactions.

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[1] For more information see: Pillo Health https://pillohealth.com/ ; ElliQ https://elliq.com/ ; Lumin https://mylumin.org ; Compaan https://www.uwcompaan.nl/ ; GrandCare https://www.grandcare.com/ ; Claris Continuum https://www.clarishealthcare.com/ ; Cutii https://www.cutii.io/en/ (accessed August 3th 2021).

Table 1. Schematic analysis of the selected products.

PRODUCTS	Pillo Health	ElliQ	Lumin	Compaan	GrandCare	Claris Continnum	Cutii
Morphology	Smart object	Smart object	Tablet-based app	Tablet-based app	Tablet-based app	Tablet-based app	Companion robot
Purpose	Social companion	Social companion	Device for telepresence	Homecare service	Homecare service	Homecare service	Social companion
	Recreational device & medical device	Recreational device	Recreational device	Recreational device & medical device	Recreational device & medical device	Recreational device & medical device	Recreational device
Personal care	Self-management app	Self-management app	Self-management app	Self-management app	Self-management app	Self-management app	Self-management app
	Health monitoring			Health monitoring	Health monitoring	Health monitoring	
	Connection for external medical devices			Connection for external medical devices	Connection for external medical devices	Connection for external medical devices	
Social connection	Remote calls	Remote calls	Remote calls	Remote calls	Remote calls	Remote calls	Remote calls
	Text messaging	Text messaging	Text messaging	Text messaging	Text messaging	Text messaging	Text messaging
	Multimedia file sharing	Multimedia file sharing	Multimedia file sharing	Multimedia file sharing	Multimedia file sharing	Multimedia file sharing	Multimedia file sharing
Coaching	Health & medical reminders	Health & medical reminders	Health & medical reminders	Health & medical reminders	Health & medical reminders	Health & medical reminders	Health & medical reminders
	Encouraging activities through health plans	Encouraging activities proactively through daily routines or behaviors		Encouraging activities through health plans	Encouraging activities through assignments	Encouraging activities through health plans	Encouraging activities through real animators
Identity & role	Visual interaction	Visual interaction	Visual interaction	Visual interaction	Visual interaction	Visual interaction	Visual interaction
	Natural dialogue & voice interaction	Natural dialogue & voice Interaction					Natural dialogue & voice interaction
	Facial expression & facial recognition	Facial expression & facial recognition					Facial expression & facial recognition

3.1. Characteristics of the products

All products are characterized by a tablet-based digital application but only **Lumin**, **Compaan**, **GrandCare** and **Claris Continuum** specifically refer their morphological aspects to the size of that device. While **Pillo Health**, **ElliQ** and **Cutii** are interactive objects that integrate the tablet in their physical products. Referring to the form of those products, **Pillo Health** has the peculiarity to incorporate in its morphological aspect a medical dispenser that can be activated with its digital service. The peculiarity of **ElliQ** is a physical element incorporated in the tabletop product that abstractly simulates a human bust, to which the system uses to dynamically interact with the elderly as an artificial companion. **Cutii**, instead, acts as a companion robot that has the ability to navigate autonomously around the older people's domestic environment.

   While **Lumin**, **ElliQ** and **Cutti** are intended for recreational and social uses, **Pillo Heath**, **Compaan**, **GrandCare** and **Claris Continuum** are devices designed for medical purposes as well. In fact, those products are able to monitor some vital signs and biometric parameters, such as blood pressure, heart rate, glucose, weight or breath, that can be useful for the older people, and also for formal or informal caregiving, to control chronic diseases or prevent future health issues. In particular, those products can increase their functionalities by allowing other external medical devices to be connected with their digital services in order to increase the elderly's monitoring of health conditions. All products enable visual interactions but **ElliQ**, **Pillo Heath** and **Cutti** are the only artifacts that make the dialogue with their users more natural by using voice interaction. Again, to empathize with that interaction model and mimic human behaviors, these products utilize anthropomorphic aspects as well, which express nonverbal signals. In fact, to communicate with older people, **ElliQ** simulates human body language through the motion of its artificial human bust while **Pillo Health** and **Cutti** use facial expressions.

3.2. Analysis of the products

The methodology used to analyze the products avoids to creating detailed benchmarking by only examining the mere functional features of the case studies. Rather, it focuses on many interaction aspects that, when harmonized in a consistent and goal-oriented design, may increase the Active Living's user experience and allow the older users empowerment, the perceived self-efficacy and the autonomy. Recurring interaction patterns among the case studies allowed the analysis to identify four design themes that trace new reflections to enrich studies and practices in this field. The four design themes are: (1) personal care, (2) social interaction, (3) coaching, and (4) identity and role.

Personal care

Personal care helps the elderly to live healthier and longer because monitoring a series of health parameters or performing activities that maintain an active lifestyle permit them to prolong their physical, social, and mental well-being over time. Considering this, all examined products, especially **Compaan**, **GrandCare**, **Claris Continuum**, have high monitoring accuracy. However, the technical and analytical data representation refers only to a passive and quantitative analysis of the elderly's health conditions without offering additional advice from a qualitative perspective. In that case, that product perception decreases the feeling of autonomy because the service may run the risk of considering the elderly as patients rather than independent people giving full control of the system to technology. This is because the products force their users to follow their pre-setting options based on reminders or alert messages that omit any willingness of choice. For this reason, the result is a passive scenario in which the elderly are perceived as passive entities who are constantly at risk and, thus, continuously in need of help. Indeed, older people's independence becomes affected by the decisions of their informal or formal caregivers who are in charge of control of their health condition through a dedicated dashboard as available on **Compaan**, **GrandCare** and **Claris Continuum**. That consequence may be stressed by **GrandCare** because it offers activity monitoring features that could make users feel constantly under surveillance.

The same issue on passive interaction appears on the elderly self-management. All artefacts provide a calendar for scheduling their own activities, though, they focus mostly on managing health or medical reminders, which, in turn, transform the service into a medical experience where users are perceived as passive entities. Moreover, this condition is empathized by the absence of engaging recreational activities or social activities. In fact, all products provide only default applications already installed on the system, which offer information and service provision without a proper interactivity, i.e. reading a weather forecast, reading a journal newspaper, or listening to radio music.

Again, all the products encourage personal care by providing mnemonic games or physical exercises for supporting older people to keep their current levels of mental and physical functioning. However, the activities present poor engagement because they are delivered through basic video tutorials or virtual games embedded in the tablet application.

Although it does not provide any monitoring service, **Cutii** is the only system that offers human interaction by allowing older people to perform physical or cognitive exercises with some animators who propose to them ludic, cultural or fitness activities in real time via video call. None of the products considers nutrition as a qualitative value for caregiving as reported in the definition of good aging.

Finally, although the products can manage monitoring of a single person – or multiple users such as **Pillo Health**, **Compaan**, **GrandCare**, **Claris Continuum** – they provide a single caregiving experience. Therefore, none of these projects incentive a participatory and shared use of the service as could happen for an elderly couple, for example.

Social connection

Social connection is an important value of Active Living because it permits older people to be socially included by enabling them to sustain relationships with their family or friends over time. The quality of social connection depends on the way an individual remains connected to the others [44]. For this reason, the analysis reports that all products give attention to social connection by giving people the ability to connect themselves with relatives or friends through their digital interfaces.

However, although maintaining people socially active is satisfied from a functional perspective, delivering qualitatively social interactions is always limited to video calls, text messages, emails, or sharing multimedia files. Moreover, **Pillo Health**, **GrandCare** and **Claris Continuum** overshadow social connection because it is perceived as an additional functionality of the caregiving service. Considering this, none of the products suggest a level of interactivity able to stimulate meaningful rich social interactions, inside or outside of the domestic environment, or cultivate contextual, endure relationships with their family or friends. In addition, all products tend to provide remote communication rather than creating an experience that stimulates relationships in presence.

Coaching

Coaching is a powerful element to empower people in increasing their health and well-being by periodically stimulating them with new challenging goals to accomplish or particular suggestions that encourage interests toward new other recreational activities. This theme can be supported by giving the products a proactive approach that is able to engage the elderly in personalized activities, encourage good behaviors or interests in new hobbies, limiting, at the same time, sedentary lifestyle, or poor care of one's own health or well-being.

However, only **ElliQ** and **Cutii** provide such technology. Apart from those products, none of the other services takes advantage of that technology because they only collect data to set up notifications only for medical reminders or health issues based on a statistical prediction on the elderly's health conditions. In addition, those products encourage physical activity only by providing health exercise plans, without the intent proactively motivating users with personalized tips or suggestions. Moreover, **GrandCare** does not offer a proper quality of coaching as the motivations it sends to the users are perceived as assignments instead of recommended activities. In that way, the product may affect the elderly's self-independence because the motivational advice may be perceived as an obligation rather than an invitation.

The most advanced level of proactivity is provided by **ElliQ**, which is the only product that encourages physical and cognitive activities based not only on monitoring the elderly's vital signs but also on their daily behaviors or routines. In addition, compared to the others that focus only on health and fitness, **ElliQ** is the only system that promotes recreational and ludic activities. However, proactivity currently refers only to passive actions such as listening to music based on the elderly's perceived mood (it uses facial recognition). The same happens to **Cutii**,

which uses its proactivity only to change facial expression according to the elderly facial recognition. Considering this, none of the products offer active support in cultivating interests in recreational activities, such as a personal hobby or passion. Again, all products do not provide proactive interactions that promote recreational activities outside the domestic environment.

Identity and role

As reported in the literature [45], designing, not only usable and intuitive functions, but also morphological and interactive elements that stimulate human emotions, are key tenets to successful product development. Using human morphology can help products to increase the level of acceptance of new technologies or trust and reliability in particular interactive systems. Moreover, those elements confer to the artefact an identity and a precise role – for our case as a caregiver assistant or companion – within the elderly's everyday life.

However, **Lumin**, **Compaan**, **GrandCare** and **Claris Continuum** do not offer any meaningful element of interaction that emotionally engages with users. On the contrary, they show an aseptic user experience since the interactions with the system are mediated by a visual interface on a tablet screen that acts as a mere communication bridge between the users and those who take care of them. Instead, **Pillo Health**, **ElliQ** and **Cutii** are able to play on the elderly's emotional aspects because they try acting as a digital companion during the caregiving experience. In fact, the ability of the products transforms the products into Actor agents [46] that actively respond to human behaviors. This consequently generates a sense of animism [47] that confers to the artefact a particular personality and identity. This type of agency is also supported by the introduction of anthropomorphic elements, such as verbal dialogue and voice control to interact with the elderly. These elements, indeed, can provide additional benefits to the elderly because they can increase their perceived sense of self-efficacy since the natural feedback of language helps them to easily understand the accomplishment of their tasks.

3.3. Discussion of results towards Active Living

Most of the examined products support the concept of Active Living mostly from a gerontology perspective since the products have great capabilities in health monitoring but they present operational lacks in the social, ludic and emotional dimensions. In fact, the products offer good qualities of empowerment but they are focused mostly on compensating the capabilities of older people rather than creating a system that really enhances their autonomy, self-independence and self-esteem. Considering this, coaching is a good opportunity to foster resourceful aging but, apart from **ElliQ**, all the products focus mainly on taking care of the elderly's health parameters, missing the chance of stimulating qualitative aspects of their lives such as promoting new hobbies, social activities or cultivating their own passions.

From the user experience perspective, the products delimitate the interaction with the elderly to a tablet touch screen. Only **Pillo Health**, **ElliQ** and **Cutii** assume a physical identity that imitates human behaviors to elicit emotional interaction. Due to the use of voice control they increase the elderly's sense of autonomy and self-efficacy as the natural interaction of verbal dialog makes communication more intuitive.

Finally, all the products relegate their functionalities only to the domestic environment, consequently limiting the chance to enrich the quality of the Active Living experience in a wider space of social interaction. However, all products offer good functionalities to support the elderly in aging well, which in turn, can be considered a scaffold for developing future generations of interactive systems based on the concept of Active Living.

The state-of-the-art analysis allows us to focus on the development of a conceptual and methodological framework to design for older people. There might be several approaches to ideate services and interactions for elderly people. The majority of the existing products follow a proper functional approach, where the design defines features and functions, such as the calendar, the video call and the cognitive exercises. On the contrary we would promote the centrality of the design of the human experience, by means of scenario-based design describing motivations, attitudes, sensemaking, and individual and social activities for supporting goal-directed action.

Furthermore most products in the present analysis foster the capability of reading, understanding, and interpreting quantitative data as key to human activity. In fact a common strategy of the analyzed products is to enhance motivation through data, trends and statistics provision, as well as medical reminders, and assignments and exercises' plans. According to this perspective motivation is thought to have arisen on the basis of stimuli coming from quantitative measures, such as frequency or data logging. Also we are interested in exploring how to support people in creating their own meaning from information, how motivation can be fostered even on the basis of subjective variability and how it can be possible to promote human contact and social exchange.

4. Rethinking Active Living: an holistic approach to the elderly experience

For a better understanding of the Active Living concept and a contribution at the methodological level the Envisioning Scenarios and the User Personas which stemmed out from the RESILIEN-T user research have been presented in the following paragraph.

During the early stages of the design process, the scenarios are used to understand how personas will take advantage of the designed solution to carry out their tasks. One of the most important conditions when we design is to start from

real users, and personas and scenarios represent useful tools to build models of their experience. In particular the personas consist in a detailed description of a potential user. It allows us to clarify needs, objectives, characteristics, context of use and so on. Moreover personas are useful to describe subjective variables such as skills, typical activities, concrete motivations, and objective aspects including why an action is done.

"Scenarios use storytelling to explore design ideas by grounding them in a real context. Their focus is on the relationship between people and the designed product or service, their objectives, the context and potential social implications." [48]. In other words scenarios refers to interaction stories used as representative cases of real situations. The purpose of a scenario is to express in detail a situation and to document the actions performed by users point by point. We propose the envisioning scenarios to imagine the characteristics of the future experience of the users, as it will be transformed by the adoption of a novel interactive system.

In the envisioning scenarios the only interactive and functional features of the system may be caught. We propose the user personas and the envisioning scenarios to describe the Active Living experience as might be supported by the interactive system that is currently under ideation in the RESILIEN-T.

4.1. Active Living Scenarios and Personas

Persona 1: Elizabeth – The autonomous patient
"*What I enjoy the most is being with others, it's just wonderful!*"

Themes: Memory, Mobility, Social Relations.
User Profile: Elizabeth is 74 years old and lives alone since her husband passed away a few years ago. Nevertheless Beth is a determined and dynamic woman. She is constantly on the move. Beth handles all her daily activities, such as grocery shopping and housework. She is also very active in the social field. She likes to do things for others, like getting groceries for her neighbors. When she gets out, she prefers to walk, but in case of necessity she uses a bus, which is another opportunity to socialize! She has no relevant age-related physical problem but she recently noticed that her memory is getting worse. She loves meeting up with her friends, especially to play Bridge. Once a month, she goes to the theatre. Elizabeth is quite capable with technology. She uses a tablet to search for online recipes and to consult the theater's program. She also uses a smartphone to communicate with her family.

Envisioning Scenario: Beth doesn't want to give up, she wants to maintain her independence, so she starts using the RESILIEN-T system. Beth has filled in her full profile into the system, including her interests, contacts and recurring meetings.

Beth heard that tomorrow evening there will be a performance and sets the appointment on the calendar. The system checks the events organized in town and compares the collected data with those recorded by Elizabeth. The system detects a

gap among data: a similar event will take place in two days. So it offers further information on the theatre program and asks her: "Are you sure your event is correct? Do you want to check?". The RESILIEN-T also suggests to book the ticket and to invite her friends, so she calls Adele and Grace and then she buys tickets for everyone. On the day of the performance, the system asks questions related to mobility in order to stimulate Beth to plan the activity: "How will you reach the theater?" "Do you want to take pictures during the show to create a memento of this evening?".

When she gets home, the system asks how the soiree went and it proposes to Elizabeth to create a "memento" of the evening by adding photos, videos, and personal notes, in order to populate her own digital album of memories.

Persona 2 : James & Margaret – The affectionate couple
"*Travelling keeps us young and alive!*"

Themes: Self-esteem, Support, Technology.

Users' Profile: James and Margaret Murphy are a very close couple. James is 68 years old and Margaret is 65. They love to travel and have visited many places, particularly South America. They are planning a trip to Vietnam next summer. James and Margaret have been married for 30 years and they have two grown-up children, Robert and Melanie, who do not live close to them. Despite the distance, they use Skype and other social networks to communicate with each other.

Margaret is starting to have some memory problems. For example she started forgetting to bring the keys, when leaving home. James tries to support and to reassure his wife. James and Margaret are familiar with technology: they use smartphones and tablets to plan their trips and to keep updated. They say that they learn something new every day! They are very grateful for what life has given them and love their home, family and friends. James and Margaret want to spend the rest of their lives together.

Envisioning Scenario: Margaret and James continue to divide the household tasks. Today they have decided to split the responsibilities: Margaret will get groceries. The system helps Margaret to plan her activity and at the same time stimulating her cognitive activity. "Which of these foods do you have to buy?" "Where do you prefer to buy these foods?" showing the nearby shops on the map. Once the shopping list is completed and she has decided the itinerary, Margaret goes out. James continues to propose new activities to Margaret. In the afternoon they will go for a walk in the park. Since Margaret wears RESILIEN-T's smartwatch, the system monitors and collects data about her physical activity.

Persona 3: Giorgio – The proud patient
"*I like to spend time on my own!*"

Themes: Nutrition, Autonomy, Physical Activity.

User Profile: Giorgio is 78 years old and used to live alone after getting divorced in 2001. Until his retirement 5 years ago, he was an important lawyer. He has always been proud and charismatic man and he rejects the idea of getting old. Giorgio appreciates loneliness, he prefers to spend his days painting, reading and listening to music. He has a few friends who visit him occasionally. Giorgio has one daughter, Sarah, who lives a few kilometers away from him. He usually goes out close to home or when his daughter Sarah picks him up by car to take a ride.

Giorgio is not interested in technology. His daughter gave him a mobile phone that he uses to communicate with his family. He has been living with diabetes since 2016. He is overweight and he leads a sedentary life. Moreover he doesn't follow a healthy diet, and this would also increase his risk of vascular problems. And as if that wasn't enough, he's had problems with his memory. Despite these challenges Giorgio wants to maintain his independence and he is convinced he doesn't need help.

Envisioning Scenario: Giorgio starts to use the RESILIEN-T system to try to keep himself active and allow his daughter to get reassured when he is alone at home.

Sarah synchronized the blood glucose measuring system with the system. It shows in real time the data just measured relating to Giorgio's blood glucose, so that it can keep a report. In addition, the system supports Giorgio with food recommendations. The system also tries to encourage Giorgio towards social interactions and to keep on moving, proposing to him to join the local association of passionate for painting. "Next Friday there will be an art class, near your home. Are you interested in it?" "On 21st June will open the exhibition "Edgar Degas: A Strange New Beauty. I thought you might be interested!"

Giorgio becomes curious and decides to visit the exhibition. Since we believe that the Active Living concept is subjective, in the following paragraph we will provide a comprehensive Active Living validation activity description that has been carried out in a dedicated research involving the Italian, Swiss, Canadian and Dutch panels.

4.2. Active Living Scenarios Validation

The user experience validation has allowed us to enter into the details of how to design for older people, how people would interact with services in order to accomplish their personal objectives. Eight sessions have been carried out in the RESILIEN-T project: two sessions for each of the pilot countries of the project, Italy, Canada, Switzerland and Netherlands. The research and design methodology proposed in the project integrates methods and techniques from a broad range of disciplines, from ethnography and psychology, to user-centered and participatory design.

4.2.1 Validation methodology

The validation has been made through the Validation sessions aiming at Active Living concept exploration and finalization by presenting the envisioning scenarios to the participants in order to start focusing on both older people and formal/ informal caregivers' daily life experience and situations. This activity was inspired by storytelling methodologies and allowed the participants to share personal opinions and perspectives.

The Validation sessions were organized by a Storytelling and UX Statement method. The envisioning scenarios have been shown and the stories have been told to participants in order for them to reflect on their own personal experiences. Each story has been also disentangled in order to define a UX statement to be used in the discussion with participants.

The Statement cards are an efficient tool to start discussions around experiential topics. By using Scenarios-inspired statements, the participants freely discuss the statement. It aims to trigger participants to react, whether they agree or disagree, without being the "owner" of the statement. The discussion is meant to lead to the placing of the statement card as "true" or "false", and to foster validation of statements as acceptable and feasible.

As example you have the Elizabeth envision scenario with the statements defined for Module 1 below:

1. Beth does not want to give up, she wants to maintain her independence, so she starts using the RESILIEN-T system. Beth has filled in her full profile into the system, including her interests, contacts and recurring meetings.
   Statement 1: I think I can also enter the description of my interests and preferences in the tool and manage a new appointment on the digital calendar.

2. Beth heard that tomorrow evening there will be a performance and sets the appointment on the calendar. The system checks the events organized in the town and compares the collected data with those recorded by Elizabeth. The system detects a gap among data: a similar event will take place in two days. So it offers further information on the theatre program and asks her: "Are you sure your event is correct? Do you want to check?".
   Statement 2: I believe that a tool for checking my calendar and confirming the scheduled event, could be useful.

3. The RESILIEN-T also suggests to book the ticket and to invite her friends, so she calls Adele and Grace and then she buys tickets for everyone. On the day of the performance, the system asks questions related to mobility in order to stimulate Beth to plan the activity: "How will you reach the theater?" "Do you want to take pictures during the show to create a memento of this evening?". When she gets home, the system asks how the soiree went and it proposes to Elizabeth to create a "memento" of the evening by adding photos, videos, and personal notes, in order to populate her own digital album of memories.

Statement 3: I believe that a reminder tool for planning my appointments and sharing my photos would be valuable and stimulating.

Statement 4: I would like to have a tool that encourages me to relate to others and cultivate my friendships.

4.2.2 Validation results

This paragraph describes the Validation session results as lived by participants. They have generally shown interest in RESILIEN-T scenarios and upcoming development from the project, and all the participants were extremely collaborative, engaged and easy going.

Participants have been engaged and stimulated to take part with questions and proposals and for validating the interactions strategies. The users participated in a proactive way, proposing interesting ideas on how to improve the service. The workshops were useful to understand the real needs of users, their motivations, habits, but above all their concerns and frustrations. Users have positively participated at the validation of the scenarios, emphasizing the aspects of the project that are most relevant and useful to them.

The subjective nature of the exploration confirmed some of the assumptions the researchers had in mind:

- older people's attitude towards technology needs to be investigated and verified through research: they are not necessarily interested in technology and personal attitude is based on prior experience with technology as well as anxiety or enthusiasm with digital services and tools;
- participants to the research largely appreciated to have useful, efficient and efficacious aids, in particular for self-management, memory and planning;

By elaborating the results obtained from the UX Statement we may re-defined the Active Living concept as an experiential notion described as follows:

Active Living re-defined as an iterative, continuous and empirical process

Active Living is a healthy life to stay fit and cultivate personal hobbies and interests, like for example cooking, driving, painting and reading. Active Living is also connected with sharing personal interests and personal experiences. Action and interests go together with maintaining social relationships and social contacts: negotiating ideas and values, discussing personal opinions with other people on different topics is considered essential for a healthy life. Active Living does also refer to living in a couple since older people living with husband or wife quite frequently tighten their lives together, by helping each other, sharing duties and taking specific responsibilities over each other. Use of personal and social spaces,

proximity and presence of the others, and overall lifestyle should be also taken into account as part of the concept.

5. Conclusion

There is an existing gap between the original vision behind the products that have been analyzed (see Par. 4) and the reality of how they have been designed or implemented at service level. And this gap is also reflected in the fact that even though older people are now surrounded by "beneficial, empowering and magical new technologies" [49], many found little everyday advantage or pleasure in using them; they were ambivalent about ICT, citing it as irrelevant to their everyday.

Sackmann and Winkler make a further distinction between the 'first-level' and 'second-level' digital divide. The 'first-level' divide is the difference in possession or access, and the 'second-level' divide refers to different operational knowledge or modes of use [50]. The concern is that with such rapid advances in technology, this divide could result in disadvantage.

Due to the subjective nature of the experience, the diversity of the target, and the ambivalent approach to technology, an integrated, iterative, participatory and user-centered approach is required to fill the gap among ideation and implementation of solutions. In fact the design for intuitive use by older people involves understanding domain-specific prior experience and competence of the user; actual motivation, values and scopes, and to design interfaces that project prior and current experience into a sustainable ageing perspective, within the context of the Active Living.

The methodological proposal explained in Par. 4 follows a user-centered interaction design approach, aiming at properly addressing real target users' needs, ethical and cross-cultural dimensions, and at monitoring and validating the psycho-social impact of the proposed solution. All the involved target groups (elderly people and caregivers) are considered to be part of a continuous, iterative, consultative design process. A Participatory design approach ought to be applied aiming at fostering:

- Diverse participation, perspective taking and inclusive decision-making,
- Mutual learning, discussion of assumptions, and generation of new concepts,
- Iterative actions to achieve a final design of an artifact that answers to the participants' requirements and ideas.

For this reason Validation sessions are foundational: in fact "Validation aids to create a common knowledge base among designers, users and other stakeholders" about elderly people goals, needs, weaknesses, and expectations. Furthermore the Validation process could also nurture a positive impact on older people because it "fosters social interaction and enhances empathic connections between participants" [51]. In this regard, the suggested design process has a recursive nature and iteratively embraces these fundamental phases:

- User research and Analysis, meaning identifying users' daily habits, their lifestyle (nutrition, physical activity, social relationships),
- Generative and explorative phase, meaning collecting ideas and merge them into few scenarios and design concept,
- Experimental phase - prototyping and refining concrete mockups of product,
- Evaluation and assessment in Validation session: the results are submitted, discussed and improved together with the users.

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